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Effects of Monetary and Macroprudential Policies on Financial Conditions: Evidence from the United States

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Abstract

The Global Financial Crisis has reopened discussions on the role of the monetary policy in preserving financial stability. Determining whether monetary policy affects financial variables domestically—especially compared to the effects of macroprudential policies—and across borders, is crucial in this context. This paper looks into these issues using U.S. exogenous monetary policy shocks and macroprudential policy measures. Estimates indicate that monetary policy shocks have significant and persistent effects on financial conditions and can attenuate long-term financial instability. In contrast, the impact of macroprudential policy measures is generally more immediate but shorter-lasting. Also, while an exogenous increase in U.S. monetary policy rates tends to reduce credit and house prices in other countries—with the effects varying with country-specific characteristics—an increase driven by improved U.S. economic conditions tends to have the opposite effect. Finally, we do not find evidence of cross-border spillover effects associated with U.S. macroprudential policies.

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I. INTRODUCTION

There are two main types of policy tools to influence financial conditions in the economy: policy rates and macroprudential policy instruments. While policy rates are well-known monetary policy tools, macroprudential measures have resurged recently and are becoming an increasingly active instrument (Zhang and Zoli, 2014).

The main advantage of having two sets of policy tools is that they can target different policy objectives, in particular as these objectives may involve important policy trade-offs. For instance, economic conditions (output and inflation gaps) may require an expansionary monetary stance, while growing financial vulnerabilities may call for monetary policy tightening. In this case, financial stability concerns can be addressed primarily through macroprudential policy measures.

Although there seems to be a broad consensus on the central role of macroprudential policy measures in containing financial instability build-ups (IMF, 2014a), there are different views on the role of monetary policy in this matter. In particular, three main views can be distinguished (Smets, 2014). The "no" view argues that monetary policy should only focus on traditional objectives, such as inflation and real economic activity. The "yes" view claims that financial stability is at least as important as traditional objectives, and that decisions regarding the setting of policy interest rates should equally consider financial stability concerns. The third view, which is increasingly gaining consensus in the aftermath of the Global Financial Crisis (GFC), acknowledges that in some circumstances, monetary policy may deviate from its traditional objective in order to support financial stability, if costs from doing so are smaller than benefits (IMF, 2015b). In this context, the decision of using monetary policy to address financial stability concerns should be preceded by a careful assessment of the sources and channels of financial risk propagation and cost-benefit analyses of the policy actions, including the interaction between different policy tools and—what interests us in this paper—their impact on financial conditions.

There is an extensive literature on the effect of monetary policy actions on domestic financial conditions. Changes in monetary policy rates have been typically found to have significant effects on credit and assets prices (Iacoviello and Minetti, 2007; Jorda et al., 2015; Laseen et al., 2015), leverage (Bruno and Shin, 2015), or risk-taking (De Nicolo et al., 2010; Gilchrist and Zakrajsek, 2012; IMF, 2014b). Similarly, macroprudential actions have been reported to be effective in reducing the procyclicality of financial variables (Lim et al., 2011; Kuttner and Shim, 2012; IMF, 2012; Claessens et al., 2013; Dell'Ariccia et al., 2013; Zhang and Zoli, 2014; Elliott et al., 2013; Cerutti et al., 2015).

Increasingly, attention has been focused on the implications of monetary policy actions for financial stability in countries outside of the major economies in which policy actions took place. In particular, concerns have been raised that monetary policy in systemic advanced economies (SAEs)—such as prolonged low interest rate environment and/or unwinding monetary support—may have large global implications (IMF, 2015a).[2]

A rapidly growing literature has typically found that changes in SAE monetary policy have significant effects on financial conditions abroad (IMF, 2011; Glick and Leduc, 2013; Rogers et al., 2014), with the impact varying with factors underlying policy changes (IMF, 2014a, 2015a) and with recipients countries' fundamentals and policies (Eichengreen and Gupta, 2014, Basu et al., 2014; Chen et al., 2014; IMF 2015a). However, relatively less has been said about international effects of macroprudential policy measures. Previous studies find some evidence of spillovers occurring across branches of foreign banks (Aiyar et al., 2012, Jeanne, 2013, Danisewicz et al., 2015) or bank cross-border flows (Beirne and Friedrich, 2014).

This paper contributes to both debates by assessing how monetary policy shocks and macroprudential policy measures in SAEs affect financial conditions within and outside national borders. In particular, we focus on the United States as long time series of exogenous monetary policy shocks are only available for this country.

The main results can be summarized as follows:

- Monetary shocks have significant and persistent effects on financial conditions and can attenuate long-term financial instability. Lags in the impact of policy changes—typically significant six quarters after the shock—are also important. In contrast, the impact of macroprudential policy measures is generally more immediate but shorter-lasting.

- Monetary and macroprudential policy tightening measures tend to have larger effects than easing ones. Also, the effect of monetary policy shocks and macroprudential policy tightening measures tend to be larger during recessions than in expansions.

- U.S. monetary policy shocks have significant effects on financial conditions in other countries, with the effects depending on factors underlying policy changes and shock-recipient economic characteristics and policies. In particular, the impact tends to be larger for emerging markets, in countries with fixed exchange rate regimes and higher capital account openness. Also, while exogenous monetary policy shocks can dampen financial conditions in other countries, "growth-driven" monetary policy rate changes have the opposite effects. In contrast, macroprudential policy measures tend to have limited spillover effects.

The rest of the paper is organized as follows. Section 2 discusses the data used in this paper on financial conditions, monetary and macroprudential policies measures. Section 3 analyzes

[2] The euro area, Japan, the United Kingdom, and the United States.

how U.S. monetary policy shocks affect domestic financial conditions and compares them with the impact associated with macroprudential measures. Section 4 looks at spillover effects of U.S. monetary policy and macroprudential actions to other economies. Section 5 summarizes the main findings.

II. Policies and Financial Conditions Measures

A. Monetary Policy Shocks

As economic and financial conditions may influence monetary policy changes, it is particularly difficult to isolate exogenous monetary policy measures. To do so, one needs series of monetary policy measures reflecting events and policies that are unrelated to economic developments, at least in the short term. Coibion (2012)—following Romer and Romer (2004)—isolates such exogenous monetary policy changes for the United States from an estimated Taylor rule with time-varying parameters:

$$\Delta f_t = c_t + \rho_{1,t} f b_m + \rho_{2,t} f b_{m-1} + \varphi_{\pi,1} F_t \pi_{t+1,t+2} + \varphi_{gy,t} F_t g y_t + \varphi_{ue,t} F_t u e_t + m_t \qquad (1),$$

where Δf_t is the intended change in the Federal Funds Rate (FFR) decided before the Federal Open Market Committee (FOMC). $fb_m$and fb_{m-1} are the level of FFR before two last FOMC meetings while $F_t\pi$, $F_t gy_t$, and $F_t ue_t$ are the forecasts of average inflation, output growth, and the unemployment rate (Fed's Greenbook forecasts over the upcoming 2 quarter horizon). The residuals—m_t— captures exogenous monetary policy shocks (Figure 1A).

As the response coefficients vary over time, these monetary policy shocks are not only exogenous to movements in output and inflation, but also to regime changes. In particular, random innovations to the rule are classified in this approach as monetary policy shocks, but policy changes such as regime changes or changes in the inflation target or GDP growth target are captured by the time-varying parameters of the rule and are, therefore, not classified as shocks.[3]

A clear advantage of this method is that an unanticipated part—m_t—of the change in the FFR is relatively free of current and forecasted real-time movements in macroeconomic variables.

[3] As, for example, when the FED abandoned targeting the FFR between 1979 and 1982.

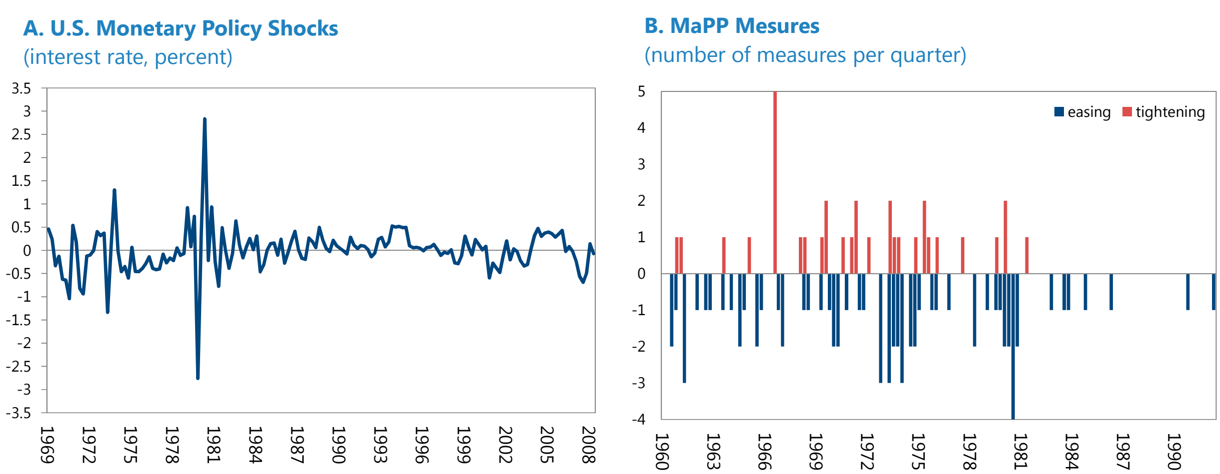
B. Macroprudential Policies Actions

While macroprudential tools have become increasingly active policy instruments in the aftermath of the GFC, they were actively used in the United States (but also in other countries) for many decades prior to the early 1990's.[4] In particular, they were deployed either jointly with monetary policy actions to affect monetary conditions—the correlation between two policies varies between 0.15 for easing and 0.25 for tightening—or separately to target credit developments in specific sectors.

To assess the effectiveness of these measures, we use data from Elliott, Feldberg, and Lehnert (2013), who are the first to provide a taxonomy of measures that the Federal Reserve and other agencies have used since 1918 until early 1990's (Annex 2). These actions consist of: (i) demand-side measures, such as limits on loans-to-value ratios, margin requirements, loan maturities, and tax policies; (ii) and supply-side actions, including lending and interest rate ceilings, reserve and capital requirements, portfolio restrictions, and supervisory guidance.

We classify Elliott et al. (2013) macroprudential actions at the quarterly basis (Figure 1.B) using a dummy variable that takes value equal to 1 in the quarter in which a macroprudential tightening measure is introduced, value equal to -1 in the quarter when a macroprudential easing action is taken, and zero otherwise.

Figure 1. Monetary and Macroprudential Policies Actions in the United States



Source: Coibion (2012), Elliott et al. (2013), and authors' calculations.

[4] As underlying by Elliott et al. (2013), the evaluation of the past macroprudential policy actions "through what we now view such actions" is a difficult and, somewhat, subjective exercise.

C. Financial Conditions

We are interested in how monetary and macroprudential policies mitigate *cyclical* financial stability concerns. We approximate financial stability by estimating the degree of financial overheating based on growth rates of real credit and property prices (hereafter financial conditions). The reason to focus on these variables is that they have been usually found to be powerful predictors of financial instability (Jorda et al., 2011; Gourinchas and Obstfeld,2012; Dell'Ariccia et al., 2012; Williams, 2015; Jorda et al. 2015).[5]

Credit is constructed using IFS bank credit to the private non-financial sector or, alternatively, BIS data on bank and nonbank credit to the private non financial sector. Property prices are measured using OECD and IMF real house prices. All series are seasonally adjusted and deflated by the CPI (Appendix 1 and 2).[6]

III. Impact of Monetary Policy and Macroprudential Actions on Domestic Financial Conditions

A. Methodology

This section assesses the effect of U.S. monetary policy and macroprudential policies actions on domestic financial conditions. To do so, we estimate a distributed lags (DL) model, similar to that used by Romer and Romer (2010):

$$\Delta fc_t = \alpha_t + \delta(L)m_t + \varepsilon_t \qquad (2),$$

where fc_t is the (log of) real credit (property prices), m_t are U.S exogenous monetary policy shocks discussed in Section 1.A., and α_t are quarterly dummies. The sample period—determined by the availability of the monetary policy shocks series and financial conditions variables—is from 1969q3 to 2008q4 for credit and from 1970q1 to 2008q4 for property prices.

Given that the monetary policy shocks considered in the analysis are exogenous, there is no reason to expect a systematic correlation between these shocks and lagged financial condition variables. Therefore, to assess how monetary policy shocks affect financial variables we simply regress financial variable growth on the lagged values of the shock.[7] From an econometric point of view, the exogenous series of shocks is unrelated to the error term in equation (2), therefore ordinary least squares (OLS) are unbiased. An alternative approach

[5] For more details on the capacities of these variables to predict financial crises, see Chen et al. (2015).

[6] Data limitation for many countries prevents using property price indices.

[7] Similarly to Romer and Romer (2004), we employ a lag length of three years. The results are broadly similar with alternative lag specifications.

would be to estimate a vector autoregression (VAR) model with financial variables and monetary policy measures (Section D). We do so as robustness check (see sub-section D).

The effects of the macroprudential policy measures on financial conditions are estimated in a similar DL model:

$$\Delta fc_t = \alpha_t + \delta(L)mapp_t + \varepsilon_t \quad (3),$$

where $mapp_t$ are US macroprudential measures dummies presented in Section 1.B. The sample period—determined by the availability of the macroprudential policy measures and financial variables series—is from 1960q1 to 1992q2.

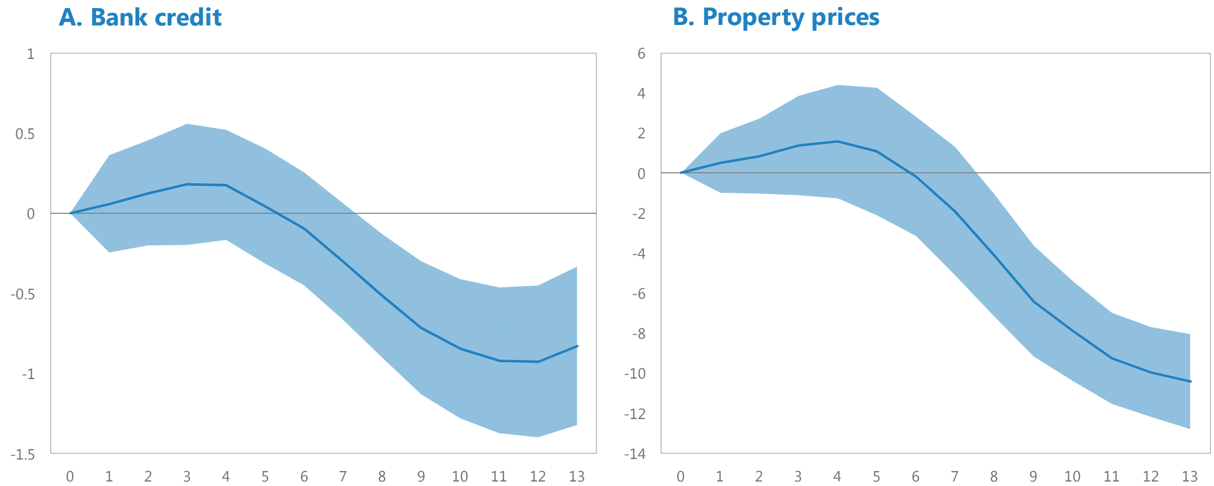
Compared to exogenous monetary policy shocks—macroprudential policy measures are affected by credit and property price developments and OLS estimates tend to be biased and inconsistent, and therefore the results should be interpreted with caution. In particular, given that an increase of credit (property price) tends to increase the probability of the occurrence of macroprudential policies, OLS estimates tend to biased toward zero. To address a possible endogeneity bias, we also make use of VAR models (see sub-section D), that accounts for possible feedbacks between financial variables and macroprudential actions.

B. Baseline Results

The results suggest that monetary policy shocks have significant and persistent effects on financial conditions (Figure 2). In particular, a 100 basic point shock reduces bank credit by 0.5 percent (0.8 standard deviations) after 7 quarters of the shock and by about 1 percent (1.7 standard deviations) after 12 quarters. The same shock lowers property prices by about 4 percent (1.1 standard deviations) after 7 quarters and by about 10 percent (2.7 standard deviations) after 12 quarters.

These findings are broadly in line with previous studies. For instance, Laseen et al. (2015) using a panel of 5 countries find that a 100 increase in the monetary policy rate decreases credit growth up to one percentage point after 5 quarters, and up to 0.5 percentage point after 10 quarters of the shock. Angeloni et al. (2014) find that a similar shock lowers real debt by about 1 percent after 5 years. Jorda et al. (2015) find that a 100 basis point increase in the policy rate reduces mortgage loans by about 3 percent after 4 years, and has a significant, although smaller, impact on property prices. Walentin (2014) finds that a 100 basis point shock reduces real property prices by 4.5 percent after 14 quarters, while Laseen et al. (2015) find that a similar shock lowers house prices by about 2 percent. Jorda et al. (2015) show that a similar monetary policy shock decreases the house-prices to income ratio by about 4 percent after 4 years. Other studies also suggest that the impact of monetary policy shocks varies with the degree of bank-dependence (Ehrmann et al., 2003; Ciccarelli et al., 2014), the size of banks (Kashyap and Stein, 2000) and the quality of balance sheets of banks (Chen, 2001) and non-financial borrowers (Adrian and Shin, 2010; Boivin et al. 2010).

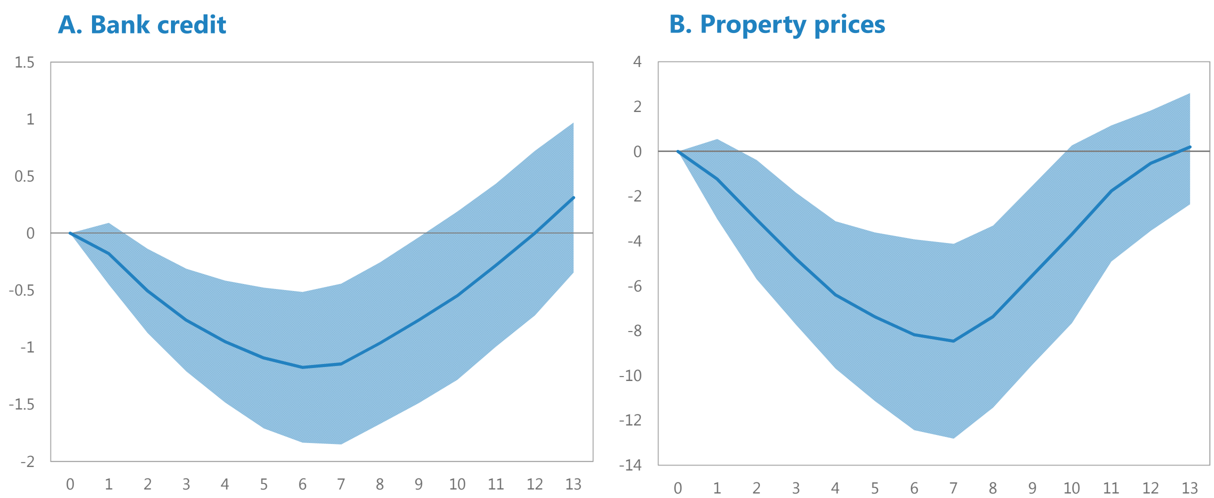
Figure 2. Impact of U.S. Monetary Policy Shocks
(percent change)



Note: The y-axis shows the impact of monetary policy shocks on the log level of real credit and property prices—the coefficients δ in Equation (2). The x-axis indicates quarters after the shock in t =0. Dashed lines indicate the 90 percent confidence bands.

Source: BIS, Haver, IFS-IMF, Coibion (2012), and authors' calculations.

Figure 3. Impact of U.S. Macroprudential Policy Measures
(percent change)



Note: The y-axis shows the impact of tightening of macroprudential measures on the log level of real credit, property prices and their deviations from trend —the coefficients δ in Equation (3). The x-axis indicates quarters after the shock in t =0. Dashed lines indicate the 90 percent confidence bands.

Source: BIS, Haver, IFS-IMF, Elliott et al. (2013), and authors' calculations.

The impact of macroprudential measures seems to be more immediate, but short-lasting (Figure 3). In particular, macroprudential policy tightening reduces bank credit by about 0.2 percent after 1 quarter and 1.6 percent after 6 quarters. The impact progressively decreases to disappear after 12 quarters (Panel A). A macroprudential tightening reduces property prices by about 9.5 percent at the peak and the impact decreases 7 quarters after the shock (Panel B). These results are broadly in line Elliott et al. (2013), who find that while many of macroprudential measures appear to reduce bank credits in the short term, they have limited effects in the long term.[8] The somewhat temporary effects of macroprudential measures on overall financial conditions might reflect, for instance, lags in their implementation. Also, single macroprudential measures in specific sectors might have different effects from the policy actions analyzed here. Finally, economy-wide effectiveness of macroprudential may be reduced by arbitrage and circumvention (Nier et al., 2015).

C. Asymmetric Effects

The results presented above suggest that monetary policy shocks have, on average, long-term effects on financial conditions while the impact of macroprudential measure is more short-lasting. However, these effects might be asymmetric, i.e. vary depending on the sign of the shock and/or state of the economy.

The idea that monetary policy tightening has larger effects than easing is well recognized in the literature at least since Keynes' *liquidity* trap. Also, there is rather extensive empirical evidence that monetary policy can be used "to stop inflation but [...] not push [...] to halt recession" (Friedman, 1968). One explanation can be found in an asymmetry in the monetary policy transmission mechanism reflecting credit market imperfections (e.g., Bernanke and Gertler, 1995).[9] For instance, with higher interest rates, smaller less liquid firms might have more difficulties to access external financing and are forced to cut investment and, thus, demand for credit (Bernanke and Blinder, 1988). Similarly, small less liquid banks might face funding shocks and cut credit supply (Kashyap and Stein, 2000).

To assess possible asymmetric effects, we extend equation (2) by allowing the response to differ between positive and negative shocks:

$$\Delta fc_t = \alpha_t + \delta_1(L)p_t + \delta_2(L)(1 - p_t) + \varepsilon_t \quad (4)$$

[8] Although much have changed in the financial system since early 1990's, some recent studies also show significant effects of some macroprudential (such as loan-to-value ratio) introduced in other countries/regions in the 2000's (Zhang and Zoli, 2014).

[9] For a more detailed review see Florio (2004).

Where $p_t$denotes positive monetary policy or macroprudential shocks and $(1 - p_t)$ negative ones; δ_1 and δ_2 captures the impact of positive (tightening) and negative (easing) policy shocks, respectively.

The results presented in Figure 4 suggest a different effect between positive and negative shocks. In particular, while the impact of monetary policy tightening and easing is not statistically different up to 10 quarters, after 12 quarters a positive monetary shock decreases credit growth by about 1.6 percent while negative shocks do not have statistically significantly effects.[10] Similarly, macroprudential tightening measures tend to have larger effects than easing measures, even though the difference is not statistically significant.

The impact of monetary policy and macroprudential might also vary depending on economic conditions. In particular, lowering interest rate in periods of recession might have little impact as demand for credit is already low. Conversely, an increase in interest rate during expansions might have larger effects as demand for credit is strong. However, monetary policy tightening may have larger effects in periods of recessions as credit market constraints limit even more access to external financing for smaller firms or affect firms' net worth. Also, asymmetric information might be more severe during recessions making banks more reluctant to issue new loans (Diamond and Rajan, 2011). Empirical evidence for the asymmetric impact for monetary policy over the business cycle has produced mixed results. Long et al. (1988) find larger impact during expansions, Garcia and Schaller (1995) during recessions, Ravn and Sola (1996) when controlling for the regime change in monetary policy shocks find symmetric effects. Recently, Angrist et al (2013) and Tenreyro and Thwaites (2015) find the evidence of larger impact of monetary policy during expansions, but the results hinges on the measure of business cycles.

To assess this asymmetry in our framework, we follow Auerbach and Gorodnichenko (2013) and Abiad et al. (2015). In particular, we first compute a smooth transition function of different growth regimes, $\mathrm{G}(\mathrm{z}_t)$:

$$G(z_t) = exp(-\gamma z_t)/(1 + exp(-\gamma z_t), \quad \gamma > 0, \tag{5},$$

where z is a normalized indicator of output growth with zero mean and unit variance, and γ is a parameter chosen equal to 1.5, to mimic the US business cycle properties (see Auerbach and Gorodnichecnko, 2013 for details). We then extend specification (2) to allow the impact of policy measures to differ depending on the growth regime:

$$\Delta fc_t = \alpha_t + \delta_1(L)G(z_t)m_t + \delta_2(L)(1 - G(z_t))m_t + \varepsilon_t \tag{6},$$

where δ_1 and δ_2 capture the impact of monetary policy shocks during economic downturns and upturns, respectively.

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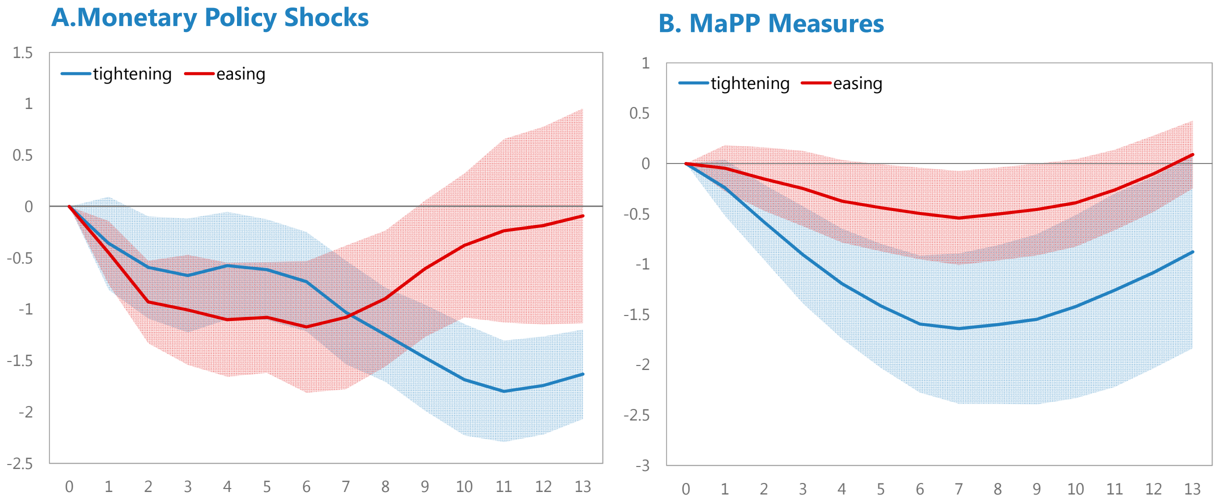
[10] Similar results are found in Cover (1992), Bernanke and Blinder (1992), Romer and Romer (1989).

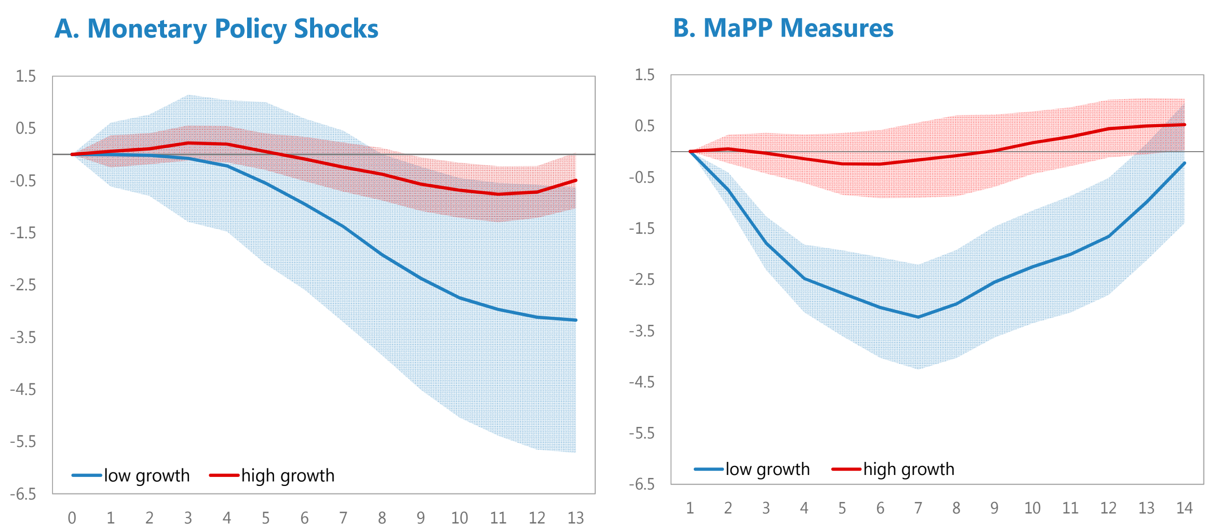
Figure 4. Asymmetric Impact of U.S. Macroprudential Policy Measures
(bank credit, percent change)



Note: The y-axis shows the impact of Monetary and Macroprudential shocks in absolute terms on the log level of real credit—the coefficients δ in Equation (4)—depending on growth regime. The x-axis indicates quarters after the shock in t =0. Dashed lines indicate the 90 percent confidence bands.

Source: BIS, Haver, IFS-IMF, Coibion (2012), Elliot et al. (2013), and authors' calculations.

Figure 5. Monetary and Macroprudential Impact in Low- vs. High-Growth Regimes
(bank credit, percent change)



Note: The y-axis shows the impact of Monetary and Macroprudential shocks on the log level of real credit—the coefficients δ in Equation (6)—depending on growth regime. The x-axis indicates quarters after the shock in t =0. Dashed lines indicate the 90 percent confidence bands. Source: BIS, Haver, IFS-IMF, Coibion (2012), Elliot et al. (2013), and authors' calculations.

The results presented in Figure 5 suggest that the impact of monetary policy tends to be larger during recessions than in expansions, even though the difference is not statistically significant.[11] The effects of macroprudential measures are statistically larger during low growth than expansion.[12] However, these results might vary depending on different measures and targeted variables. For instance, IMF (2012) show that the impact of reserve and capital requirements is stronger during credit bursts that are usually associated with growth slowdown.

D. Robustness Checks

Macroprudential vs. monetary policy shocks

To compare the impact of monetary and macroprudential policy measures equations (2) and (3) are estimated controlling for the influence of macroprudential and monetary policy shocks, respectively. In particular, the following specification is estimated over a common period for which both measures are available (i.e. from 1969q3 to 1992q2):

$$\Delta fc_t = \alpha_t + \delta_1(L)m_t + \delta_2(L)mapp_t + \varepsilon_t \qquad (7),$$

where fc_t is the (log of) real credit (property prices), δ_1 captures the impact of U.S. monetary policy shocks, δ_2 measures the effect of U.S. macroprudential policy measures, and α_t are quarterly time dummies.

The results presented in Figure 6 confirm our previous findings that monetary policy shocks have significant and persistent effects on credit while the impact of macroprudential measures is significantly larger in the short term, but much less persistent.[13] Although assessing policy interactions is beyond the scope of this paper, these results may also suggest monetary policy might still need to be used to contain persistently financial risks if macroprudential measures are not fully effective (Agur and Demertzis, 2013).

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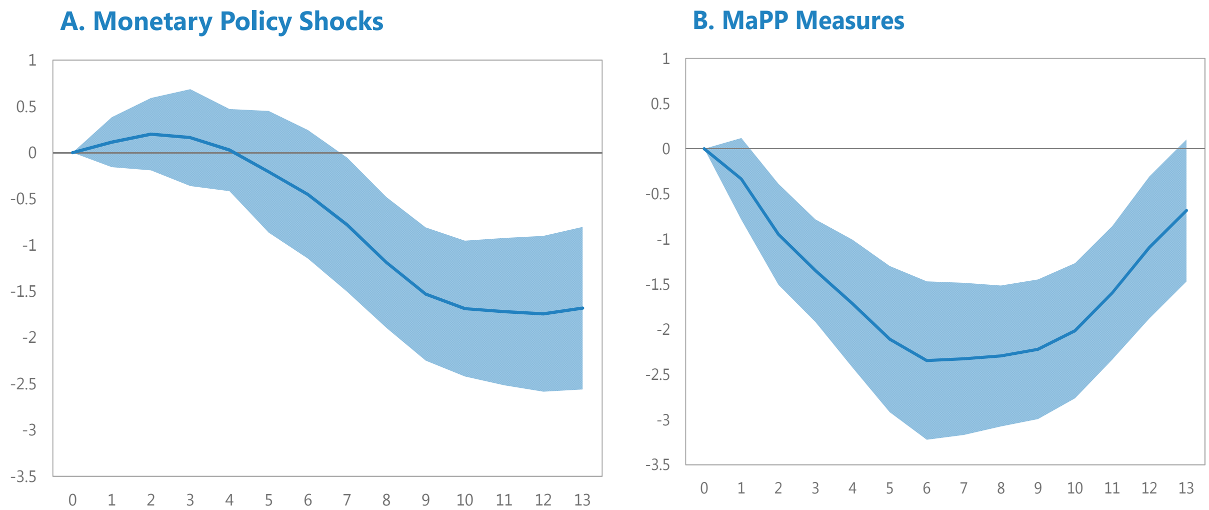
[11] There is little difference in the distribution of monetary policy shocks between periods of low and high growth to affect the results.

[12] Similar results, not shown here, are found for property prices and BIS, and using the specification in equation (7) are available upon request.

[13] Similar results, not shown here, are found for property prices and BIS credit, and are available upon request.

Figure 6. Impact of U.S. Monetary vs. Macroprudential Policy Measures on Bank Credit

(percent change)



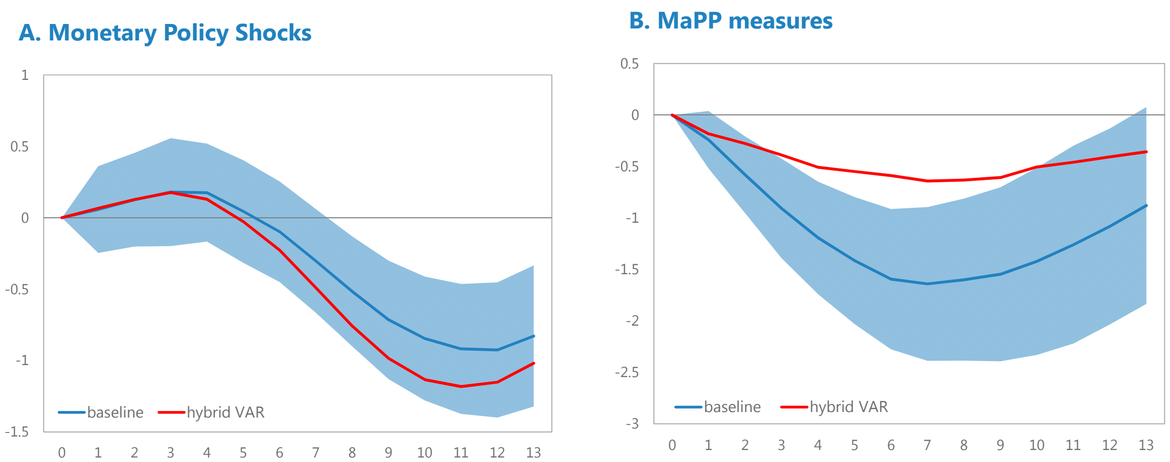
Note: The y-axis shows the impact of tightening of Macroprudential and monetary policy shocks on the log level of real credit—the coefficients δ in Equation (7). The x-axis indicates quarters after the shock in t =0. Dashed lines indicate the 90 percent confidence bands. Source: BIS, Haver, IFS-IMF, Coibion (2012), Elliott et al. (2013), and authors' calculations.

Additional specifications (VAR)

As an additional robustness check we repeat the estimation using VAR models. Since variables affecting credit growth are typically serially correlated, the inclusion of lags should allow controlling for short-term factors that affect the short-term response of credit shocks to monetary and macroprudential measures. In addition, VAR models allow accounting for feedback effects of financial conditions to monetary policy shocks and macroprudential measures. In this specification, monetary policy shocks affect real credit contemporaneously and are placed first. Following Romer and Romer (2004), exogenous monetary policy shocks estimated in equation (1) are used instead of more traditional FFR (*hybrid* VAR). Figure 7 shows that the response of real credit to monetary policy shocks (Panel A) and to macroprudential measures (Panel B) is generally not statistically significantly different in *hybrid* VAR models from that presented in the baseline.

Figure 7. Alternative Specifications

(percent change)



Note: The y-axis shows the impact of monetary policy shocks on the log level of real credit—the coefficients δ in Equation (2) and in ARDL and *hybrid* VAR specification to the cumulate shock, respectively. The x-axis indicates quarters after the shock in t =0. Dashed lines indicate the 90 percent confidence bands. Source: BIS, Haver, IFS-IMF, Coibion (2012), Elliott et al. (2013), and authors' calculations.

IV. Impact of Monetary Policy Shocks and Macroprudential Measures on Financial Conditions in Other Countries

A. Cross-Country Spillovers

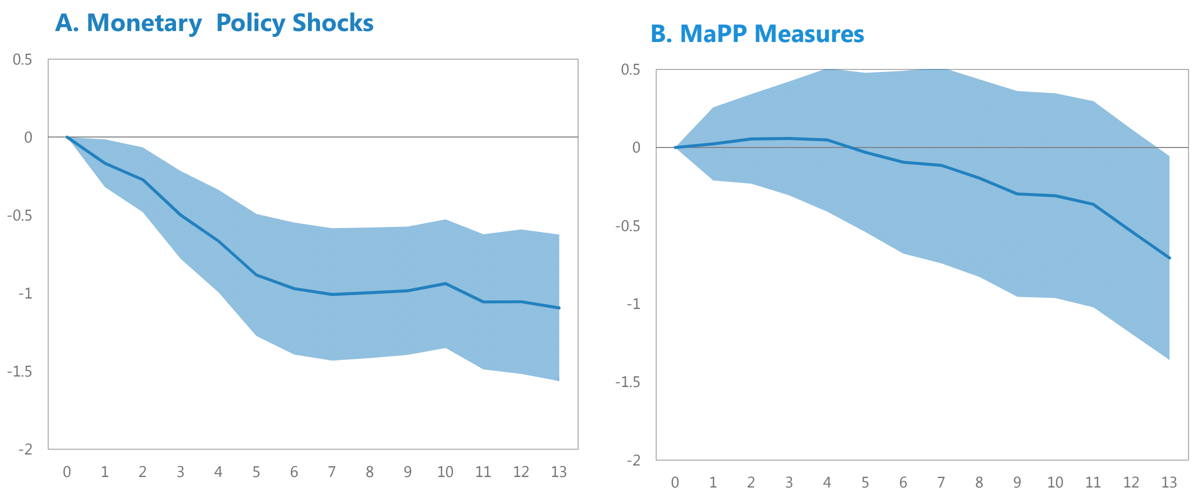
This section assesses how U.S. monetary policy actions affect financial conditions in other countries by estimating the following DL model:

$$\Delta fc_{it} = \alpha_i + \delta(L)m_t + \varepsilon_{it} \qquad (8),$$

where fc_{it} is the (log of) real credit in country i, m are U.S exogenous monetary policy shocks identified by Coibion (2012) and α_i are country fixed-effects. The sample consists of a balanced panel of 20 advanced and emerging market economies over the period 1969Q3-2008Q4.

The results presented in Figure 8 suggest that U.S. monetary policy shocks have also significant effects on financial conditions in other countries. In particular, an exogenous 100 basis points increase in the U.S. monetary policy rate typically contracts the level of real credit by about 1 percent after 12 quarters.[14]

Figure 8. Spillovers from U.S. Monetary Policy
(bank credit, percent change)



Note: The y-axis shows the impact of monetary policy shocks and Macroprudential measures on the log level of real credit—the coefficients δ in Equation (8), respectively. The x-axis indicates quarters after the shock in t =0. Dashed lines indicate the 90 percent confidence bands.

Source: BIS, Haver, IFS-IMF, Coibion (2012), Elliott et al. (2013), and authors' calculations.

[14] Similar results, not shown here, are found for property prices and are available upon request.

To determine whether macroprudential measures have similar spillover effects, we estimate equation (8) using macroprudential measures indentified by Elliott et al. (2013) over the period 1960Q1-1992Q2. Contrary to monetary policy shocks, we do not find evidence of spillover effects associated with U.S. macroprudential policies (Panel B). In the case of spillovers, reverse causality is less of an issue as it is unlikely that an increase in credit (property price) outside of the U.S. affects the probability of the occurrence of U.S. macroprudential measures. However, the results should again be interpreted with caution since other omitted global factors may still affect both US macroprudential measures and domestic credit growth.[15] Moreover, financial sectors have become much more integrated since U.S. macroprudential measures were actively used. In fact, recent findings in the literature report significant effects of macroprudential measures on bank cross-border flows (Beirne and Friedrich, 2014) or foreign branches lending (Danisewicz et al., 2015).

B. Role of Country-Specific Factors

The impact of U.S. monetary policy shocks might differ depending on economic conditions and policy settings in shock-recipients countries. For instance, the impact of shocks may be larger for emerging economies that typically rely more on foreign financing and, thus, are more vulnerable to capital flow reversals (IMF 2015a). In addition, country-specific policies may provide buffers to foreign policy spillovers. For instance, the impact may be larger for countries with pegged—in particular to the U.S. dollar—exchange rate as they tend to react more closely to U.S. monetary policy changes (e.g., Di Giovanni and Shambaugh, 2008). In countries with flexible exchange rate, however, domestic rate monetary policy may help attenuate spillover effects (Broda and Tille, 2003; IMF, 2014a).

To explore the role of country-specific factors, we estimate equation (8) distinguishing between advanced and emerging economies. The results in Figure 9 show that the impact of U.S. monetary policy shocks is larger for emerging market economies (about 1.3 percent after 12 quarter of the shock) than for advanced economies (about 0.8 percent). Interestingly, the impact on emerging markets is also larger than domestic impact of monetary policy for the United States (Eichengreen and Gupta, 2013).

Subsequently, we assess the transmission channels of spillovers by allowing the response to vary with country-specific characteristics including the exchange rate regime, the degree of capital account openness and the size of market capitalization.[16] In particular, as in Section IIIC, we estimate the following regression:

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[15] The results are robust when including global shocks such as oil prices.

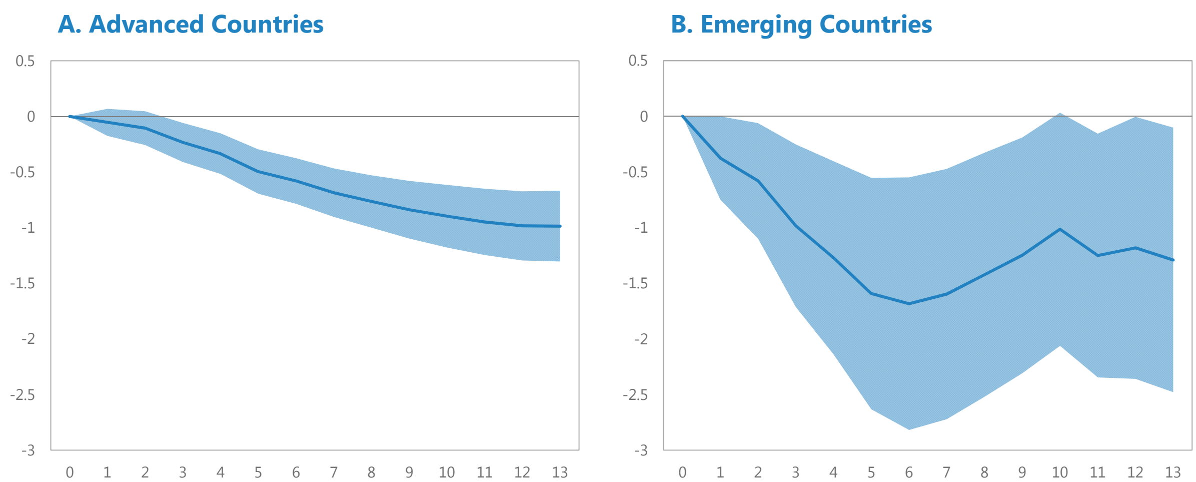
[16] Exchange regimes are those identified by Reinhart and Rogoff (2004), capital account openness is measured by the Chinn-Ito (2012) index, and market capitalization is defined as the period average of the stock market value (Appendix 2).

$$\Delta c_{it} = \alpha_i + \delta_1(L)G(z_{it})m_t + \delta_2(L)(1 - G(z_{it}))m_t + \varepsilon_{it} \quad (9),$$

with $G(z_{it}) = exp(-\gamma z_{it})/(1 + exp(-\gamma z_{it}), \quad \gamma > 0$

where z is, in this case, an indicator of the country-specific characteristic normalized to have zero mean and unit variance.

Figure 9. Spillovers from U.S. Monetary Policy Shocks
(bank credit, percent change)

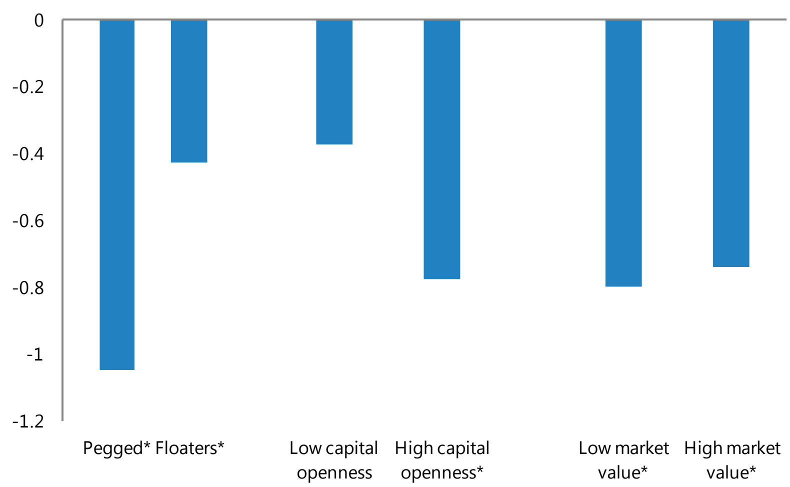


Note: The y-axis shows the impact of monetary policy shocks on the log level of real credit—the coefficients δ in Equation (8). The x-axis indicates quarters after the shock in t =0. Dashed lines indicate the 90-percent confidence bars. * indicates statistically significant effects.

Source: BIS, Haver, IFS-IMF, Coibion (2012), and authors' calculations.

The results presented in Figure 10 suggest that spillover effects from the U.S. monetary policy shocks are larger for countries with fixed exchange rate regimes (1 percent) than for counties with flexible exchange rates (0.4 percent), and for countries with higher capital account openness (0.8 percent). In contrast, the impact of U.S. monetary policy shocks on real credit is similar and not statistically significantly different across countries with different degree of market capitalization.

Figure 10. Spillovers from U.S. Monetary Policy Shocks
(bank credit, percent change)



Note: The y-axis shows the impact of monetary policy shocks on the log level of real credit—the coefficients δ in Equation (9). The x-axis indicates quarters after the shock in t =0. Dashed lines indicate the 90-percent confidence bars. * indicates statistically significant effects.

Source: BIS, Haver, IFS-IMF, Coibion (2012), and authors' calculations.

C. "Growth-Driven" vs. Exogenous Monetary Policy Shocks

The effects of US monetary policy shocks may also differ depending on the underlying reasons behind these changes. In particular, the impact might vary depending on whether monetary policy tightening reflects changes in economic conditions or not. For instance, a "growth-driven" increase in monetary policy rates may have a positive impact on real economy through higher external demand (IMF 2014a, 2015a) and, therefore, put upward pressure on financial variables. In contrast, monetary policy changes triggered, for instance, by financial stability concerns without growth stimulus may have the opposite effects.

"Growth-driven" monetary policy shocks (e_t) are identified as the expected changes in FFR. In particular, are obtained by subtracting from intended change in the FFR (Δf_t) the exogenous monetary policy innovations (m_t):

$$e_t = \Delta f_t - m_t \quad (10),$$

Then, to assess the spillover effects of "growth-driven" versus exogenous monetary policy shocks on credit conditions in other countries the following specification is estimated:

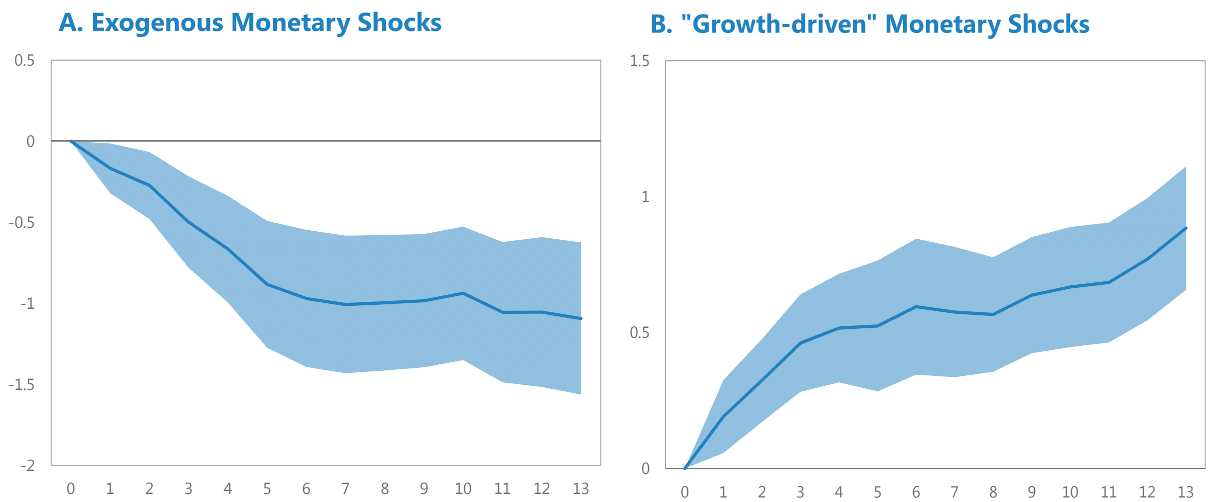
$$\Delta c_{it} = \alpha_i + \delta_1(L)e_t + \delta_2(L)m_t + \mu_{it} \quad (11),$$

where c_{it} is the (log of) real credit in country i at time t, α_i are country fixed-effects e and m are, respectively, "growth-driven" and exogenous U.S. monetary policy shocks. The sample consists of 20 advanced and emerging market economies over the period 1969Q3-2008Q4.[17]

The results in Figure 11 show that both types of shocks significantly affect credit dynamics in other countries. However, while exogenous monetary policy shocks reduce credit by about 1 percent at the peak (panel A), "growth-driven" shocks have opposite effects (Panel B). In particular, a 100 basis point "growth-driven" shock increases credit in other countries by 0.2 percent after one quarter and by about 1 percent after 12 quarters.

Figure 11. Spillovers from "Growth-Driven" vs. Exogenous U.S. Monetary Policy Shocks

(bank credit, percent change)



Note: The y-axis shows the impact of monetary policy shocks on the log level of real credit—the coefficients δ in Equation (11). The x-axis indicates quarters after the shock in t =0. Dashed lines indicate the 90-percent confidence bars.

Source: BIS, Haver, IFS-IMF, Coibion (2012), and authors' calculations.

[17] In the case of spillovers—contrary to domestic effects—reverse causality is less of an issue as it is unlikely that an increase in credit (property price) outside of the U.S. affects the probability of the changes in the FFR.

V. CONCLUSIONS

The Global Financial Crisis has reopened discussions on the role of the monetary policy in maintaining financial stability domestically and across borders. The decision on extending monetary policy objective to financial stability concerns should be preceded by a careful costs and benefits analysis for each country.[18] In this context, determining whether and how monetary policy, in particular compared to macroprudential measures, affects financial variables is crucial. This paper tries to shed lights on these issues.

Estimates provided in this paper indicate that monetary policy shocks have significant and persistent effects on financial conditions and can attenuate long-term financial instability. Lags in the impact of policy changes are also important. For instance, a one percent point monetary policy shock starts to reduce credit after 6 quarter with the peak effect (of about 1 percent) occurring 3 years after the shock. For property prices, the maximum effect is about 2 percent after 3 years. Macroprudential measures have in general immediate, but significantly shorter-lasting effects. Moreover, monetary and macroprudential policy tightening measures tend to have larger effects than easing ones. Also, the effect of monetary policy shocks and macroprudential policy tightening measures tend to be larger during recessions than expansions.

The results also suggest that U.S. monetary policy shocks can affect financial conditions in other countries. However, spillover effects depend on factors underlying policy changes and shock-recipient economic characteristics and policies. The impact—consistent with previous findings—is larger for emerging economies, countries with fixed exchange rate regimes and higher capital account openness, but independent from degree of market capitalization. Exogenous changes in policy rates dampen financial conditions in other countries, while changes in policy rates driven by changes in U.S. economic conditions tend to have the opposite effects. Finally, the results suggest that general macroprudential measures tend to have limited spillover effects on other countries. However, these results should be interpreted with caution as increasing financial linkages (e.g., cross-border flows, presence of foreign-owned banks) may amplify these effects in the future.

[18] See IMF (2015a,b) for more discussion on the policy implications on the role of monetary policy in maintaining financial stability, and on spillovers from monetary and macroprudential polices.

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APPENDIX I. Summary Statistics

Financial Indicators	Country	Mean	Standard Deviation
Bank credit	USA	0.49	0.60
Bank credit	Advanced Economies	1.52	2.64
Bank credit	Emerging Countries	1.84	5.92
Property prices	USA	1.66	3.71
Property prices	Advanced Economies	2.06	7.68
Property prices	Emerging Countries	0.31	7.70

Note: Statistics for the log year on year change of each financial indicator. Period: 1969q3 - 2008q4
Advanced economies: Australia, Austria, Canada, Denmark, Greece, Israel, Japan, New Zealand, Norway, Portugal, Singapore, Sweden, Switzerland; Emerging countries: Brazil, Colombia, India, Malaysia, Mexico, Thailand, and Uruguay.
Source: BIS, Haver, IFS-IMF, and authors' calculations.

APPENDIX II. Data

Data is obtained from the International Financial Statistics and the Real Estate Markets Module of the International Monetary Fund, the long series on credit to the private non-financial sector of the Bank for International Settlements, Haver Analytics, Coibion (2012), Chinn and Ito (2006), Elliott et al. (2013), and Reinhart and Rogoff (2004). The variables used in this paper are the following:

Bank credit to the private non-financial sector: CPI deflated Claims to the private sector from International Financial Statistics (codes XXX22D..ZK... , XXX22s..ZK... and XXX22D..ZF...).

Capital account openness is measured by an update Chinn-Ito (2013) financial openness index, available at http://graduateinstitute.ch/home/study/academicdepartments/international-economics/md4stata/datasets/chinn_ito.html.

CPI: Non-harmonised Consumer price index obtained from IFS through Haver Analytics (code PC).

Credit from all sectors to the private non-financial sector: The series capture the outstanding amount of credit at the end of the reference quarter and are taken from the Bank for International Settlements. Borrowers include non-financial corporations, households and NPISHs. In terms of financial instruments, credit covers loans and debt securities. The series are adjusted for breaks by the BIS.

Exchange regimes are those identified by Reinhart and Rogoff (2004), and available at http://www.carmenreinhart.com/data/browse-by-topic/topics/11/.

Real house price index: Series adjusted for inflation using CPI. Series from the Real Estate Markets Module of the IMF Research Department. The advanced economies data is obtained from the OECD Housing Prices Database.

US Monetary policy shocks: Exogenous innovations in the U.S. federal funds rate identified by Coibion (2012) as the residuals from an estimated Taylor rule with time-varying parameters. The approach is similar to the one originally proposed by Romer and Romer (2004), but it allows a distinction between innovations to the central bank's rule (policy shocks) and changes in the rule itself. In this approach, random innovations to the rule are classified as monetary policy shocks, but policy changes such as regime changes or changes in the inflation target or GDP growth target are captured by the time-varying parameters of the rule and are therefore not classified as shocks.

Macroprudential policy actions: Dates are identified by Elliott et al. (2013) using a narrative approach that distinguishes between tools that affect the demand for credit and those that affect its supply (Table below). Data is available from 1918 to 1992.

Market capitalization is defined as the period average of the stock market value. The data are taken from the World Bank Development Indicators.

APPENDIX III. Summary of Macroprudential Tools

	Examples	Examples of countercyclical use*
Macroprudential tools affecting demand for credit		
Loan-to-value ratios	State laws	1941-52 (consumer)
	National Banking Act and Federal Reserve Act (OCC)	1950-2 (housing)
	Federal Reserve Regulation W (consumer credit)	1950, 1955 (FHA)
	Federal Reserve Regulation X (housing credit)	
	Federal Housing Administration lending rules	
Margin requirements	Fed. Reserve Reg. T and U (stock margins)	1934-1974 (Fed)
	Clearinghouse rules (stock and futures margins)	
Loan maturities	State laws	1941-52 (consumer)
	National Banking Act and Federal Reserve Act	1950-2 (housing)
	Federal Reserve Regulations W and X	1950, 1955 (FHA)
	Federal Housing Administration lending rules	
Tax policy and incentives	Mortgage interest deductions and credits	1951, 1975, 1981 (housing)
	Investment tax credit (ITC)	1960s-1970s (ITC)
Macroprudential tools affecting supply of credit		
Lending rate ceilings	State usury laws	--
	Federal Housing Administration lending rules	
Interest rate ceilings	Deposit rates (Federal Reserve Regulation Q)	1966, 1969, 1973-4
	Other liabilities (Federal Reserve Regulation Q)	
Reserve requirements	State laws	1936-1991 (Federal Reserve)
	Savings and loan regulations	1960s-1970s (FHLBB)
	Commercial banks (Fed. Reserve Regulation D)	1980 (Credit Control Act invoked)
	Special marginal reserve requirements	
	Special asset-based reserve requirements	
Capital requirements	State laws	1980s (savings and loans)
	Savings and loan regulations	1985-6 (farm/energy banks)
	Commercial banks and holding companies	
Portfolio restrictions	State laws	1941-5, 1951-2 (wartime controls)
	National Banking Act and Fed. Reserve Act (OCC)	1947 (credit restraint)
	Savings and loan regulations	1965-74 (foreign credit restraint)
	Special voluntary credit restraint programs	1966 (business credit)
		1980 (Special Credit Restraint)
Supervisory pressure	Measures to promote credit availability in recession	1938, 1991, 1993 (promote)
	Measures to discourage excess in booms	1920s, 1995, 2000s (discourage)

*Note that examples of usage are not meant to line up with examples of tools in the second column.
Source: Elliott, Feldberg, and Lehnert (2013)