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Revisiting the Monetary Transmission Mechanism through an Industry-Level Differential Approach

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April 2023

2023RWP-215

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First draft: August 2021
This draft: April 2023

Abstract

We combine industry-level data on output and prices with monetary policy shock estimates for 105 countries to analyze how the effects of monetary policy vary with industry characteristics. Next to being interesting in their own right, our findings are informative on the importance of various transmission mechanisms, as they are thought to vary systematically with the included characteristics. Results suggest that monetary policy has greater output effects in industries featuring assets that are more difficult to collateralize, consistent with the credit channel, followed by industries producing durables, as predicted by the interest rate channel. The credit channel is stronger during bad times as well as in countries with lower levels of financial development, in line with financial accelerator logic. We do not find support for the cost channel of monetary policy, nor for a channel running via exports. Our database (containing estimated monetary policy shocks for 177 countries) may be of independent interest to researchers.

Keywords: Monetary policy transmission; Industry growth; Financial frictions; Heterogeneity in transmission; Monetary policy shocks.

JEL codes: E32, E52, F43, G20

* We thank Noh-Sun Kwark (discussant), Jaebin Ahn, Nina Biljanovska, Romain Bouis, Davide Furceri, Yuriy Gorodnichenko, Andreas Joseph, Kwang Hwan Kim, Myunghwan Andrew Lee, Seung Hoon Lee, Tomohide Mineyama, Yasuyuki Sawada, Inhwan So, Tianxiao Zheng, and participants at the 2023 Royal Economic Society Conference, Bank of Korea, Korea-Japan Joint Economics Seminar, KAFE SKKU International Conference on Finance, Korea International Economic Association Conference, Korea International Economic Forum, and Yonsei University for useful comments and discussions. Thanks to Niklas Amberg, Hiroyuki Kubota, and Byungho Lee for sharing their high-frequency monetary policy shock data. Zhuo Chen and Hyun Pyung Kim provided excellent research assistance. This research was (in part) supported by the Yonsei Signature Research Cluster Program of 2022 (2022-22-0012). The views expressed are those of the authors and do not reflect those of the Bank of England or any of its Committees.

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I. Introduction

How does monetary policy affect key macroeconomic variables? Although our understanding of this "transmission mechanism" has improved over time, studies have not reached a consensus regarding the empirical relevance of competing channels (e.g., Mishkin, 1995; Boivin, Kiley, and Mishkin, 2010). This paper aims to enhance our understanding by using a broad panel dataset (featuring 105 countries and 22 industries) covering the period from 1973 to 2019 to analyze the impact of monetary policy on industry-level outcomes. It combines estimates of monetary policy surprises with data on various industry-level characteristics, enabling us to analyze what type of industries (and associated characteristics) are particularly susceptible to changes in the stance of monetary policy—thereby generating information on the relative importance of various monetary transmission channels.

Economic theory has laid out several channels via which monetary policy can have real effects. Traditionally, the monetary policy literature has distinguished between four different transmission channels (Mishkin, 1995)—the interest rate channel, the exchange rate channel, the asset price channel, and the credit channel; in addition, the literature has also discussed the cost channel (Barth and Ramey, 2001), the signaling channel (Romer and Romer, 2000), as well as the mortgage refinancing channel (Wong, 2019), among many others.

By interacting monetary surprises with industry-level characteristics, we introduce the powerful and influential approach of Rajan and Zingales (1998) to the monetary policy literature. We find strong evidence that monetary contractions reduce output more in industries featuring assets that are more difficult to collateralize, followed by industries producing durable goods. The latter finding supports the interest rate channel, while the former points to the importance of financial frictions and the associated credit channel of monetary policy. As predicted by the underlying theory, we find that the credit channel is amplified during economic and financial downturns when external financing becomes more difficult to access.

In addition, we do not find consistent evidence for the hypothesis that exporting industries suffer more from a monetary tightening. Instead, our result is more in line with the theory of "dominant currency pricing" (Gopinath et al., 2020): when most traded goods are priced in a "dominant" vehicle currency (typically U.S. dollars), a monetary tightening in the exporting country may well appreciate the associated currency, but does not affect the exchange rate between the importer's currency and the U.S. dollar—meaning that the standard contractionary impact on exports (as for example present under the assumption of producing currency pricing) does not arise.

Along similar lines, we also test for the cost channel of monetary policy, as for example discussed in Barth and Ramey (2001). This takes the view that borrowing working capital is a necessary input to the production process (particularly for industries with high liquidity needs), implying that interest rate increases become like adverse cost-push shocks—putting upward pressure on the price level. Our results, however, do not lend support to this view, as relative prices of products produced in industries that are more reliant on working capital, if anything, appear to *decrease* following monetary contractions (which runs counter to the prediction of the cost channel).

Our paper is most closely related to Dedola and Lippi (2005) and Peersman and Smets (2005), who have also analyzed the heterogeneous impact of monetary policy shocks on different industries, drawing links to the importance of various transmission channels.[1] Relative to these contributions our paper is much broader in scope—covering 105 countries, including many emerging and developing economies.[2] Such a broadened coverage supplies the econometric analysis with

[1] Along similar lines, Gertler and Gilchrist (1994) and Carlino and DeFina (1998) study the behavior of small versus large firms in response to monetary policy shocks using U.S. data. They find that small firms tend to be more sensitive to monetary policy, a result consistent with the credit channel (as small firms are typically less able to pledge collateral). Recent work by Corsetti, Duarte, and Mann (2022) explores the drivers of heterogeneity observed within the eurozone in the response to ECB monetary policy shocks; they focus on a set of factors orthogonal to our study, namely the importance of floating rate mortgages, homeownership rates, hand-to-mouth consumers, and wage rigidities—characteristics our Rajan and Zingales (1998)-type approach is not able to test, making our work complementary to theirs.

[2] The analysis of Dedola and Lippi (2005) is based on five OECD countries, while Peersman and Smets (2005) cover seven eurozone countries. Both studies rely on monetary policy shock identification in a VAR framework employing a recursive identification scheme (following Christiano, Eichenbaum, and Evans, 1999), while we take a different approach (detailed in Section III below). Recently, Auer, Bernardini, and Cecioni (2021) test the credit channel of monetary policy using

greater variation—increasing the signal-to-noise ratio—but is also interesting in its own right as it for example enables us to analyze whether the transmission mechanism meaningfully differs across countries, e.g., based on their level of financial development (which we find to be the case, with the credit channel being more important in countries with less developed financial systems).

In addition, our focus on the *differential* impact of monetary policy on industry-level outcomes (and linking that to industry-level characteristics) eases standard concerns related to reverse causality, which we can address by including a simple-yet-powerful set of fixed effects. We include these on top of the standard strategy of using monetary policy *shocks*, but since proper identification of the latter remains a formidable challenge (see, e.g., Bauer and Swanson (2022)) we consider the ability to include fixed effects a welcome aid. In particular, our country-industry level panel data setup allows for country-time fixed effects, which absorb any country-specific variation over time and separate the differential impact of monetary policy from unobserved macroeconomic shocks.

On top of our baseline analysis, we also investigate whether the relevance of each transmission channel varies over business and credit cycles. Our findings suggest that the transmission channels tend to be more potent during contractions in real GDP or private credit, especially when considering proxies for the credit channel; this is consistent with "financial accelerator" effects stemming from financial frictions, which become more severe in downturns.

The remainder of the paper is organized as follows. In Section II, we discuss the main transmission channels of monetary policy. Section III presents our empirical methodology, after which Section IV describes the data underlying our exercises. Section V presents the main findings and the results of various robustness checks and extensions. Section VI concludes.

seven eurozone countries and 22 manufacturing industries. They use eurozone high-frequency monetary surprises by Jarociński and Karadi (2020) and find that corporate leverage increases the effectiveness of monetary policy.

II. Monetary Transmission Channels

As will be set out in greater detail in Section III, this paper looks at the differential impact of monetary policy based on technological characteristics at the industry level. Next to being informative in its own right, an analysis of how the response to monetary policy changes varies with these characteristics is also illuminating the relative importance of the various monetary transmission channels, as they are expected to vary with specific characteristics. As argued by Dedola and Lippi (2005), industry-level data are especially informative on the monetary transmission channel since factors determining the sensitivity to monetary policy typically vary more across industries within a country than across countries.[3]

As mentioned in the Introduction, the literature has traditionally distinguished four different ways via which changes in monetary policy can affect economic outcomes: the interest rate channel, credit channel, exchange rate channel, and asset price channel (Mishkin, 1995). Since our dataset is not informative on the asset price channel, we focus on the remaining three. The availability of an additional dataset (featuring industry-level price deflators) also enables us to investigate the cost channel. The latter features in several prominent models (such as Christiano, Eichenbaum, and Evans (2005)) and has important implications for the optimal conduct of monetary policy (Ravenna and Walsh, 2006).

1. The interest rate channel. This channel is typically seen as the main "Keynesian" transmission mechanism, whereby a monetary contraction (increase in the short-term interest rate) ends up pushing up longer-term rates through the expectations-hypothesis of the term structure. With prices being sticky, this translates into an increase in the real interest rate. Firms (consumers) respond to

[3] Recently, several studies have analyzed the monetary transmission mechanism using firm-level data (see, e.g., Jeenas, 2019; Ottonello and Winberry, 2020; Durante, Ferrando, and Vermeulen, 2022; Cloyne et al., forthcoming). But as discussed in Auer, Bernardini, and Cecioni (2021), the use of firm-level data has its shortcomings too as these data generally only cover publicly-listed firms (which are not necessarily representative for the broader economy) while being hardly available for developing economies. In that sense, we see our industry-level analysis as complementary to recent firm-level studies.

this increased cost of capital by cutting back on investment (durable purchases), which depresses output and prices.

2. The credit channel. This channel is associated with the seminal contributions of Bernanke and Gertler (1989) and Bernanke, Gertler, and Gilchrist (1999), who developed the idea that a monetary contraction reduces firms' net worth (the sum of liquid assets and marketable collateral, less outstanding obligations).[4] This makes borrowers less able to put up collateral for their loans, increasing agency problems: firm owners now have less "skin in the game," making them more likely to engage in risky investment strategies that are not in lenders' interest. To compensate for this risk, lenders will charge a higher interest rate (via the "external financing premium"), reducing firm investment and thus output. However, due to the inherent difficulty in observing the external financing premium, the literature has relied on various proxies for financial constraints (firm size, age, leverage, dividend payout, etc.) when testing this channel.

In particular, firms that face greater inherent difficulties in pledging collateral (e.g., due to their smaller size or the nature of their assets) are believed to be more vulnerable to this mechanism (Gertler and Gilchrist, 1994), with downturns making creditors "flee to quality" (credit flowing away from borrowers without much collateral; Bernanke, Gertler, and Gilchrist, 1996). In line with this narrative, unsecured debt is found to be strongly procyclical in U.S. data (Azariadis, Kaas, and Wen, 2016), with the unsecured credit spread going up in recessions (Benmelech, Kumar, and Rajan, 2020).[5] As a result, firms with fewer collateralizable assets are expected to be more sensitive to

[4] Occasionally, the credit channel is separated into the balance sheet channel (focusing on the borrower's side) and the bank lending channel (focusing on the lender's side, with a change in monetary policy affecting borrowing rates and volumes, which then impacts output and prices). Since we have no access to data on bank lending, we cannot separately identify these two channels. As Braun and Larrain (2005: 1102) note: "In practice, the distinction between the balance sheet and the bank lending view becomes blurred when the correlation between dependence on external funds and dependence on bank loans is high, or when banks are the predominant source of external finance." Since many emerging/developing economies in our sample do not have well-developed corporate bond markets like the United States, focusing on the broad credit channel appears a reasonable approach.

[5] As noted in Azariadis, Kaas, and Wen (2016), these observations pose a challenge for models in the spirit of Kiyotaki and Moore (1997), as Kiyotaki-Moore-type models imply that *secured* debt is driving/amplifying the business cycle. Instead, these empirical observations call for models featuring both secured and unsecured financing (to capture the "flight

monetary contractions (and economic slowdowns in general); in this context, Bernanke, Gertler, and Gilchrist (1999, pp. 1374-5) also speak of "excess sensitivity" to monetary shocks for firms that are more financially constrained.

3. The exchange rate channel. Since monetary contractions typically appreciate the home currency, they can reduce net exports and aggregate demand (Taylor, 1995). The exact mechanism however varies depending on the currency in which prices are set. In particular, when prices are set in the producer's (i.e., exporter's) currency, a depreciation of the exporter's currency will make the exporter's good cheaper for importers elsewhere, predicting that a monetary tightening (typically leading to exchange rate appreciation) should contract output by more in more export-dependent industries. In practice, however, prices for many traded goods are set in U.S. dollars (even if both exporter and importer reside in countries where the U.S. dollar is not legal tender; Gopinath et al., 2020). An appreciation of the home currency then has no direct impact on external demand for home exports, as the exchange rate between importer currencies and the U.S. dollar is not affected; net exports may still fall, but in this case mainly through higher imports.

4. The cost channel. The last theoretical channel we investigate is the cost channel of monetary policy, as, e.g., emphasized by Barth and Ramey (2001); it also features in the influential model by Christiano, Eichenbaum, and Evans (2005). When firms need to pay factors of production (wages, inventories, etc.) before receiving sale revenues, they must "bridge" the resulting gap by borrowing some working capital. Effectively, this turns the cost of borrowing into an input to the production process, meaning that interest rate increases become like adverse cost-push shocks. Thus, a distinctive prediction of the cost channel is that a contractionary monetary shock will increase prices for products produced by firms that rely more heavily on external financing. Needless to say, such a flipped response of prices to monetary shocks has important implications for the optimal conduct

to quality" out of unsecured lending during downturns), such as Azariadis, Kaas, and Wen (2016) and Luk and Zheng (2022).

of monetary policy (Ravenna and Walsh, 2006), making it important to analyze whether this channel has empirical relevance.

In the remainder of this paper, we aim to shed some light on the importance of these channels by analyzing the industry-specific responses to monetary policy shocks. Since the above channels are likely to differ in their importance across industries (depending on industry-specific characteristics, more on which in Section IV.A), this "differential" approach (laid out in Section III) can teach us something about *how* changes in monetary policy end up affecting output and prices.

III. Methodology

As stated in the Introduction, the focus of this paper is different from most papers in the monetary policy literature. While most papers—those in the tradition of Christiano, Eichenbaum, and Evans (1999)—aim to identify the causal effect of surprise changes in monetary policy on macroeconomic variables of interest (such as output, inflation, and exchange rates), we have a different objective: we wish to analyze what industry-level characteristics are giving rise to greater responsiveness to monetary policy shocks (taking a "differential" perspective, to uncover information on the underlying transmission channel).

Given this different objective, we can (and will) deploy a different method. Next to the fact that a diversity of approaches is generally desirable to assess the robustness of earlier findings, our method has the added benefit (relative to VAR-based studies, such as Peersman and Smets (2005) and Dedola and Lippi (2005)) that it is less dependent on the direct identification of structural shocks. In most studies analyzing the effects of monetary policy, shock identification is as crucial as it is difficult and controversial (Ramey, 2016).

Instead, our focus on differential outcomes at the industry level enables us to further mitigate endogeneity concerns by including multi-way fixed effects (on top of taking more standard approaches to monetary policy shock identification). This fixed-effects approach has been deployed to overcome endogeneity issues in a wide variety of different contexts, including when analyzing the channel through which growth is affected by financial development (the seminal paper by Rajan and Zingales (1998)), by the occurrence of recessions (Braun and Larrain, 2005; Samaniego and Sun, 2015), by banking crises (Kroszner, Laeven, and Klingebiel, 2007; Dell'Ariccia, Detragiache, and Rajan, 2008), and many other factors.

To the best of our knowledge, ours is the first study to use this "Rajan-Zingales approach" to analyze the differential impact of monetary policy on different industries using a large international panel dataset.

A. Econometric specification

To analyze the importance of industry-level characteristics in the monetary policy transmission process, we apply the methodology proposed by Rajan and Zingales (1998) to a three-dimensional panel setup. Specifically, the following specification is estimated for an unbalanced panel of 105 countries and 22 manufacturing industries over the period 1973-2019:

$$Y_{i,c,t+1} = \alpha_{i,c} + \alpha_{i,t} + \alpha_{c,t} + \beta(X_i \times MPS_{c,t}) + \gamma Share_{i,c,t} + \varepsilon_{i,c,t+1}, \tag{1}$$

where i denotes industries, c countries, and t years. $Y_{i,c,t+1}$ is a measure of industry growth during year (t+1). The variable X_i characterizes industry i along a certain dimension (eight in total, such as external financial dependence, asset tangibility, and durability of output; see Section IV.A for details); $MPS_{c,t}$ is our measure of the monetary policy shock for each country c during year t (with positive values indicating monetary contractions; see Section III.B for details); finally, $Share_{i,c,t}$ is the share of industry i in country c's total manufacturing sector value-added at time t (included to allow for "convergence effects", i.e., the possibility that larger industries tend to grow more slowly). When testing the cost channel of monetary policy, we replace output growth with the growth of price deflators $\pi_{i,c,t}$ at the country-industry level:

$$\pi_{i,c,t+1} = \alpha_{i,c} + \alpha_{i,t} + \alpha_{c,t} + \beta(X_i \times MPS_{c,t}) + \gamma \pi_{i,c,t} + \varepsilon_{i,c,t+1}. \tag{1'}$$

The main object of interest in equation (1) is β, the coefficient on the interaction term ($X_i \times MPS_{c,t}$). The interpretation of β is akin to a difference in differences, which measures the *differential* impact of monetary contractions in industries with characteristics as proxied by X_i. This coefficient is informative about what type of industries are particularly affected by the monetary policy shock, which is, in turn, informative about the importance of the various transmission channels. By differentiating equation (1) one obtains that $\beta = \partial^2 Y_{i,c,t+1}/\partial X_i \partial MPS_{c,t}$. When $\beta < 0$, this means that a monetary contraction ($MPS > 0$) ends up having a larger negative effect on output growth in industries that score higher along characteristic X.

Note how regression (1) also contains industry-country, industry-time, and country-time fixed effects ($\alpha_{i,c}$, $\alpha_{i,t}$, and $\alpha_{c,t}$, respectively). This constitutes a powerful set of controls, reducing any lingering concerns about any omitted variables, model misspecification, or reverse causality (Rajan and Zingales, 1998). After all:

- industry-country fixed effects ($\alpha_{i,c}$) control for all industry i-country c-specific factors that affect the growth of industry i in country c (such as a country's industrial policies, to the extent that they persist over time);
- industry-time fixed effects ($\alpha_{i,t}$) control for all global factors impacting the growth rate of industry i at time t across all countries in the sample (e.g., a positive oil price shock, which is expansionary for the oil-producing sector but contractionary for the transport sector);
- country-time fixed effects ($\alpha_{c,t}$) control for all macroeconomic developments affecting country c in year t (such as the state of the country's business cycle), including any aggregate effects stemming from monetary, fiscal, or other policies.

Given the presence of these fixed effects, the only remaining source of variation is quite narrow—namely factors that are specific to industry i in country c during year t, such as our interaction term of interest ($X_i \times MPS_{c,t}$). Following Abadie et al. (2017), we cluster standard errors at the treatment level, which is country by time.

B. Endogeneity and our measure of monetary policy shocks

In studies analyzing the effects of monetary policy, the main challenge is typically to overcome the fact that monetary policy is highly endogenous (Ramey, 2016). Following a change in the stance of monetary policy, one does not know whether any observed impact is the cause or the effect of that policy change.

On this front, the approach developed by Rajan and Zingales (1998) is a welcome aid. As discussed in Section III.A, this specification allows for a powerful set of controls—most notably country-time fixed effects ($\alpha_{c,t}$). Their presence implies that we can "freeze" the aggregate state of the economy during year t (rate of growth, inflation, etc.), only analyzing a "partial" change in monetary policy—one that delivers a stronger "treatment" to agents operating in an environment characterized by higher X (and no treatment to agents operating under $X = 0$). Suppose it is true that the inherent characteristic measured by X makes an industry more sensitive to monetary policy shocks. Then, we should find that the resulting estimate for β is significantly different from zero (in particular, smaller than zero if "high-X" industries are more prone to contract following a monetary tightening).

Our focus on the differential impact based on industry-level characteristics alleviates concerns about reverse causality—especially in combination with the inclusion of country-time (and other) fixed effects. In this setup, claiming reverse causality is equivalent to arguing that monetary policy is set with an eye toward differences in growth rates across industries. This strikes us as implausible. In addition, our independent variable of interest is an interaction term consisting of the product of our indicator of monetary policy and industry-specific characteristics obtained from U.S. firm-level data (see Section IV.A)—making it even more unlikely that causality runs from industry-level growth to this interaction variable.

But next to worries about reverse causality, there is also the possibility that endogeneity stems from an omitted variable bias. After all, country c's central bank is likely to determine its monetary policy stance by looking at developments in certain macro-variables, which may in and of themselves bring about differential responses in the various industries included in our analysis. For example, a central bank may tighten monetary policy in response to inflationary pressures, growth exceeding potential, or exchange rate depreciation. If those drivers of monetary policy decisions have a heterogeneous impact on different industries based on their underlying characteristics X_i (e.g., exchange rate depreciation hurting industries with high investment intensity more), $\widehat{\beta}$ would not give an unbiased estimate of the differential impact of pure changes in the monetary policy stance;

instead, the impact of the underlying drivers of the change in the monetary policy stance (depreciation of the exchange rate, in this example) would shine through.

To address this concern, we do our best to identify proper monetary policy *shocks* for all country-year pairs in our sample. Note that this is a deviation from (we would argue: an improvement over) the traditional Rajan-Zingales approach, which does not attempt to purge the interaction term from any endogeneity—fully relying on the constellation of fixed effects instead (which is effective in dealing with issues related to reverse causality, but less so with respect to an omitted variable bias). More specifically, we take a hierarchical approach when it comes to shock identification that can be summarized as follows:

i. Where available, we take monetary policy shocks as identified by *high-frequency studies* in the spirit of Kuttner (2001), which is considered the gold standard in the literature. In particular, we take shocks from Bauer and Swanson (2022) for the U.S. (1988-2019), Jarociński and Karadi (2020) for the eurozone (1999-2016), Cesa-Bianchi, Thwaites, and Vicondoa (2020) for the U.K. (1997-2015), Champagne and Sekkel (2018) for Canada (1974-2015), Holm, Paul, and Tischbirek (2021) for Norway (1990-2018), Amberg et al. (2022) for Sweden (1999-2018), Alberola et al. (2021) for Brazil (2001-2017), Lakdawala and Sengupta (2021) for India (2003-2020), Kubota and Shintani (2022) for Japan (1992-2020), and Ahn, Kim, and Lee (2021) for Korea (1990-2018). We follow the convention that positive shock realizations correspond to a monetary contraction.

ii. If i) is not available, we proxy the monetary policy shock by the *one-day change in the 3-month swap yield* (obtained from Bloomberg) around monetary policy decision days, i.e., the yield at the close of day T minus the yield at the close of day (T-1), with the decision taking place sometime on day T.[6] The floating leg of interest rate swaps is

[6] Dates of monetary policy decisions are obtained from Bloomberg. Ideally, one would wish to use a narrower window around the announcement of the rate decision (of, say, 24 *minutes* rather than 24 *hours*) but the exact hour:minute-information of monetary policy announcements is typically not available for emerging market and developing economies. Moreover, as their financial markets tend to be less liquid than those of the U.S. and other advanced economies, there is a good reason to allow more time for the news to be incorporated.

tightly linked to the stance of monetary policy and any changes around monetary policy decision dates should capture the monetary surprise. This approach goes back to the pioneering work of Skinner and Zettelmeyer (1996).

iii. If i) and ii) are not available, we proxy the monetary policy shock by the *one-day change in the short-term domestic government bond yield* around monetary policy decision days. We look at the shortest possible tenor, only considering bonds with an original maturity of less than a year (i.e., domestic t-bills of 1, 3, 6, or 12-month maturity) as obtained from Bloomberg. Those are typically excluded from debt restructuring operations (which, more generally, tend to focus on *external* debt only), meaning that they do not carry a default risk premium—being intimately linked to the monetary policy stance instead. Focusing on a narrow one-day window around any policy rate decisions further helps to eliminate (difference out) a default premium, if somehow present.

iv. If i), ii), and iii) are not available, we rely on *Bloomberg's survey of financial market participants* to obtain prior (i.e., pre-decision) expectations for each monetary policy rate decision and proxy the shock by subtracting this prior expectation from the subsequent realization (so that positive surprises, again, correspond to contractionary shocks).

v. When i), ii), iii), and iv) are not available (the case for most lower-income countries), we proxy the monetary policy shock by taking *residuals from an estimated Taylor rule.* While this approach may be too crude for advanced economies characterized by a wealth of financial market data, it may be a reasonable way forward for developing countries where data are scarce and forecasts are even scarcer. This naturally puts growth and inflation data (two series commonly available for all countries) at the center of attention, implying that policy-rate forecasts may be well-approximated by a Taylor rule.[7] We

[7] In fact, even for the U.S., we obtain a significant positive correlation (of 0.43) between the annualized shocks identified through high-frequency methods by Bauer and Swanson (2022) and the U.S.'s Taylor residuals that follow from equation (2). We view this as encouraging regarding the potential for our Taylor residuals to approximate the true monetary policy shocks in less-developed economies. Barnichon and Brownless (2019) also show encouraging results (their Figure 3) when it comes to using residuals from a Taylor rule to proxy U.S. monetary policy shocks.

obtain Taylor residuals by estimating equation (2) country-by-country via OLS, following the suggestion by Carvalho, Nechio, and Tristão (2021).

The specific rule we estimate postulates that the systematic component of monetary policy is set with an eye toward a country's real GDP growth, inflation, and exchange rate (given its likely impact on future inflation). In particular, for each country c we estimate:

$$\Delta R_t = \theta + \sum_{j=1}^{3} \kappa_j g_{t-j} + \sum_{j=1}^{3} \lambda_j \pi_{t-j} + \sum_{j=1}^{3} \tau_j \Delta e_{t-j} + \sum_{j=1}^{3} \rho_j \Delta R_{t-j} + \varepsilon_t^R, \quad (2)$$

where ΔR_t is the change in the central bank's policy rate, g_t is the real rate of economic growth, π_t is the rate of inflation, and Δe_t is the change in the logged nominal exchange rate vis-à-vis the U.S. dollar (all during year t); note that (2) also includes lags of the dependent variable, to allow for interest rate smoothing.[8] We include three lags of all variables in (2) since past developments may affect monetary policy decisions during year t.[9] Importantly, results are robust to a variety of alternative specifications—both when it comes to different lag structures as well as to dropping Δe_t or adding additional variables (like the change in the price of oil).

vi. If i), ii), iii), iv), and v) are not available, and the country under consideration pegged its exchange rate to some anchor currency in a given year (per Ilzetzki, Reinhart, and

[8] Data on growth and the exchange rate are taken from the IMF's WEO database; the inflation data come from the World Bank's Global Inflation Database constructed by Ha, Kose, and Ohnsorge (2021) which constitutes a comprehensive, single source for inflation series with greater coverage than other publicly available dataaabases; data on monetary policy rates are taken from Haver and, where complementary, the IMF's IFS database. The rates are quoted annually at end-of-period values, enabling us to calculate the change in the policy rate during each year ($\Delta R_{c,t}$). After conditioning on countries with at least ten years of available data, coverage is such that we have policy rates for 84 countries, with an average time dimension (at the country level) of 29 years.

[9] Our Taylor rule specification (2) does not include any *forecasts* for growth and inflation, but those tend to be less important in emerging/developing economies where such variables are more difficult to predict (and forecasting capacity might be lower); recently, even the U.S. Federal Reserve has signaled that it will attach a lower weight to forecasted inflation (Clarida, 2021). In addition, as for example argued by Stock and Watson (2003), forecasts for both growth and inflation are typically well described by an autoregressive representation, which does feature in equation (2)—as does the nominal exchange rate, which tends to be another strong determinant of future inflation (especially for open economies with strong exchange rate pass-through).

Rogoff (2019)), we use the *estimated monetary policy shock in the anchor country*. This follows the standard trilemma logic, implying that pegging countries end up importing monetary policy from the anchor country (subject to capital account openness). This strategy also underlies Willems (2013) and Jordà, Schularick, and Taylor (2020). Following the latter paper, we construct the monetary policy shock for the receiving country by multiplying the original shock in the anchor country with the Chinn-Ito measure of capital account openness (Chinn and Ito, 2006), which runs continuously between 0 (when the capital account is fully closed) and 1 (indicating a fully open capital account). This adjusts the strength of the instrument in line with the degree of capital account openness, as the trilemma dictates (Jordà, Schularick, and Taylor 2020: 25).

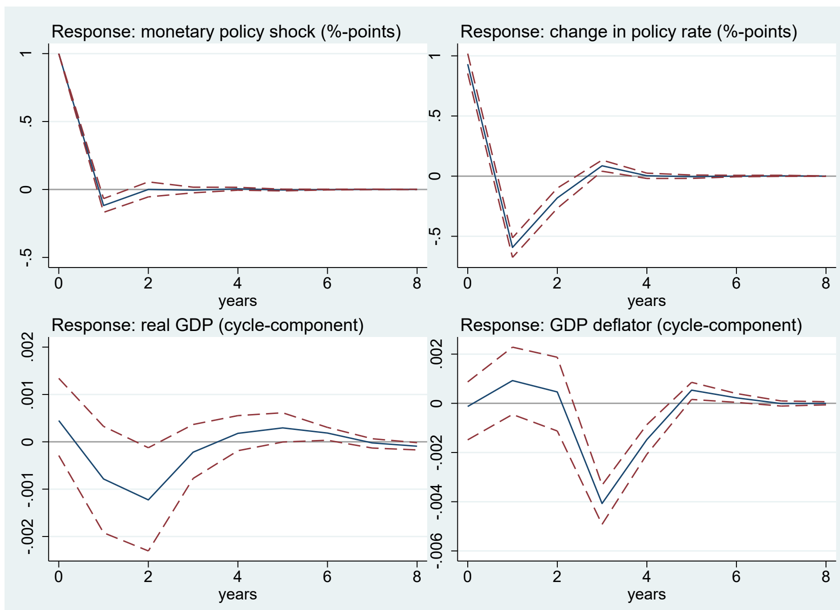
Proxies i), ii), iii), and iv) are calculated on days of monetary policy announcements so we annualize them by cumulation (since our dependent variable is only available at the annual frequency).

Table 1. Sourcing of our monetary policy shock series

Source	Share (I)	Share (II)
High-frequency studies	8.8%	57.8%
Change in swap yields	5.4%	5.4%
Change in bond yields	1.7%	1.7%
Survey-based measure	2.2%	2.2%
Taylor residuals	23.3%	32.9%
Taken from anchor countries	58.6%	n/a
High-frequency studies	*49.0%*	
Change in swap yields	*0.0%*	
Change in bond yields	*0.0%*	
Survey-based measure	*0.0%*	
Taylor residuals	*9.6%*	

Table 1 shows the sourcing of the monetary policy shocks when constructing the series in the above way. Given the prevalence of pegging (as documented by Ilzetzki, Reinhart, and Rogoff (2019)) over half of the monetary policy shocks are taken from anchor countries (see Column (I)); since those are all advanced economies, most shock measures for anchor countries are obtained through high-frequency methods (which we consider desirable, as the high-frequency approach is the current gold standard in the literature). When allocating the shocks taken from anchor countries to the original sources (as done in Column (II) of Table 1), we see that only a third of all shocks are estimated Taylor residuals; the other two-thirds are obtained through more sophisticated methods, with shocks taken from pre-existing high-frequency studies accounting for almost 60% of all 5,433 observations. Figure A.1 in the appendix provides a visual summary of sources of monetary policy shocks for every country (row) and year (column) pair used in our analysis.

Figure 1. Impulse-responses following a positive monetary policy shock



Note: dashed lines represent the 95% confidence interval.

Reassuringly, using the resulting monetary policy shock series in a panel VAR yields puzzle-free responses for the cyclical components of real GDP and the GDP deflator (Figure 1), giving credence to the underlying shock series that sits at the core of the remainder of this paper. These IRFs are generated using the panel fixed effect estimator of Cagala and Glogowsky (2014),[10] with the cyclical components of real GDP and the GDP deflator obtained by applying the Hamilton (2018) filter at the country level. In the spirit of Beaudry and Saito (1998), Stock and Watson (2012), and Mertens and Ravn (2013), we use our monetary policy shock series as an instrument for

[10] Results are nearly identical when estimating the panel VAR in a pooled fashion.

the true monetary policy shock. Following Plagborg-Møller and Wolf (2021), we implement this by estimating a recursive VAR with the instrument (our shock series) ordered first.

Since there is no denying that identifying true monetary policy shocks is difficult (even in the best of circumstances where the high-frequency route is open; see Bauer and Swanson (2022)), we re-emphasize that we not only deploy our best efforts on this front (as described by points i)-vi) above), but also include industry-country ($\alpha_{i,c}$), industry-time ($\alpha_{i,t}$), and country-time ($\alpha_{c,t}$) fixed effects in equation (1)—further controlling for a broad range of factors, mitigating concerns related to reverse causality via that approach (recall the discussion in Section III.A).

IV. Data

A. Technological characteristics at the industry-level

Since our ultimate objective is to investigate whether certain technological characteristics make specific industries more sensitive to changes in monetary policy, we need to obtain industry-level data on those characteristics. This places our paper in the Rajan-Zingales tradition. At the core of Rajan and Zingales (1998) lies the assumption that technological factors vary systematically across industries—a notion for which we will present supporting evidence in Section V.A (which will also show that our main result, the relevance of the credit channel, is robust to using a *country-specific* variable proxying access to credit for each industry).

In line with earlier studies, such as Dedola and Lippi (2005) and the large literature following Rajan and Zingales (1998), most of our industry characteristics are measured using U.S. firm-level or industry-level data. These are assumed to represent technological characteristics in a relatively frictionless and unregulated environment, serving as our analysis' natural benchmark. Basing industry characteristics on U.S. data has an additional advantage of mitigating concerns regarding reverse causality (recall Section III; industry i developments in country c are unlikely to affect the U.S. metrics that determine X_i). To the extent that certain industries are fundamentally and persistently different in other countries, this will be picked up by the industry-country fixed effects ($\alpha_{i,c}$).

We use the following eight industry-level characteristics to investigate the transmission channel of monetary policy. Unless mentioned otherwise, these measures are taken from Samaniego and Sun (2015), who construct industry characteristics at the three-digit ISIC level using U.S. firm-level data. We aggregate them up the two-digit ISIC level employed in our analysis using the industry-level average value-added during the sample period as a weight, as in Choi, Furceri, and Jalles (2022).[11]

1. External financial dependence (EFD). Following Rajan and Zingales (1998), dependence on external finance in each industry is proxied by that share of capital expenditure that is not financed by cash flow from operations; the industry value is that of the median U.S. firm in each industry. External financial dependence captures firms' need for external financing and is employed by, *inter alia*, Dedola and Lippi (2005) to test the credit channel of monetary policy. According to the latter, we expect a negative sign on the interaction term between external financial dependence and the monetary policy shock (as firms relying more heavily on external funding are more vulnerable to an increase in the premium driven by a monetary tightening). At the same time, according to the cost channel of monetary policy, firms with heavy reliance on external funding are more likely to raise the prices of their products following a monetary contraction, predicting a positive interaction term when the dependent variable is the price deflator.

2. Asset tangibility (TAN). Asset tangibility measures the share of tangible capital in a firm's total assets and hence proxies the fraction of a firm's assets that can be pledged as collateral to obtain funding (Hart and Moore, 1994). Asset tangibility can therefore be seen as a measure of an industry's access to secured credit and its industry-level values are used in the Rajan-Zingales-based literature to proxy for the importance of the credit channel (Braun and Larrain, 2005; Aghion, Hemous, and Kharroubi, 2014). The logic is that firms with plenty of tangible (collateralizable) assets will find it easier to obtain external funding after a monetary tightening compared to firms without tangible assets since secured credit tends to be more stable over the cycle (Azariadis, Kaas, and Wen, 2016;

[11] The UNIDO INDSTAT3 dataset used in Samaniego and Sun (2015) was discontinued. Currently, only the INDSTAT2 and INDSTAT4 databases are provided by UNIDO.

Benmelech, Kumar, and Rajan, 2020). Indeed, this kind of exercise was explicitly performed by Bernanke, Gertler, and Gilchrist (1999: 1374-5) to demonstrate how firms without access to secured credit show excessive sensitivity to monetary policy shocks. As a result, industries high on asset tangibility can be expected to suffer less following a contraction, implying that the interaction term between asset tangibility and ΔMP should be positive if the credit sheet channel is important.

3. Investment intensity (INV). This characteristic (also featuring in Dedola and Lippi (2005) and Peersman and Smets (2005)) is measured as the ratio of gross investment over value-added. We compute the investment intensity of U.S. industries using the two-digit UNIDO data. As to its relevance, the interest rate channel predicts that capital-intensive industries (those with high investment intensity) are more vulnerable to a monetary tightening via an increase in the user cost of capital. At the same time, industries with a higher investment ratio are those with plenty of collateral, which can cope with a monetary tightening better than others as they have greater access to secured funding. Thus, similar to asset tangibility, investigating the interaction term on investment intensity is particularly helpful in assessing whether the *ability to secure* external financing is of first-order relevance to the transmission of monetary policy.

4. Labor intensity (LAB). Labor intensity is computed as the ratio of total wages and salaries over total value-added in the United States, using UNIDO data. This variable can be used to test both the credit and cost channels of monetary policy. On the one hand, labor-intensive industries are more likely to suffer from monetary contractions because labor input cannot serve as collateral (suggesting a weaker ability to secure external financing). On the other hand, as discussed in Ilyina and Samaniego (2011), labor-intensive industries are less dependent on external financing for investment. So, if we were to find a significant role for LAB, this suggests that the ability to secure external financing (rather than the need to obtain it) is important for the monetary transmission mechanism. Lastly, according to the cost channel, firms with higher labor intensity face more pressure on their production costs following a monetary tightening (as they face greater wage bill-induced borrowing requirements), which would lead to higher prices for their products according to the cost channel.

5. Liquidity needs (LIQ). Liquidity needs are taken from Raddatz (2006) and are measured by the ratio of inventories to sales, which proxy for the reliance on short-term working capital to maintain inventories. Note that liquidity needs capture somewhat different dimensions of credit constraints relative to the aforementioned technological characteristics, as they are not associated with collateral pledgeability and are likely a short-run phenomenon. Thus, investigating this channel also helps sort out the relative importance between the "ability to secure" and "need to obtain" external funds. Simultaneously, when using prices as a dependent variable, consideration of LIQ is informative on the relevance of the cost channel, which is about short-term borrowing requirements.

6. Capital depreciation (DEP). This variable is computed using industry-specific rates of depreciation from the BEA's capital flow tables. It is based on the resale value of capital goods and thus reflects all factors that result in the decline in the value of capital goods, including both physical and economic depreciation. Similar to asset tangibility, capital depreciation can be used to test the credit channel of monetary policy because less durable capital stocks are not readily collateralizable (suggesting a weaker ability to secure external financing).

7. Durability (DUR). Following Dedola and Lippi (2005) and Peersman and Smets (2005), we use a binary dummy for durability, which takes a value of one if the industry produces durable goods. Durability is defined by the economic destination of production from the national accounts statistics, and 12 out of 22 industries fall into this category. The durability of goods produced by each industry is useful in testing the conventional interest channel of monetary policy. This channel predicts a stronger effect of monetary policy on industries producing more durable goods, as such purchases are often financed by credit and thus more sensitive to interest rates.

8. Export intensity (EXP). Data on this characteristic are taken from Giovanni and Levchenko (2009), who calculated industry-level averages of the ratio of industry-level exports to value-added. We use this variable to test the exchange rate channel of monetary policy. To the extent that a domestic monetary tightening leads to an appreciation, industries more reliant on exports may suffer more. Note that this characteristic is only testing the export-related part of the exchange rate channel: it is important to keep in mind that the latter also allows for an effect on imports, but since our dataset only spans the value-added growth of different industries, we are not able to analyze the impact on, e.g., imports of final consumer goods.

Table 2. Industry-level characteristics and associated theoretical channels

Characteristics	Corresponding transmission channels	Expected sign on the interaction term (β)
EFD	Credit channel (needs)	−
	Cost channel (if $Y_{i,c,t}$ is price growth)	+
TAN	Credit channel (ability)	+
INV	Interest rate channel	−
	Credit channel (ability)	+
LAB	Credit channel (ability)	−
	Credit channel (needs)	+
	Cost channel (if $Y_{i,c,t}$ is price growth)	+
LIQ	Credit channel (needs)	−
	Cost channel (if $Y_{i,c,t}$ is price growth)	+
DEP	Credit channel (ability)	−
DUR	Interest rate channel	−
EXP	Exchange rate channel	−

Note: EFD (external financial dependence), TAN (asset tangibility), INV (investment intensity), LAB (labor intensity), LIQ (liquidity), DEP (capital depreciation), DUR (durability), EXP (export intensity). "Ability" refers to the ability to secure external financing; "needs" refers to the need for external financing.

In Table 2 we summarize how each industry characteristic relates to the theoretical transmission channels discussed in Section II, adding the predicted sign of the interaction term according to the underlying channel.

Table 3. Correlation matrix of industry-level characteristics

	EFD	TAN	INV	LAB	LIQ	DEP	DUR	EXP
EFD	1							
TAN	-0.113	1						
INV	0.160	0.813	1					
LAB	0.141	-0.247	-0.278	1				
LIQ	-0.055	-0.688	-0.576	-0.010	1			
DEP	0.335	-0.194	-0.073	0.491	-0.137	1		
DUR	0.441	-0.201	-0.097	0.504	0.200	0.361	1	
EXP	0.338	-0.369	-0.250	0.278	0.239	0.232	0.396	1

Note: EFD (external financial dependence), TAN (asset tangibility), INV (investment intensity), LAB (labor intensity), LIQ (liquidity), DEP (capital depreciation), DUR (durability), EXP (export intensity).

Table 3 presents the correlation matrix of these variables. The correlations among industry characteristic measures are exceedingly high in a few cases (intuitive, as there are various characteristics capturing a similar concept, e.g., proxies for access to collateral, such as INV and TAN), which prevents the simultaneous inclusion of multiple measures in the same regression due to multicollinearity. To ease the comparison of the economic magnitude across different transmission channels, we normalize each measure X to have a zero mean and unit standard deviation over all industries.

B. Industry-level outcomes

We take the main dependent variable featuring in our analysis, industry-level growth outcomes, from the United Nations Industrial Development Organization (UNIDO) database. It covers 153 different countries—advanced, emerging, and developing—thus enabling us to broaden the scope relative to earlier analyses of the question at hand, which were limited to only 5 to 7 advanced economies (recall footnote 2).

We measure baseline industry growth by value-added growth, which is reported for 22 manufacturing industries at the two-digit INDSTAT2 2021, ISIC Revision 3.[12] We use data reported in current local currencies, then deflate them using Consumer Price Indices taken from the Global Inflation Database (Ha, Kose, and Ohnsorge, 2021). We ensure that, for each industry, there are at least ten years of consecutive data, and the top and bottom one percent of the growth variables are winsorized to reduce the influence of extreme outliers.

To test the cost channel of monetary policy, we also create an industry price index, dividing value-added by the production index (as done by Samaniego and Sun (2015)). However, the sample size for the resulting price deflator is smaller by 30 percent because the coverage of the production index is smaller than that of value-added. To overcome this limitation, we also use the "EU KLEMS" and "World KLEMS" databases in separate exercises. The KLEMS databases have better quality

[12] While the original INDSTAT2 database includes 23 manufacturing industries, we exclude the "manufacture of recycling" industry due to insufficient observations.

observations on price deflators because they are taken directly from the National Accounts, not imputed from the production index (O'Mahony and Timmer, 2009). Another advantage of KLEMS is that it covers not only manufacturing but also service sectors (which are not included in UNIDO). However, these advantages come at some cost: the level of disaggregation of the manufacturing sector in KLEMS (12 sectors) is coarser than in UNIDO (23 sectors). Consequently, we regard these two datasets as complements, not substitutes.

Table A.1 in the appendix provides a list of countries used in our analysis, including their industry and period coverage. The sample includes 105 countries (33 advanced economies and 72 emerging market and developing economies) for which proxies for monetary policy shocks are available with at least ten years of available industry-level data. Following the Rajan-Zingales tradition, the U.S. is not included in regressions to further alleviate reverse causality. Table A.2 reports the 22 manufacturing industries and their technological characteristics.

V. EMPIRICAL FINDINGS

A. Baseline results

Table 4 presents the main findings of this paper, resulting from the estimation of equation (1). Among the eight industry characteristics featured in our analysis, five (TAN, INV, LAB, DEP, and DUR) turn out to be statistically significant, while EFD, LIQ, and EXP are insignificant.

[Insert Table 4]

First, the positive estimates for interaction terms on asset tangibility (TAN) and investment intensity (INV), alongside the negative estimates on depreciation (DEP) and labor intensity (LAB), lend support to the credit channel of monetary policy—suggesting that industries with greater difficulty to pledge collateral are more sensitive to monetary policy. This poses a challenge to models in the tradition of Kiyotaki and Moore (1997), where secured financing is driving/amplifying the business cycle; instead, our findings point to the importance of unsecured financing in the monetary transmission mechanism, with there being a "flight to quality" (i.e., towards secured financing) in downturns; see Luk and Zheng (2022) for a recent model along these lines. Related to the difference in findings between Ottonello and Winberry (2020) and Jeenas (2019), as discussed in Cloyne et al. (forthcoming), our industry-level analysis (which does not suffer from the same endogeneity issues regarding firm-level financial constraints[13]) can provide complementary evidence on the importance of the credit channel.

Moreover, combined with the insignificant results on external financial dependence (EFD) and liquidity needs (LIQ), this suggests that the *ability* to draw external funds by pledging collateral is an important determinant of the output response, not dependence *per se* (which, our results suggest, does not expose firms excessively to changes in monetary policy provided they have access to collateral). While EFD and LIQ have been regarded as proxies for financial constraints, our findings indicate that they capture distinct aspects of financial frictions from the pledgeability of capital. Such orthogonality between EFD and TAN is also highlighted in Braun and Larrain (2015) and highlights the importance of distinguishing multiple dimensions of financial constraints.

Second, we find that industries producing durable goods (DUR) are more sensitive to changes in monetary policy. This is consistent with earlier findings in this literature, such as Dedola and Lippi (2005), Peersman and Smets (2005), and more recently Durante, Ferrando, and Vermeulen (2022). This confirms the traditional interest rate channel of monetary policy. When applied to firms rather than consumers, the interest rate channel also predicts that industries with higher investment intensity (INV) are more sensitive to monetary policy, but that effect (if any) seems overturned by their greater ability to draw external funds (as discussed in the previous paragraph).

[13] Theoretically, it is unclear whether highly leveraged firms are financially constrained or not. Although they were typically treated as being constrained in earlier studies, high leverage also implies that these firms clearly did have access to external financing in the past (otherwise they would not end up as being highly leveraged). That is: there is an endogeneity issue here. Reflecting these contrasting views, Ottonello and Winberry (2020) and Jeenas (2019) find different relationships between corporate leverage and the investment sensitivity of U.S. firms to monetary policy: while the former finds lower sensitivity of high-levered firms, the latter finds them to be more sensitive to monetary shocks. Such contrasting findings are attributed to the empirical difficulty of identifying a shift in the marginal cost curve of investment (i.e., financial constraints) from a shift in the marginal benefit curve (i.e., investment opportunities); see Vats (2022). Our industry-level proxies for access to external financing do not suffer from this endogeneity issue at a business cycle frequency as they are constructed by taking the average (over decades) of U.S. firm-level variables belonging to each industry.

Third, the insignificant coefficient on the interaction term with export intensity (EXP) suggests that industries more reliant on exports do not contract more following a monetary tightening; estimates continue to be insignificant when focusing solely on countries with floating currencies (using the classification from Ilzetzki, Reinhart, and Rogoff, 2019). This is consistent with models of "dominant currency pricing", which predict that the exchange rate channel (if important) mostly runs through imports (Gopinath et al., 2020).

To test the cost channel, Table 5 presents the same set of results after replacing value-added growth with growth in the price deflator. Here, we do not find any evidence of price increases for industries characterized by higher values for EFD, LAB, or LIQ (all believed to proxy the importance of the cost channel).[14] If anything, the sign of LAB is opposite of the prediction of the cost channel and statistically significant at the 10% level.

[Insert Table 5]

While our findings do not lend support to the empirical relevance of the cost channel of monetary policy, this null result might stem from the smaller sample size due to the narrower coverage of the production index or greater measurement error surrounding the industry price index imputed from UNIDO.[15] To investigate this possibility, we have repeated the same exercise using the price deflator taken from KLEMS, which is less likely to be subject to measurement error (O'Mahony and Timmer, 2009). But, as shown in Table A.3 in the appendix, we still do not find any support for the cost channel of monetary policy. The lack of evidence for the cost channel arising from our analysis is complementary to Rabanal (2007) and Henzel et al. (2009), who estimate a New Keynesian DSGE model embedding the working capital channel and find only a limited role for it.

[14] Our conclusion about the relevance of each theoretical channel is robust to using weighted least squares (WLS), with weights given by the value added or the number of employees at the country-industry level, or the relative size of each industry within a country. This suggests that our findings are unlikely to be driven by observations without economic significance.

[15] Unlike other industry outcomes directly taken from UNIDO, we imputed the price index from the ratio of the value-added to the production index, which might generate additional measurement error.

Our findings (and the robustness checks that are to follow) lend strong support to the credit channel of monetary policy. As set out before, however, these results rest on the assumption that technological factors vary systematically across industries—enabling one to use generic values for X_i (typically based on U.S. data) for all countries in the analysis. While this assumption is standard in the literature following Rajan and Zingales (1998), and while it has received some empirical support in studies using cross-country data on technological factors (Carlin and Mayer, 2003; Kroszner, Laeven, and Klingebiel, 2007; Ilyina and Samaniego, 2011), it is still important to check that this assumption is not driving our main result regarding the importance of the identified channels.

Consequently, we assess its robustness by using a proxy for financial constraints which can be constructed *at the country-industry level*, namely the average firm size in each industry. Firm size is thought to be a good proxy for especially the ability to draw external funds, with bigger firms enjoying greater access to external financing—for example, on the back of better access to capital markets, greater availability of assets that can be collateralized, or creditors facing smaller informational disadvantages (see, e.g., Gertler and Gilchrist, 1994; Beck et al., 2008; Hadlock and Pierce, 2010). Indeed, Beck et al. (2008) show that their firm size measure is correlated with asset tangibility but not with external financial dependence in U.S. data.

As the UNIDO database contains information on both the number of establishments and the number of employees in each industry, we can compute the average firm size (in terms of the number of employees) at the country-industry level by dividing the number of employees by the number of establishments, and then average the resulting series over the sample period.[16] The average correlation coefficient of the resulting industry-level firm size measure between the U.S. and the other countries in our sample equals 0.56, pointing to a strong positive correlation. As expected, the average correlation with the U.S. measure is higher for advanced economies (0.67) than for

[16] While we take the average over time to reduce potential measurement errors, the ranking of industries according to their size is highly stable over time. Using value-added (instead of the number of employees) as a size proxy yields similar results, which is not surprising given that its correlation with the baseline measure using the number of workers is 0.86.

emerging and developing economies (0.52), but even the latter is sizeable. This suggests that a U.S.-based measure of industry-specific characteristics has significant relevance to other economies, also when of the emerging or developing type.

In this light, Table 6 summarizes estimation results using three measures of average firm size in each industry: (i) a U.S.-based measure (thus maintaining the Rajan-Zingales assumption of systematic variation across countries), (ii) a "global" measure (taking the median across countries for each industry, still maintaining the Rajan-Zingales assumption but moving away from using the U.S. as the benchmark), (iii) a country-specific measure (*dropping* the Rajan-Zingales assumption). We test both the credit sheet channel (top panel) and the cost channel (bottom panel) of monetary policy.

Our previous conclusion about the (ir)relevance of both channels is maintained: while the credit channel continues to enjoy strong empirical support, the cost channel does not. Importantly, the results using the country-specific measure are *stronger* than those using the U.S.-based measure, consistent with the notion that measurement error (stemming from using the U.S. statistics as a proxy for the rest of the world) induces an attenuation bias, working against finding any significant results. In this sense, our baseline estimates using U.S.-based measures may be biased toward zero, rendering them conservative lower bounds.

[Insert Table 6]

B. Robustness checks

Our results point to the empirical relevance of the credit channel and the conventional interest rate channel; we do not find empirical support for the exchange rate channel and the cost channel of monetary policy. Regarding the credit channel, the results for EFD, TAN, INV, LAB, LIQ, and DEP suggest that the ability to draw external funds, not the need for external funds, shapes how different industries respond to a monetary tightening. This section shows that these results are largely robust to a battery of checks, with the credit channel receiving the most consistent support throughout our various checks.

Instrumental variable approach. Our first robustness check moves away from treating $MPS_{c,t}$ as a structural shock in equation (1), instead considering it as a noisy proxy for a true monetary policy shock. Here, we proceed with a two-stage least squares (2SLS) approach. In the first step, we regress the interaction variable of changes in short-term policy rates and industry characteristics on the composite instrument (the monetary policy shock interacted with industry characteristics). In the second step, we re-estimate equation (1) using the exogenous variation driven by the instrument—that is, the fitted value of the first step. This IV approach alleviates any concern arising from potential measurement errors in constructing the cross-country monetary policy shock series.

Table A.4 in the appendix shows the IV estimation results. The first-stage F-statistics suggest that instruments are strong. The resulting second-stage estimates are remarkably similar to the OLS coefficients in Table 4. If anything, statistical significance tends to increase, suggesting that our new measure of monetary policy shocks is unlikely to suffer from a severe endogeneity bias. The only meaningful change is that the export channel becomes statistically significant, but only at the 10% level.

Short-term policy rate as a monetary policy instrument. Our empirical strategy assumes that the short-term policy rate is a good proxy for the monetary policy stance. While this is plausible for countries with a modern monetary policy framework (i.e., following a Taylor rule under inflation targeting), it may not hold for emerging or developing economies without a developed money market. Even for advanced economies, it is well-known that various central banks were targeting monetary aggregates in the past.

To guard against this possibility, we limit our analysis to the subsample of country-years that operated under an inflation-targeting framework (using the dating of Ha, Kose, and Ohnsorge, 2019). Our working assumption is that the adoption of inflation targeting indicates a transition toward a modern monetary policy framework, justifying our choice of the short-term policy rate as a measure of the monetary policy stance. Table A.5 presents the results, which confirm our baseline findings.[17]

Placebo test. As we essentially use a difference-in-differences design, our identification hinges on the assumption that industries characterized by a certain value of X do not have different trends in growth than other industries before the change in monetary policy. While this "parallel trends" assumption is plausible (since monetary policy is normally not systematically conducted in response to industry-level developments), we examine this concern more directly via a placebo-type test. The placebo test using non-events is widely used in studies of the difference-in-differences type (e.g., Bertrand, Duflo, and Mullainathan, 2004; Duchin, Ozbas, and Sensoy, 2010).

As our baseline analysis deals with a continuous variable rather than a binary dummy, we instead change the timing of ΔMPS in equation (1) so that current industry growth is regressed on the future (not the past) value of monetary policy changes (i.e., the independent variable leading the dependent variable). To the extent that monetary tightening is not anticipated by industry growth differentials given controls, we should not find any statistically significant coefficients on the future independent variable. Table A.6 confirms that essentially none of the interaction variables when using the lead of monetary policy shocks is statistically significant, suggesting that our "parallel trends" assumption is a reasonable one.

C. Asymmetries in the transmission channels

State of the business- and financial cycle. Earlier papers have presented evidence that the response of the economy to monetary policy shocks depends on the state of the business cycle (e.g., Tenreyro and Thwaites, 2016; Jordà, Schularick, and Taylor, 2020). Against this background, we adopt the

[17] We also investigate whether the adoption of inflation targeting changes the empirical relevance of transmission channels. We do this by adding a triple interaction term ($X_i \times MPS_{c,t} \times IT_{c,t}$), where $IT_{c,t}$ is a dummy variable taking a value of one once country c adopted inflation targeting after year t. None of the triple interaction terms are statistically significant, suggesting that the importance of the underlying monetary transmission channels has not been altered by the adoption of inflation targeting.

smooth transition approach proposed by Auerbach and Gorodnichenko (2012) and estimate the following regression:

$$Y_{i,c,t+1} = \alpha_{i,c} + \alpha_{i,t} + \alpha_{c,t} + \beta^E((1 - F(z_{c,t-1})) \times X_i \times MPS_{c,t})$$
$$+\beta^C(F(z_{c,t-1}) \times X_i \times MPS_{c,t}) + \gamma Share_{i,c,t} + \varepsilon_{i,c,t+1}, \qquad (3)$$
$$\text{with } F(z_{c,t}) = \frac{exp\left(\theta\frac{z_{c,t}-\mu_z}{\sigma_z}\right)}{1+exp\left(\theta\frac{z_{c,t}-\mu_z}{\sigma_z}\right)},\ \theta > 0.$$

Here, $z_{c,t}$ is an indicator of the state of the economy specific to each country (the real rate of economic growth), μ_z is a parameter that controls what proportion of the sample the economy spends in either state, σ_z is the standard deviation of the state variable z, and $F(z_{c,t})$ is the corresponding smooth transition function between the two states and enters the equation with a lag to mitigate reverse causality. The coefficients β^E and β^C capture the state-dependent effect of monetary policy during economic expansions and contractions, respectively. This approach considers a continuum of states to compute the impact, thereby making resulting estimates more precise.

The parameter $\theta > 0$ determines how smooth a transition is between the two states. As θ increases, the transition becomes more sudden, and $\theta \to \infty$ corresponds to the binary case while setting $\theta = 0$ is equivalent to the original linear specification of equation (1). Following Auerbach and Gorodnichenko (2012), we choose $\theta = 1.5$, but our results are largely invariant to θ. While Auerbach and Gorodnichenko (2012) use a seven-quarter moving average of real GDP growth, our analysis uses annual real GDP growth to distinguish between good and bad times. We choose the country-specific value of μ_z to make sure that each country evenly splits its time between expansions and contractions. This approach allows for a direct test of whether the monetary transmission channels vary over the business cycle.

The results reported in Table 7 suggest that the strength of the various monetary transmission channels indeed varies with the state of the business cycle. Especially the interaction terms capturing the credit channel (INV, LAB, and DEP) tend to be larger in absolute value and/or associated with higher t-statistics during bad times. This is as predicted by the financial accelerator mechanism and consistent with the recent finding by Vats (2022) that financially-constrained firms respond more to monetary policy shocks during economic downturns, lending further support to the relevance of the credit channel. On the other hand, proxies for other channels of monetary policy do not exhibit business-cycle dependency.

[Insert Table 7]

We conduct a similar exercise but use financial conditions as an underlying state $z_{c,t}$ to shed further light on the importance of the credit channel, which predicts that monetary policy has stronger effects when financial conditions are tight (e.g., Caldara and Herbst, 2019; Miranda-Agrippino and Ricco, 2021). Unlike advanced economies, where credit price-based measures of financial conditions are available (for example, credit spreads or excess bond premiums emphasized in Gilchrist and Zakrajšek, 2012), these measures are difficult to construct in emerging or developing economies due to the lack of developed debt markets. Given this reality, we measure financial conditions by the so-called credit gap, defined as a cyclical deviation of the private credit to GDP ratio from its trend.[18]

We proceed by using a *quantity*-based credit measure and isolate the cyclical component from its trend using the Hamilton filter (Hamilton, 2018) to account for financial deepening over time. Similar to the exercise above, each country evenly splits its time between credit expansions and credit contractions (i.e., above and below the trend). Table A.7 shows that the interaction terms capturing the credit channel indeed are stronger during credit contractions, echoing the evidence in Table 7 and consistent with the financial accelerator mechanism.[19]

Amplification of the credit channel of monetary policy. Our results so far strongly point to the empirical relevance of the credit channel of monetary policy. In this subsection, we jointly consider other states of the economy, which are known to affect the credit channel of monetary policy, to shed further light on this channel. The first potential candidate is the level of financial development.

[18] This exercise uses "Domestic credit to private sector (% of GDP)" from the World Bank.

[19] Table A.8 in the appendix confirms that our findings are robust to using the one-sided HP filter.

As originally discussed by Rajan and Zingales (1998), financial development tends to be of greater benefit to credit-constrained industries. Thus, one can expect that financial development would weaken the credit channel of monetary policy. Following Rajan and Zingales (1998), we use the ratio of private credit to GDP to measure financial development and add its interaction with X as an additional control to our regression (1), that is we estimate:

$$\begin{aligned} Y_{i,c,t+1} &= \alpha_{i,c} + \alpha_{i,t} + \alpha_{c,t} + \beta(X_i \times MPS_{c,t}) + \varphi(X_i \times U_{c,t}) \\ &+\theta(X_i \times MPS_{c,t} \times U_{c,t}) + \gamma Share_{i,c,t} + \varepsilon_{i,c,t+1}, \end{aligned} \tag{4}$$

with our measure of financial development taking the place of $U_{c,t}$ in equation (4).

The slow-moving nature of financial development differentiates this exercise from the one in equation (3) in which *cyclical* financial conditions specific to each country interact with monetary policy shocks. Before estimating equation (4), we estimate the version without the triple interaction term to check whether our measure of monetary policy shocks is truly orthogonal to potential confounding factors.[20] Table A.9 in the appendix confirms that the inclusion of financial development hardly changes the channel through which monetary policy shocks affect industry growth.[21] More importantly, Table 8 shows that the triple interaction term capturing the credit channel is often statistically significant, suggesting that the credit channel of monetary policy is stronger in less-developed financial markets. In contrast, financial development does not affect the strength of other transmission channels, which gives credence to the approach (as the interaction with characteristics not related to the credit channel can be seen as a "placebo test", where no effect is to be expected).

[20] Despite the use of arguably exogenous monetary surprise measures and our inclusion of two-way fixed effects, we cannot fully exclude the possibility that other factors correlated with monetary policy shocks have heterogeneous effects on industry growth.

[21] Although many of the interaction terms on financial development are statistically insignificant, our results do not contradict the original findings in Rajan and Zingales (1998) because external financial dependence—the key interest of Rajan and Zingales (1998)—is highly statistically significant in our sample. While we exploit the annual variation in financial development in a given country, Rajan and Zingales (1998) and subsequent studies documenting an important role for financial development (e.g., Raddatz, 2006; Levchenko, Rancière, and Thoenig, 2009; Ilyina and Samaniego, 2011) exploit cross-country variation in financial development and focus on long-term growth instead.

A second possible confounding factor is severe crises (e.g., of the banking-, currency-, or sovereign debt-type) during which the central bank tends to employ aggressive policy actions and the external financing premium tends to rise.[22] To investigate whether the credit channel of monetary policy is amplified during crisis episodes, we employ an updated crisis database constructed by Laeven and Valencia (2020), which incorporates a comprehensive list of banking, currency, and sovereign debt crisis. Consistent with the financial accelerator mechanism, Table 9 confirms that the credit channel of monetary policy is amplified during crisis episodes (when credit constraints are likely to be more binding).

VI. Conclusion

This paper presents new evidence on the empirical relevance of various transmission channels of monetary policy. To do so, we have constructed a panel dataset collecting estimates of monetary policy shocks for a sample covering 177 countries—an effort that will hopefully be of use to other researchers. Ultimately, our approach does not solely rely on traditional approaches to monetary policy shock identification but also combats the endogeneity problem through the inclusion of a simple-yet-powerful set of fixed effects. We achieved this by shifting focus away from analyzing the overall effect of changes in the stance of monetary policy—analyzing the *differential* impact linked to industry-level characteristics instead.

Across a battery of sensitivity tests, we find that the credit channel of monetary policy emerges as the most robust transmission channel of monetary policy (including stronger effects during bad times, as predicted by the theory), followed by the interest rate channel (with industries producing durable goods more heavily affected). The credit channel appears to be amplified during economic downturns or periods of tightened credit conditions as well as in countries with less developed financial markets or experiencing crises. In contrast, we do not find evidence supporting

[22] Moreover, severe crises might coincide with sudden changes in monetary policy and at the same time interact with industry characteristics when affecting industry growth. Kroszner, Laeven, and Klingebiel (2007), and Dell'Ariccia, Detragiache, and Rajan (2008), for example, find that industries with heavier external financial dependence suffer more from banking crises. When adding this crisis dummy for $U_{c,t}$ in (4) without the triple interaction term, Table A.10 in the appendix shows that monetary policy shocks bring about distinct effects from crises.

the cost channel of monetary policy, nor for a channel running through exports. The latter finding aligns well with recent work on "dominant currency pricing" (Gopinath et al., 2020) which suggests that exchange rate movements have only minor effects on exports, with any exchange rate channel of monetary transmission mostly working through imports.

Zooming in on the credit channel, we find that the ability to secure external financing (i.e., having access to collateral) is more relevant to the transmission of monetary policy than the need for external financing. Our results suggest that firms with high external financing needs do not suffer more following monetary contractions, conditional on having access to collateral. This distinction between the "ability to secure" and "need for" external financing has not been made in earlier studies on the monetary transmission mechanism and may warrant further study to improve our understanding of it. For one, it points to the importance of cyclical fluctuations in *unsecured* debt, with there being a "flight to quality" out of unsecured (into secured) lending during economic slowdowns. This poses a challenge for models in the spirit of Kiyotaki and Moore (1997), where secured debt is driving/amplifying the business cycle, and calls for models featuring both secured and unsecured lending.

Tables and figures

Table 4. Baseline value-added growth

Dependent variable: real value-added growth								
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Share	-1.846***	-1.846***	-1.846***	-1.848***	-1.846***	-1.847***	-1.847***	-1.846***
	(0.082)	(0.082)	(0.082)	(0.082)	(0.082)	(0.082)	(0.082)	(0.082)
EFD × *MPS*	0.014							
	(0.029)							
TAN × *MPS*		0.063*						
		(0.035)						
INV × *MPS*			0.110**					
			(0.045)					
LAB × *MPS*				-0.157**				
				(0.062)				
LIQ × *MPS*					-0.038			
					(0.052)			
DEP × *MPS*						-0.114**		
						(0.056)		
DUR × *MPS*							-0.082**	
							(0.034)	
EXP × *MPS*								-0.029
								(0.037)
R-squared	0.305	0.305	0.305	0.305	0.305	0.305	0.305	0.305
Observations	44,191	44,191	44,191	44,191	44,191	44,191	44,191	44,191

Note: The dependent variable is the annual growth rate of real value-added for each industry-country pair. Estimates are based on equation (1). Clustered standard errors at the country-time level are reported in parenthesis. *, **, *** denote significance at 10, 5, and 1 percent, respectively.

Table 5. Baseline price growth

Dependent variable: price index growth								
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
L. Dep	-0.158***	-0.158***	-0.158***	-0.158***	-0.158***	-0.158***	-0.158***	-0.158***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
$EFD \times MPS$	0.017							
	(0.028)							
$TAN \times MPS$		0.020						
		(0.046)						
$INV \times MPS$			0.071					
			(0.045)					
$LAB \times MPS$				-0.117*				
				(0.061)				
$LIQ \times MPS$					0.001			
					(0.067)			
$DEP \times MPS$						-0.059*		
						(0.031)		
$DUR \times MPS$							-0.040	
							(0.037)	
$EXP \times MPS$								-0.019
								(0.024)
R-squared	0.346	0.346	0.347	0.347	0.346	0.347	0.346	0.346
Observations	30,582	30,582	30,582	30,582	30,582	30,582	30,582	30,582

Note: The dependent variable is the annual growth rate of the price index for each industry-country pair. Estimates are based on equation (1'). Clustered standard errors at the country-time level are reported in parenthesis. *, **, *** denote significance at 10, 5, and 1 percent, respectively.

Table 6. Robustness checks: firm size as a measure of financial constraints

Dependent variable: real value-added growth			
	(I)	(II)	(III)
Share	-1.844***	-1.845***	-1.844***
	(0.082)	(0.082)	(0.082)
$Size_{US} \times MPS$	0.119*		
	(0.072)		
$Size_{Glob} \times MPS$		0.159**	
		(0.067)	
$Size_{Country} \times MPS$			0.251*
			(0.138)
Observations	0.305	0.305	0.305
R-squared	44,040	44,040	44,040
Dependent variable: price index growth			
	(I)	(II)	(III)
$L.Dep$	-0.158***	-0.158***	-0.158***
	(0.013)	(0.013)	(0.013)
$Size_{US} \times MPS$	0.088		
	(0.071)		
$Size_{Glob} \times MPS$		0.100	
		(0.066)	
$Size_{Country} \times MPS$			0.141
			(0.122)
R-squared	0.347	0.347	0.347
Observations	30,578	30,578	30,578

Note: The dependent variable is the annual growth rate of real value-added (top panel) and price index (bottom panel) for each industry-country pair. Estimates are based on equations (1) and (1'). Clustered standard errors at the country-time level are reported in parenthesis. *, **, *** denote significance at 10, 5, and 1 percent, respectively.

Table 7. Value-added growth: role of the state of the business cycle

Dependent variable: real value-added growth								
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Share	-1.962***	-1.962***	-1.962***	-1.963***	-1.961***	-1.962***	-1.962***	-1.962***
	(0.087)	(0.087)	(0.087)	(0.087)	(0.087)	(0.087)	(0.087)	(0.087)
EFD × MPS × Expansion	0.007							
	(0.068)							
EFD × MPS × Contraction	0.012							
	(0.045)							
TAN × MPS × Expansion		0.045						
		(0.088)						
TAN × MPS × Contraction		0.066						
		(0.043)						
INV × MPS × Expansion			0.081					
			(0.110)					
INV × MPS × Contraction			0.121***					
			(0.042)					
LAB × MPS × Expansion				-0.272				
				(0.202)				
LAB × MPS × Contraction				-0.110**				
				(0.053)				
LIQ × MPS × Expansion					-0.162			
					(0.110)			
LIQ × MPS × Contraction					0.054			
					(0.038)			
DEP × MPS × Expansion						-0.070		
						(0.108)		
DEP × MPS × Contraction						-0.146**		
						(0.069)		
DUR × MPS × Expansion							-0.153	
							(0.102)	
DUR × MPS × Contraction							-0.041	
							(0.054)	
EXP × MPS × Expansion								-0.021
								(0.088)
EXP × MPS × Contraction								-0.050
								(0.032)
R-squared	0.307	0.307	0.307	0.307	0.307	0.307	0.307	0.307
Observations	42,031	42,031	42,031	42,031	42,031	42,031	42,031	42,031

Note: The dependent variable is the annual growth rate of real value-added for each industry-country pair. Estimates are based on equation (3). Business cycle expansions and contractions are identified using real GDP growth. Clustered standard errors at the country-time level are reported in parenthesis. *, **, *** denote significance at 10, 5, and 1 percent, respectively.

Table 8. Value-added growth: role of financial development

Dependent variable: real value-added growth								
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Share	-1.920***	-1.917***	-1.918***	-1.918***	-1.917***	-1.918***	-1.918***	-1.918***
	(0.083)	(0.083)	(0.083)	(0.083)	(0.083)	(0.083)	(0.083)	(0.083)
$EFD \times MPS$	0.020							
	(0.051)							
$EFD \times MPS \times FD$	-0.000							
	(0.001)							
$TAN \times MPS$		0.170***						
		(0.057)						
$TAN \times MPS \times FD$		-0.003**						
		(0.001)						
$INV \times MPS$			0.224***					
			(0.070)					
$INV \times MPS \times FD$			-0.004**					
			(0.002)					
$LAB \times MPS$				-0.190*				
				(0.097)				
$LAB \times MPS \times FD$				0.001				
				(0.002)				
$LIQ \times MPS$					-0.045			
					(0.091)			
$LIQ \times MPS \times FD$					0.000			
					(0.002)			
$DEP \times MPS$						-0.252***		
						(0.053)		
$DEP \times MPS \times FD$						0.004***		
						(0.001)		
$DUR \times MPS$							-0.121**	
							(0.056)	
$DUR \times MPS \times FD$							0.001	
							(0.001)	
$EXP \times MPS$								-0.084
								(0.056)
$EXP \times MPS \times FD$								0.001
								(0.001)
R-squared	0.306	0.306	0.306	0.306	0.306	0.306	0.306	0.306
Observations	42,737	42,737	42,737	42,737	42,737	42,737	42,737	42,737

Note: The dependent variable is the annual growth rate of real value-added for each industry-country pair. Estimates are based on equation (4), and *FD* denotes financial development measured by the private credit to GDP ratio. The interaction between *FD* and *MPS* is not reported for brevity. Clustered standard errors at the country-time level are reported in parenthesis. *, **, *** denote significance at 10, 5, and 1 percent, respectively.

Table 9. Value-added growth: role of financial crises

Dependent variable: real value-added growth								
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Share	-1.847***	-1.846***	-1.846***	-1.848***	-1.846***	-1.846***	-1.848***	-1.846***
	(0.082)	(0.082)	(0.082)	(0.082)	(0.082)	(0.082)	(0.082)	(0.082)
$EFD \times MPS$	0.047							
	(0.048)							
$EFD \times MPS \times Crisis$	-0.080							
	(0.062)							
$TAN \times MPS$		0.003						
		(0.059)						
$TAN \times MPS \times Crisis$		0.129*						
		(0.069)						
$INV \times MPS$			0.029					
			(0.074)					
$INV \times MPS \times Crisis$			0.161*					
			(0.096)					
$LAB \times MPS$				-0.050				
				(0.092)				
$LAB \times MPS \times Crisis$				-0.176				
				(0.156)				
$LIQ \times MPS$					-0.084			
					(0.075)			
$LIQ \times MPS \times Crisis$					0.072			
					(0.094)			
$DEP \times MPS$						-0.008		
						(0.058)		
$DEP \times MPS \times Crisis$						-0.205***		
						(0.066)		
$DUR \times MPS$							-0.059	
							(0.057)	
$DUR \times MPS \times Crisis$							-0.025	
							(0.073)	
$EXP \times MPS$								-0.004
								(0.048)
$EXP \times MPS \times Crisis$								-0.049
								(0.072)
R-squared	0.305	0.305	0.305	0.305	0.305	0.305	0.305	0.305
Observations	44,191	44,191	44,191	44,191	44,191	44,191	44,191	44,191

Note: The dependent variable is the annual growth rate of real value-added for each industry-country pair. Estimates are based on equation (4) and *Crisis* denotes a financial crisis dummy. Clustered standard errors at the country-time level are reported in parenthesis. *, **, *** denote significance at 10, 5, and 1 percent, respectively.

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Appendix. Additional tables

Table A.1. Sample coverage

Country	Number of industries	Period	Group	Country	Number of industries	Period	Group
			Baseline sample				
Albania	10	2001-2019	EMDE	Kenya	17	1996-2019	EMDE
Algeria	8	1985-2017	EMDE	Korea, Rep.	22	1987-2019	ADV
Armenia	18	2005-2019	EMDE	Kuwait	19	1987-2018	EMDE
Australia	22	1975-2019	ADV	Kyrgyz Republic	22	2001-2019	EMDE
Austria	20	1990-2019	ADV	Lao PDR	20	2002-2017	EMDE
Azerbaijan	20	2002-2019	EMDE	Latvia	20	1996-2019	ADV
Bahrain	19	2008-2018	EMDE	Lithuania	19	2001-2019	ADV
Barbados	13	1974-1997	EMDE	Luxembourg	13	1990-2019	ADV
Belarus	14	2006-2019	EMDE	Malawi	12	1996-2012	EMDE
Belgium	22	1985-2019	ADV	Malaysia	21	1974-2019	EMDE
Bolivia	19	1988-2014	EMDE	Malta	22	1974-2019	ADV
Bosnia and Herzegovina	17	2011-2019	EMDE	Mauritius	17	1974-2006	EMDE
Botswana	4	1993-2019	EMDE	Mexico	22	1990-2019	EMDE
Brazil	22	1996-2019	EMDE	Moldova	20	1997-2019	EMDE
Bulgaria	22	1997-2019	EMDE	Mongolia	17	1993-2019	EMDE
Cameroon	14	1994-2002	EMDE	Morocco	22	1994-2019	EMDE
Canada	22	1975-2019	ADV	Myanmar	8	1993-2018	EMDE
Chile	18	1987-2019	EMDE	Netherlands	22	1990-2019	ADV
China	22	1986-2018	EMDE	New Zealand	15	2001-2019	ADV
Colombia	21	1987-2019	EMDE	Niger	5	1994-2018	EMDE
Congo, Dem. Rep.	6	2004-2009	EMDE	North Macedonia	20	1996-2019	EMDE
Costa Rica	19	1987-2019	EMDE	Norway	21	1987-2019	ADV
Cote d'Ivoire	8	1994-1997	EMDE	Oman	18	2001-2019	EMDE
Croatia	19	1996-2019	EMDE	Pakistan	18	1987-1991	EMDE
Cyprus	20	1974-2019	ADV	Panama	17	1987-2001	EMDE
Czech Republic	21	1996-2019	EMDE	Peru	22	1995-2019	EMDE
Denmark	21	1974-2019	ADV	Philippines	22	1987-2019	EMDE
Ecuador	21	1987-2019	EMDE	Poland	22	1995-2019	EMDE
Egypt, Arab Rep.	22	1987-2018	EMDE	Portugal	21	1990-2019	ADV
Estonia	20	1994-2019	ADV	Qatar	18	2009-2018	EMDE
Ethiopia	16	1991-2015	EMDE	Romania	22	1999-2019	EMDE
Fiji	14	1974-1976	EMDE	Russian Federation	21	1996-2019	EMDE
Finland	21	1990-2019	ADV	Saudi Arabia	20	2011-2019	EMDE

France	21	1990-2019	ADV	Senegal	18	1994-2014	EMDE
Georgia	20	2001-2019	EMDE	Singapore	22	1987-2019	ADV
Germany	22	1999-2019	ADV	Slovak Republic	19	1995-2019	ADV
Ghana	18	1974-2015	EMDE	Slovenia	20	1995-2019	ADV
Greece	22	1990-2019	ADV	South Africa	21	1987-2019	EMDE
Honduras	18	1987-1996	EMDE	Spain	22	1985-2019	ADV
Hong Kong	18	1987-2019	ADV	Sri Lanka	19	1988-2019	EMDE
Hungary	21	1990-2019	EMDE	Sweden	22	1990-2019	ADV
Iceland	19	1990-2019	ADV	Switzerland	17	1990-2019	ADV
India	22	1974-2019	EMDE	Syrian Arab Republic	6	1987-1988	EMDE
Indonesia	22	1987-2019	EMDE	Tanzania	18	1987-2018	EMDE
Iran, Islamic Rep.	22	1990-2018	EMDE	Thailand	22	1989-2018	EMDE
Iraq	11	2008-2019	EMDE	Trinidad and Tobago	16	1974-1995	EMDE
Ireland	21	1974-2018	ADV	Tunisia	14	1994-1999	EMDE
Israel	19	1987-2019	ADV	Turkey	22	1990-2019	EMDE
Italy	22	1990-2019	ADV	United Kingdom	22	1974-2019	ADV
Jamaica	9	1974-1996	EMDE	Uruguay	20	1992-2016	EMDE
Japan	22	1990-2018	ADV	Vietnam	21	1999-2019	EMDE
Jordan	20	1991-2018	EMDE	Yemen, Rep.	17	2002-2014	EMDE
Kazakhstan	20	2010-2019	EMDE				

Note: Only industries with more than ten years of data are included in the analysis.

Table A.2. Industry technological characteristics

ISIC code	Industry	EFD	TAN	INV	LAB	LIQ	DEP	DUR	EXP
15	Food products and beverages	-0.601	0.766	-0.222	-1.148	-1.315	-0.918	-1.070	-0.604
16	Tobacco products	-2.063	-0.890	-1.181	-2.836	2.318	-2.167	-1.070	-0.668
17	Textiles	-0.392	0.514	-0.018	0.761	0.098	-0.528	-1.070	-0.441
18	Wearing apparel; dressing and dyeing of fur	-0.810	-1.385	-1.442	0.645	0.905	-1.361	-1.070	0.388
19	Tanning and dressing of leather	-1.254	-1.295	-1.123	0.624	1.228	0.323	-1.070	0.008
20	Wood and of products of wood and cork, except furniture	-0.157	0.154	0.243	0.856	-1.113	0.734	0.892	-0.497
21	Paper and paper products	-0.445	1.658	1.492	-0.241	-0.709	0.128	-1.070	-0.637
22	Publishing, printing and reproduction of recorded media	-0.366	-0.242	-0.396	0.223	-1.920	0.883	-1.070	-0.778
23	Coke, refined petroleum products and nuclear fuel	-0.784	2.351	2.916	-1.981	-1.718	-1.131	-1.070	-0.559
24	Chemicals and chemical products	0.417	-0.008	0.621	-1.654	-0.406	-0.196	-1.070	-0.379
25	Rubber and plastics products	0.900	0.685	0.388	0.212	-0.628	1.105	-1.070	-0.569
26	Other non-metallic mineral products	-0.732	1.577	0.534	0.044	-0.305	-0.228	0.892	-0.434
27	Basic metals	-0.758	1.009	0.940	0.719	-0.124	-1.614	0.892	0.077
28	Fabricated metal products, except machinery and equipment	-0.262	-0.125	-0.425	0.729	-0.104	-0.950	0.892	-0.638
29	Machinery and equipment n.e.c.	0.678	-0.836	-0.396	0.497	0.098	0.264	0.892	3.748
30	Office, accounting and computing machinery	1.618	-0.719	-0.512	0.223	0.704	0.636	0.892	-0.281
31	Electrical machinery and apparatus n.e.c.	1.592	-0.719	-0.193	0.223	0.704	0.636	0.892	-0.281
32	Radio, television and communication equipment and apparatus	1.618	-0.719	1.057	0.223	0.704	0.636	0.892	-0.281
33	Medical, precision and optical instruments, watches and clocks	1.618	-0.962	-0.571	-0.041	0.905	0.520	0.892	1.094
34	Motor vehicles, trailers and semi-trailers	0.052	-0.215	0.011	0.571	0.300	1.435	0.892	0.924
35	Other transport equipment	0.052	-0.215	-0.890	0.571	0.300	1.435	0.892	0.924
36	Furniture; manufacturing n.e.c.	0.078	-0.386	-0.832	0.782	0.078	0.356	0.892	-0.116

Note: The indices for external financial dependence (EFD), asset tangibility (TAN), labor intensity (LAB), and depreciation (DEP) are taken from Samaniego and Sun (2015); investment intensity (INV) is computed using the UNIDO database for U.S. industries; the index for liquidity needs (LIQ) is taken from Raddatz (2006); the dummy for durability (DUR) is taken from Dedola and Lippi (2005); the index for export intensity is taken from Giovanni and Levchenko (2009). Each index is normalized to have a zero mean and unit standard deviation over all industries.

Table A.3. Robustness check: alternative KLEMS data

Dependent variable	(I) Value-added growth	(II) Price index growth
$EFD \times MPS$	-0.179	0.287
	(0.330)	(0.290)
R-squared	0.502	0.489
Observations	8,155	7,880
$LAB \times MPS$	-0.768**	-0.533
	(0.360)	(0.397)
R-squared	0.502	0.489
Observations	8,155	7,880

Note: The dependent variables are (i) the annual growth rate of real value-added for each industry-country pair and (ii) the annual growth rate of price index growth for each industry-country pair. Lacking proxies for every industry characteristic directly corresponding to the KLEMS industry specification, we can only use alternative versions of EFD and LAB for this exercise. We take external financial dependence from Tong and Wei (2021) at the SIC three-digit sector level, including both manufacturing and non-manufacturing sectors, then aggregate it up to the two-digit level in which the recent KLEMS databases are available. The labor intensity measure is directly computed by using the corresponding U.S. industry data from KLEMS. We only report interaction coefficients for brevity. Estimates are based on equations (1) and (1') but using value-added and price data from KLEMS. Clustered standard errors at the country-time level are reported in parenthesis. *, **, *** denote significance at 10, 5, and 1 percent, respectively.

Table A.4. Robustness check: IV regression

Dependent variable: real value-added growth								
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Share	-2.024***	-2.026***	-2.027***	-2.022***	-2.025***	-2.024***	-2.025***	-2.027***
	(0.112)	(0.112)	(0.112)	(0.111)	(0.112)	(0.112)	(0.112)	(0.112)
EFD × *MPS*	0.006							
	(0.025)							
TAN × *MPS*		0.065**						
		(0.028)						
INV × *MPS*			0.101***					
			(0.031)					
LAB × *MPS*				-0.126***				
				(0.044)				
LIQ × *MPS*					-0.041			
					(0.055)			
DEP × *MPS*						-0.112***		
						(0.028)		
DUR × *MPS*							-0.085**	
							(0.042)	
EXP × *MPS*								-0.054*
								(0.028)
F-statistics	5,938.960	5,985.619	6,415.074	6,662.989	6,214.009	5,934.613	5,593.524	5,358.595
Observations	31,109	31,109	31,109	31,109	31,109	31,109	31,109	31,109

Note: The dependent variable is the annual growth rate of real value-added for each industry-country pair. Estimates are based on equation (1). Clustered standard errors at the country-time level are reported in parenthesis. *, **, *** denote significance at 10, 5, and 1 percent, respectively.

Table A.5. Robustness check: inflation-targeting countries subsample analysis

Dependent variable: real value-added growth								
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Share	-1.983***	-1.983***	-1.983***	-1.988***	-1.983***	-1.984***	-1.984***	-1.983***
	(0.149)	(0.149)	(0.149)	(0.149)	(0.149)	(0.149)	(0.149)	(0.149)
EFD × *MPS*	-0.007							
	(0.025)							
TAN × *MPS*		0.062**						
		(0.031)						
INV × *MPS*			0.116***					
			(0.043)					
LAB × *MPS*				-0.162***				
				(0.061)				
LIQ × *MPS*					-0.028			
					(0.048)			
DEP × *MPS*						-0.121**		
						(0.058)		
DUR × *MPS*							-0.079***	
							(0.027)	
EXP × *MPS*								-0.042
								(0.037)
R-squared	0.373	0.373	0.373	0.373	0.373	0.373	0.373	0.373
Observations	21,845	21,845	21,845	21,845	21,845	21,845	21,845	21,845

Note: The dependent variable is the annual growth rate of real value-added for each industry-country pair. Estimates are based on equation (1). Clustered standard errors at the country-time level are reported in parenthesis. *, **, *** denote significance at 10, 5, and 1 percent, respectively.

Table A.6. Robustness check: Placebo test

Dependent variable: real value-added growth								
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Share	-1.853***	-1.853***	-1.853***	-1.853***	-1.853***	-1.853***	-1.853***	-1.853***
	(0.084)	(0.084)	(0.084)	(0.084)	(0.084)	(0.084)	(0.084)	(0.084)
EFD × *MPS*	0.058**							
	(0.026)							
TAN × *MPS*		-0.040						
		(0.049)						
INV × *MPS*			-0.006					
			(0.055)					
LAB × *MPS*				-0.058				
				(0.070)				
LIQ × *MPS*					0.061			
					(0.039)			
DEP × *MPS*						0.002		
						(0.042)		
DUR × *MPS*							0.040	
							(0.051)	
EXP × *MPS*								0.014
								(0.039)
R-squared	0.324	0.324	0.324	0.324	0.324	0.324	0.324	0.324
Observations	43,986	43,986	43,986	43,986	43,986	43,986	43,986	43,986

Note: The dependent variable is the annual growth rate of real value-added for each industry-country pair. Estimates are based on equation (1), with the lagged monetary policy changes replaced by their forward variable. Clustered standard errors at the country-time level are reported in parenthesis. *, **, *** denote significance at 10, 5, and 1 percent, respectively.

Table A.7. Robustness check: role of the state of financial conditions

Dependent variable: real value-added growth								
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Share	-1.961***	-1.961***	-1.962***	-1.963***	-1.961***	-1.961***	-1.961***	-1.961***
	(0.088)	(0.088)	(0.088)	(0.088)	(0.088)	(0.088)	(0.088)	(0.088)
EFD × *MPS* × *Expansion*	0.003							
	(0.069)							
EFD × *MPS* × *Contraction*	0.012							
	(0.043)							
TAN × *MPS* × *Expansion*		-0.033						
		(0.100)						
TAN × *MPS* × *Contraction*		0.103***						
		(0.030)						
INV × *MPS* × *Expansion*			-0.031					
			(0.130)					
INV × *MPS* × *Contraction*			0.174***					
			(0.039)					
LAB × *MPS* × *Expansion*				-0.193				
				(0.228)				
LAB × *MPS* × *Contraction*				-0.162***				
				(0.044)				
LIQ × *MPS* × *Expansion*					-0.049			
					(0.116)			
LIQ × *MPS* × *Contraction*					-0.009			
					(0.062)			
DEP × *MPS* × *Expansion*						0.061		
						(0.109)		
DEP × *MPS* × *Contraction*						-0.217***		
						(0.032)		
DUR × *MPS* × *Expansion*							-0.066	
							(0.093)	
DUR × *MPS* × *Contraction*							-0.104***	
							(0.033)	
EXP × *MPS* × *Expansion*								-0.030
								(0.099)
EXP × *MPS* × *Contraction*								-0.042
								(0.029)
R-squared	0.310	0.310	0.310	0.310	0.310	0.310	0.310	0.310
Observations	42,042	42,042	42,042	42,042	42,042	42,042	42,042	42,042

Note: The dependent variable is the annual growth rate of real value-added for each industry-country pair. Estimates are based on equation (4). Credit expansions and contractions are identified using the cyclical component of the private credit-to-GDP ratio. Clustered standard errors at the country-time level are reported in parenthesis. *, **, *** denote significance at 10, 5, and 1 percent, respectively.

Table A.8. Robustness check: role of the state of financial conditions using a one-sided HP filter

Dependent variable: real value-added growth								
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Share	-1.956***	-1.956***	-1.957***	-1.958***	-1.956***	-1.956***	-1.956***	-1.956***
	(0.087)	(0.087)	(0.087)	(0.087)	(0.087)	(0.087)	(0.087)	(0.087)
EFD × MPS × Expansion	0.012							
	(0.125)							
EFD × MPS × Contraction	0.015							
	(0.050)							
TAN × MPS × Expansion		-0.010						
		(0.150)						
TAN × MPS × Contraction		0.095*						
		(0.053)						
INV × MPS × Expansion			-0.015					
			(0.165)					
INV × MPS × Contraction			0.174***					
			(0.065)					
LAB × MPS × Expansion				-0.061				
				(0.219)				
LAB × MPS × Contraction				-0.223**				
				(0.095)				
LIQ × MPS × Expansion					-0.076			
					(0.166)			
LIQ × MPS × Contraction					-0.005			
					(0.071)			
DEP × MPS × Expansion						0.036		
						(0.144)		
DEP × MPS × Contraction						-0.194**		
						(0.076)		
DUR × MPS × Expansion							-0.135	
							(0.156)	
DUR × MPS × Contraction							-0.066	
							(0.050)	
EXP × MPS × Expansion								-0.084
								(0.113)
EXP × MPS × Contraction								-0.012
								(0.060)
R-squared	0.309	0.309	0.309	0.309	0.309	0.309	0.309	0.309
Observations	42,254	42,254	42,254	42,254	42,254	42,254	42,254	42,254

Note: The dependent variable is the annual growth rate of real value-added for each industry-country pair. Estimates are based on equation (4). Credit expansions and contractions are identified using the cyclical component of the private credit-to-GDP ratio. Clustered standard errors at the country-time level are reported in parenthesis. *, **, *** denote significance at 10, 5, and 1 percent, respectively.

Table A.9. Robustness check: controlling for financial development

Dependent variable: real value-added growth								
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Share	-1.920***	-1.917***	-1.918***	-1.918***	-1.917***	-1.917***	-1.918***	-1.918***
	(0.083)	(0.083)	(0.083)	(0.083)	(0.083)	(0.083)	(0.083)	(0.083)
$EFD \times \Delta MP$	0.013							
	(0.028)							
$EFD \times FD$	0.019***							
	(0.006)							
$TAN \times \Delta MP$		0.062*						
		(0.034)						
$TAN \times FD$		0.003						
		(0.007)						
$INV \times \Delta MP$			0.107**					
			(0.044)					
$INV \times FD$			0.015*					
			(0.009)					
$LAB \times \Delta MP$				-0.157**				
				(0.062)				
$LAB \times FD$				-0.002				
				(0.008)				
$LIQ \times \Delta MP$					-0.038			
					(0.053)			
$LIQ \times FD$					0.006			
					(0.008)			
$DEP \times \Delta MP$						-0.113**		
						(0.056)		
$DEP \times FD$						-0.002		
						(0.006)		
$DUR \times \Delta MP$							-0.080**	
							(0.034)	
$DUR \times FD$							0.002	
							(0.006)	
$EXP \times \Delta MP$								-0.032
								(0.037)
$EXP \times FD$								0.007
								(0.006)
R-squared	0.306	0.306	0.306	0.306	0.306	0.306	0.306	0.306
Observations	42,737	42,737	42,737	42,737	42,737	42,737	42,737	42,737

Note: The dependent variable is the annual growth rate of real value-added for each industry-country pair. Estimates are based on equation (4), and *FD* denotes financial development measured by the private credit to GDP ratio. Clustered standard errors at the country-time level are reported in parenthesis. *, **, *** denote significance at 10, 5, and 1 percent, respectively.

Table A.10. Robustness check: controlling for crisis episodes

Dependent variable: real value-added growth								
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Share	-1.846***	-1.846***	-1.846***	-1.848***	-1.846***	-1.847***	-1.848***	-1.846***
	(0.082)	(0.082)	(0.082)	(0.082)	(0.082)	(0.082)	(0.082)	(0.082)
$EFD \times \Delta MP$	0.006							
	(0.032)							
$EFD \times Crisis$	1.299**							
	(0.651)							
$TAN \times \Delta MP$		0.069*						
		(0.036)						
$TAN \times Crisis$		-1.019						
		(0.745)						
$INV \times \Delta MP$			0.117**					
			(0.046)					
$INV \times Crisis$			-1.040					
			(0.810)					
$LAB \times \Delta MP$				-0.151**				
				(0.066)				
$LAB \times Crisis$				-0.848				
				(0.865)				
$LIQ \times \Delta MP$					-0.045			
					(0.051)			
$LIQ \times Crisis$					1.077			
					(0.749)			
$DEP \times \Delta MP$						-0.114**		
						(0.056)		
$DEP \times Crisis$						-0.030		
						(0.683)		
$DUR \times \Delta MP$							-0.071**	
							(0.035)	
$DUR \times Crisis$							-1.720**	
							(0.713)	
$EXP \times \Delta MP$								-0.027
								(0.037)
$EXP \times Crisis$								-0.270
								(0.673)
R-squared	0.305	0.305	0.305	0.305	0.305	0.305	0.305	0.305
Observations	44,191	44,191	44,191	44,191	44,191	44,191	44,191	44,191

Note: The dependent variable is the annual growth rate of real value-added for each industry-country pair. Estimates are based on equation (4) and *Crisis* denotes a financial crisis dummy. Clustered standard errors at the country-time level are reported in parenthesis. *, **, *** denote significance at 10, 5, and 1 percent, respectively.

Figure A.1. Source of monetary policy shocks, 1973-2019

Country	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Albania																						61	61	61			61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	65	65	65
Algeria												5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	65
Armenia																								61	61	61	61	61	61	61	61	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Australia		5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	2	2	2	2	2	2	2	2	2	2	2	2
Austria																	5	5	5	5	5	5	5	5	5	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	5
Azerbaijan																									61	61	61	61	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Bahrain														65	65	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
Barbados	65	65	65											65	65	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
Belarus																										5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Belgium												5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	5
Bolivia															65	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
Bosnia and Herzegovina																							65	65	65	65	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	65	65	65
Botswana												5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Brazil																							61	61	61	61	61	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2
Bulgaria																							5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Cameroon																					65	65	65	65	65	65	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	65	65	65
Canada		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2
Chile														65	65	61	61	5	5	5	5	5	5	5	5	5	5	5	4	4	4	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
China												5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	2
Colombia														65	65	61	61	61	61	61	61	61	61	61	61	61	5	5	5	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2
Congo, Dem. Rep.																															61	61	61	61	61	61		61	61	61	61	61	61	61	61	61	61
Costa Rica														65	65	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
Cote d'Ivoire																					65	65	65	65	65	65	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	65	65	65
Croatia																							65	65	65	65	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Cyprus	65																65	65	65	65	65	65	65	65	65	65	61	61	61	61	61	61	61	61	61	1	1	1	1	1	1	1	1	1	5	5	5
Czech Republic																			65	65	65	65	65	65	65	65	5	5	5	5	5	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Denmark	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Ecuador														65	65							61	61	61	61				61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
Egypt, Arab Rep.														65	65	61	61	61	61	61	61	61	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	4	4	4	4	4	4
Estonia																					65	65	65	65	65	65	61	61	61	61	61	61	61	61	61	61	61	61	1	1	1	1	1	1	5	5	5
Ethiopia														65	65	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61		61	61	61	61	61	61	61	61	61	61	61
Fiji	65	65	65																																												
Finland																	5	5	5	5	5	5	5	5	5	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	5
France																	65	65	65	65	5	5	5	5	5	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	5
Georgia																									61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
Germany																	5	5	5	5	5	5	5	5	5	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3
Ghana	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	4	4	4	4	4	4	4
Greece																	65	65	65	65	65	65	65	65	65	65	61	61	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	5
Honduras														65	65	61	61	61		61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
Hong Kong SAR, China														65	65	61	61	61	61	61	61	61	61	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Hungary																	65	65	65	65	65	65	5	5	5	5	5	5	5	5	5	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Iceland																	65	65	65	65	65	65	65	65	65	65	61	61	61	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
India	65	65	65	65	65	65	65							65	65	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Indonesia														65	65	61	61	61	61	61	61	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	3	3	3	3
Iran, Islamic Rep.														65	65	61	61	61	61	61	61	61			61	61	61	61	61	61	61	61	61	61	61	61	61	61	61		61	61	61	61	61	61	61
Iraq														65	65	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61		61	61	61	61	61	61	61	61	61	61	61	61	61
Ireland	65	65	65	65	65	65	65					5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	5
Israel														65	65	61	61	61	61	61	61	61	61	61	61	61	5	5	5	5	4	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Italy																	65	65	65	65		5	5	5	5	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	5
Jamaica	65													65	65	61	61	61			61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
Japan																	5	5	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Jordan																		61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
Kazakhstan																									61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	4	4	4	4

Country	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Kenya																							61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	4	4	4	4	4	4	4	4	4
Korea, Rep.														65	65	61	61	61	61	61	61	61	61	61	61		61	61	61	61	5	5	5	5	5	2	1	1	1	1	1	1	1	1	1	1	1
Kuwait														65	65	61	61	61	61	61	61	61	61	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Kyrgyz Republic																												61	61	61	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Lao PDR														65	65	61			61	61	61	61	61	61					61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
Latvia																							61	61	61	61	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	1	1	5	5	5
Lithuania																							61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	1	1	5	5	5
Luxembourg																	5	5	5	5	5	5	5	5	5	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	5
Malawi	65																						61	61	61			61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
Malaysia	65	65	65											65	65	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Malta	65	65	65	65	65												65	65	65	65	65	65	65	65	65	65	61	61	61	61	5	5	5	5	5	1	1	1	1	1	1	1	1	1	5	5	5
Mauritius	65	65	65											65	65	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61														
Mexico																	61	61	61	61	61	61			61	61	61	61	61	61	61	61	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Moldova																								61	61	61			61	61	61	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Mongolia																				61	61					61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
Morocco																					65	65	65	65	65	65	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Myanmar	65	65												65	65	61				61			61	61				61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
Netherlands																	5	5	5	5	5	5	5	5	5	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	5
New Zealand																												4	4	4	4	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Niger																					65	65	65	65	65	65	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	65	65	65
North Macedonia																							65	65	65	65	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	65	65	65
Norway														5	5	5	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
Oman														65	65	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
Pakistan														65	65	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	4	4	4	4	4
Panama														65	65	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
Peru																						61	61	61	61	61	61	61	61	61	61	61	61	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Philippines														65	65	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Poland																						61	61	65	65	65				5	5	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Portugal																	65	65	65	65	65	65	65	65	5	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	5
Qatar														65	65	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Romania																										5	5	5			61	61	61	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Russian Federation																							5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	3	3	3	3	3	3	2
Saudi Arabia														65	65	61	61	61	61	61	61	61	61	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Senegal																					65	65	65	65	65	65	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	65	65	65
Singapore														65	65	61	61	61	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Slovak Republic																						65	65	65	65	65	61	61	61	61	61	61	61	61	61	61	1	1	1	1	1	1	1	1	5	5	5
Slovenia																						65	65	65	65	65	61	61	61	61	61	61	61	1	1	1	1	1	1	1	1	1	1	1	5	5	5
South Africa														65	65	61	61	61	61	61	61	61	61	61	61	61	61	61	4		4	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Spain												5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	5
Sri Lanka	65	65	65	65										65	65	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Sweden																	65	65	5	5	5	5	5	5	5	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
Switzerland																	65	65	65	65	65	65	65	65	65	65	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	2	3	3	3	2
Syrian Arab Republic														65	65	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61					
Tanzania														65	65	61	61	61	61			61	61	61	61	61	61	61	61	61	61	61	61	61	61	61		61	61	61	61	61	61	61	61	61	61
Thailand														65	65	61	61	61	61	61	61	61	61	61	61		61	61	61	61	61	5	5	5	4	4	4	4	3	3	3	3	3	3	3	3	2
Trinidad and Tobago	65	65	65	65										65	65	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
Tunisia																					65	65	65	65	65	65																					
Turkey																	65	65	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	3	3	3	3	3	3	3	3	3	2
United Kingdom	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2
Uruguay																			61					61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
Vietnam														65	65					61	61	61	61	61	61	61	61	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Yemen, Rep.																			61	61	61	61		61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61			

Note: The labeling is as follows: 1 (Red) = High-frequency shocks, 2 (Green) = Shocks implied by changes in swap yields, 3 (Blue) = Shocks implied by changes in bond yields, 4 (Grey) = Survey-based shock estimates, 5 (Yellow) = Taylor residuals, 61 (Red) = High-frequency shocks coming from anchoring currencies, 65 (Yellow) = Taylor residuals coming from anchoring currencies.