DISCUSSION PAPER SERIES

DP15365

MONETARY POLICY IN THE NEXT RECESSION?

Stephen G. Cecchetti, Michael Feroli, Anil K Kashyap, Catherine L. Mann and Kermit L. Schoenholtz

INTERNATIONAL MACROECONOMICS AND FINANCE

MONETARY ECONOMICS AND FLUCTUATIONS

MONETARY POLICY IN THE NEXT RECESSION?

Stephen G. Cecchetti, Michael Feroli, Anil K Kashyap, Catherine L. Mann and Kermit L. Schoenholtz

MONETARY POLICY IN THE NEXT RECESSION?

Abstract

In many advanced countries, lowering the policy rate to zero probably will be insufficient to counter the next conventional recession. We explore a range of new monetary policy (NMP) tools including forward guidance, balance sheet tools and negative interest rates. Reflecting the complex transmission of monetary policy, we examine each NMP's impact on financial conditions indexes (FCIs) in eight advanced economies. We find: (1) the global component of financial conditions is quite important; (2) state-contingent forward guidance is the tool most associated with improved conditions; (3) policymakers typically implemented NMPs during stress periods, and this endogenous usage pattern makes any econometric assessment difficult; (4) NMPs generally were not sufficient to overcome the headwinds already present. This leads us to conclude that, while central bankers should work to incorporate NMP tools into their reaction function, they should be humble about their likely effectiveness.

Stephen G. Cecchetti - cecchetti@brandeis.edu
Brandeis International Business School and CEPR

Michael Feroli - michael.e.feroli@jpmorgan.com
J.P. Morgan

Anil K Kashyap - anil.kashyap@chicagobooth.edu
University of Chicago and CEPR

Catherine L. Mann - catherine.mann@citi.com
Citi, Global Chief Economist

Kermit L. Schoenholtz - kschoenh@stern.nyu.edu
NYU Stern School of Business

U.S. Monetary Policy Forum 2020

Monetary Policy in the Next Recession?

Stephen G. Cecchetti, Michael Feroli, Anil K Kashyap,
Catherine L. Mann and Kermit L. Schoenholtz[*]

February 2020
Revised September 2020

Abstract

In many advanced countries, lowering the policy rate to zero probably will be insufficient to counter the next conventional recession. We explore a range of new monetary policy (NMP) tools including forward guidance, balance sheet tools and negative interest rates. Reflecting the complex transmission of monetary policy, we examine each NMP's impact on financial conditions indexes (FCIs) in eight advanced economies. We find: (1) the global component of financial conditions is quite important; (2) state-contingent forward guidance is the tool most associated with improved conditions; (3) policymakers typically implemented NMPs during stress periods, and this endogenous usage pattern makes any econometric assessment difficult; (4) NMPs generally were not sufficient to overcome the headwinds already present. This leads us to conclude that, while central bankers should work to incorporate NMP tools into their reaction function, they should be humble about their likely effectiveness.

I.   Introduction

The most profound challenge facing monetary policymakers in the United States and other advanced economies is how to counter the next cyclical slump and maintain price stability. Until the Great Recession of 2007-2009, central banks relied on lowering their policy interest rates to ease financial conditions and stimulate aggregate demand. However, the effective lower bound (ELB) on nominal interest rates now severely limits the scope both for lower policy rates and for lower long-term sovereign yields.

Policy rates already are negative in the euro area, Japan, and several smaller economies, while sovereign yields are near or below zero in much of Europe and Japan. Even in the United States, where interest rates are somewhat higher, the federal funds rate and the 10-year Treasury yield are both below 2%. Yet, on average, around the past three recessions, these U.S. interest rates fell by 510 and 160 basis points, respectively.[1] Given where interest rates are today, this magnitude of decline will not be possible.

Moreover, as has been the case in recent decades, there is a strong chance that the next U.S. recession will coincide with a downturn in the rest of the world. In that setting, there would be little prospect for dollar depreciation to boost domestic activity.

How might central banks respond? In this report, we explore a range of policy tools that central bankers in Europe, Japan, and the United States have exploited to ease financial conditions (and, thereby, economic activity and inflation) at the ELB. Ben Bernanke (2020) labels these "new tools," and they include forward guidance, balance sheet policies, negative nominal interest rates, yield curve control, and (in smaller open economies) exchange rate policies.[2]

Starting with forward guidance, if market participants understand a central bank's conventional policy reaction function, then what matters is the *commitment*—either date-contingent (FGD) or state-contingent (FGS)—to keep the policy rate "lower for longer." If credible, this form of guidance will depress expected future short-term interest rates as well as term premia on longer-maturity bonds.

The list of balance sheet tools is long and includes quantitative easing (QE: a policy-driven increase in bank reserves that expands the balance sheet), maturity extension (ME: a lengthening in the duration of assets owned by the central bank), credit easing (CE: a change of the balance sheet mix in favor of riskier

---

[1] See Figure 1 in Kiley (2019).
[2] See Bernanke (2020).

assets), and various funding-for-lending schemes that extend subsidized credit to banks that expand credit. Research suggests that these quantity tools all operate through a mix of portfolio balance effects and signaling effects. The former raises the prices of assets that the central banks acquire directly or (in the case of funding-for-lending) motivate banks to acquire. The latter reinforce forward guidance commitments. Yield curve control extends the maturity of interest rates that the central bank directly targets.[3]

Despite a vast array of research, the effectiveness of these "new tools" remains unclear.[4] Measuring their efficacy is challenging for several reasons. First and foremost, the policy impact will be spread over time. And, if financial market participants anticipate their use, adjustments begin in advance of observed implementation. Second, these tools have been used on only a few occasions in each country. Most of these occurred after the last recession began, and frequently amid extreme financial stress. These considerations introduce endogeneity for which it is extremely difficult to control. Third, the conditions under which the tools are likely to be deployed matter: going forward, low global bond yields likely will hamper any attempt to lower safe interest rates using either old or new monetary policy tools.

Against this backdrop, we seek to answer three questions. First, how can we devise an econometric approach to judge the effectiveness of the new tools given their limited use thus far? Second, what can we say about their relative usefulness? Third, given our judgments about effectiveness, what does that imply for monetary policy in the next recession?

From our analysis, we draw several conclusions. First, it is important to assess the impact of the new monetary policy (NMP) tools on a *range* of financial conditions (as a proxy for their impact on economic activity and inflation), both because the monetary transmission is complex and varied, and because the most traditional channel for transmission—a reduction of long-term bond yields—is likely to be constrained. Second, financial conditions involve a significant global component that is relatively insensitive to individual central bank policies. Third, central banks introduced forward guidance or used balance sheet policies when financial conditions were typically much tighter than the norm: namely, about 20 percentiles above the post-1995 average. In the absence of compelling controls for such endogeneity, we can draw only limited inference from reduced-form linkages between NMP tools and financial conditions across countries.

---

[3] See Brainard (2019).
[4] See, among others, Curcuru et al. (2018), Bernanke et al. (2019), Christensen (2019), Chung et al. (2019), De Fiore and Tristani (2019), Rossi (2019 and Fabo et al (2020).

At the same time, given the strains that buffeted advanced economies over the past decade, we *can* ask whether NMP tools were powerful enough to ease financial conditions in a statistically significant way. To be sure, we are unable to assess what would have occurred had central banks *not* acted. Instead, we examine the *net* impact on financial conditions of the new tools, accounting for headwinds that were typically in place when the various tools were used.

On this front, our results are decidedly mixed. Most of the time, new monetary policies were insufficient to overcome financial headwinds. Based on our analysis of eight countries, using two financial conditions indexes and up to six NMP indicators for each, we find that fewer than one in four episodes when NMP tools were applied meet this test. Moreover, one sixth of the episodes were followed by a statistically significant *tightening* of financial conditions. To be clear, this does not mean that the policy tools operated perversely; rather, it means that (as implemented) they were insufficient to prevent a further meaningful increase of financial strain.

When deployed, *state-contingent* forward guidance was the tool most likely to be associated with improved financial conditions. This observation may seem surprising to a U.S. audience, given that the Federal Reserve's specific *date-contingent* announcement in August 2011 (that conditions "are likely to warrant exceptionally low levels for the federal funds rate at least through mid-2013") had such a large impact on markets.[5] However, in other countries tighter financial conditions often followed the announcement of date-contingent policies. These results appear consistent with the view that the effectiveness of forward guidance depends on the specificity and credibility of the commitment, as well as on complementary balance sheet actions, which perhaps were constrained in some cases.

In our sample, there are no countries in which the use of NMP tools is uniformly associated with improved financial conditions: in every country, at least one policy was associated with a significant tightening of financial conditions. Comparing the countries, the United States is typical in the extent to which the new tools worked. Focusing on episodes where conditions changed in a statistically significant way following policy actions, about half the time U.S. domestic financial conditions eased. In the euro area, the success rate was slightly higher, while in Japan the tools were rarely followed by a significant easing of conditions.

The overall lesson that we draw is that, in the next recession, policymakers should be humble about the prospects for success in using NMPs. To some extent, experience has allowed central banks to refine

---

[5] See Federal Open Market Committee Statement, August 9, 2011.

these tools to make them more effective than they were on average over the past decade. Moreover, a run-of-the-mill recession would involve far fewer financial headwinds than the disruptions in which the new monetary policy tools were first applied.

However, if long-term nominal yields are already at very low levels when activity begins to slow, then the scope for using policies that aim at interest rates will naturally be limited. In that case, it is unclear whether new tools will be strong enough to move other asset prices in ways that will stimulate aggregate demand. Furthermore, the importance of global financial factors suggests that any individual central bank—even the Federal Reserve—may be battling forces over which they have limited influence.

Ironically perhaps, these concerns make it all the more important that central banks adopt and communicate an aggressive reaction function—not just in words, but in deeds—for the new policy tools. As with conventional policy, investors anticipating such an aggressive response will speed changes in financial conditions that affect economic activity and inflation. In fact, our analysis suggests that the power of these tools to move financial conditions from the 70th to the 50th percentile of each country's distribution is greater than their ability to move conditions from the 90th to the 70th percentile, implying that policymakers should deploy their tools early.

Finally, we do not attempt an assessment of responses to the pandemic. As a practical matter, in many countries central banks responded rapidly making use of multiple tools simultaneously. This, together with lags in the availability of data, makes it challenging to come to any conclusions about the efficacy of individual actions. More importantly, the pandemic policy response extended far beyond the response of central banks to include lockdowns that intentionally crushed economic activity in many countries. Hence, the objectives of policy actions during this period differ from those that normally obtain.

One legacy of the pandemic, however, is that interest rates have fallen further. So, the headroom to use conventional policy easing to stimulate the economy over the next few years seems likely to be even smaller than it was before the pandemic. This raises the importance of judging the effectiveness of new monetary policy tools.

The remainder of this report contains four sections. Section II motivates our study in light of a large body of related research. Section III describes our construction of the global and domestic financial conditions indexes that we view as key for understanding monetary policy transmission. Section IV examines the impact of new monetary policy (NMP) tools on domestic financial conditions. Finally, in Section V, we draw conclusions.

II.   Basic Motivations

Our goal is to assess the effectiveness of the new monetary policy tools that central banks have used over the past decade to stimulate economic activity at the ELB.[6]

The key challenge is identifying their causal effects. To divine the impact of NMP tools, most observers have relied on event studies that measure the impact on specific financial conditions—typically longer-term bond yields—over a very short time interval before and after a policy announcement. Bernanke (2020) summarizes these results. For example, Krishnamurthy and Vissing-Jorgensen (2011) find that the Fed's November 2010 announcement of $600 billion of Treasury purchases lowered the 10-year yield by 18 basis points over a one-day window.

However, extrapolating from event studies assumes that measured effects persist and that they are stable over time. Greenlaw et al. (2018) are skeptical of both assumptions in assessing the impact of Fed balance sheet policies. They also note that the first use of balance sheet tools in the United States—at the height of the financial crisis—had an outsized impact compared to subsequent events, raising doubt about the usefulness of these tools during other, less extreme situations.

Bernanke (2020) counters that: (1) market anticipation of later episodes might have masked their impact; (2) predicting reversals following a temporary policy-induced effect does not appear to be a profitable strategy; and (3) other financial conditions (corporate bonds, equities, the exchange rate, and credit default swaps) responded to policy developments.

Our focus takes off from this vantage point. First, we are agnostic about the effectiveness of the NMP tools. At the same time, we are *not* interested in their very short-run impact that (by themselves) have limited economic importance. Instead, recognizing that statistically sound identification is very difficult to establish, we wish to explore whether the new tools were sufficient on average (across countries and episodes) to shift adverse financial conditions in a positive direction. To the extent that use of these tools is most likely when interest rates are low and the economy is sluggish, the future challenges may be similar. In making our assessment, we exploit the collective experience of the various central banks that utilized these new tools, rather than analyzing them in isolation.

Second, we hypothesize that the transmission of monetary policy to the economy is through a wide array of financial conditions, so that efforts to judge policy effectiveness should take account of the co-

---

[6] For a favorable assessment of these tools by a working group representing 18 central banks, see Committee on the Global Financial System (2019).

movements of a range of financial indicators over time. Taking this perspective, we build on the voluminous literature regarding financial conditions indexes (FCIs).[7] Some of these, like the Federal Reserve Bank of Chicago's National Financial Conditions Index, are now in wide use among policymakers and financial market participants as summary statistics for financial developments that influence economic activity and inflation. Nonetheless, we believe this point deserves emphasis because the inclusion of such complex policy transmission mechanisms in models used to assess monetary policy is still a work in progress.[8]

Third, as might be expected based on extensive research regarding global financial co-movements, we find that there is an important global factor driving financial conditions.[9] To the extent that central banks are unable to influence this global factor—a question on which we prefer to let the data speak for itself—then we also need to extract that factor to judge whether and how monetary policy affects the residual of domestic financial conditions.

We turn now to developing FCIs that are both comparable across a set of countries and of high enough frequency to help us track the impact of new monetary policies over economically meaningful time horizons.

III.   Measuring Financial Conditions

Our analysis of the impact of monetary policy, both the old and the new, begins with the construction of financial conditions indexes (FCIs). Following the procedure in Hatzius et al (2010), we take a set of financial variables, strip them of their cyclical variation, and then compute their principal components. We do this for eight countries: France, Germany, Italy, Japan, Sweden, Switzerland, the United Kingdom, and the United States. In addition to constructing measures of *domestic* financial conditions for these eight countries, we also construct a common, *global* FCI.

A.   A Global Financial Conditions Index

We start with the construction of a global FCI (GFCI), using the full set of 56 unique financial variables from the eight countries. Define financial variable i for country j at time t as F_{ijt}. For all jurisdictions, F_{ijt} includes equity returns, equity volatility, the interbank spread, the yield curve slope, a credit risk spread,

---

[7] See, for example, Brave and Kelley (2017).
[8] The Fed's FRB/US model includes a variety of interest rates and financial risk premia, but it is far more eclectic than workhorse New Keynesian DSGE models that are often used for policy analysis. See, for example, Brayton, Laubach and Reifschneider (2014).
[9] See, for example, Miranda-Aggripino and Rey (2020).

a measure of credit, and the exchange rate. In addition, for France, Italy, Sweden, and Switzerland, we include a sovereign 10-year yield spread (relative to Germany).

Very briefly, while we use implied equity volatility based on the S&P 100 for the United States, for most countries, we construct equity volatility as the standard deviation of daily returns.[10] We compute the interbank spread by subtracting a three-month sovereign rate from an equivalent maturity interbank rate. The yield curve slope is a long-term (generally 10 year) sovereign rate less the three-month rate. We measure credit as the change in total credit to the nonfinancial sector divided by nominal GDP. The exchange rate is the percentage change in the nominal effective rate. The sovereign spreads compare long-term sovereign rates to the German long-term rate. Finally, all financial variables are monthly starting in 1988, and we standardize them to have mean zero and standard deviation one over the available sample.[11] Appendix B provides details of the data sources and transformations.

Continuing with the construction of the GFCI, the next step is to purge these financial indicators of their dependence on economic activity and inflation. To do this, we need global indexes for activity and for inflation. To compute these, we start with the Conference Board's Coincident Index for France, Germany, Japan, the United Kingdom and the United States;[12] and the OECD's measure of consumer prices for all eight countries. Using the three-month log difference, we standardize the activity and inflation data over the sample and compute the first principal component for each. Labeling these Y^g and π^g, we proceed to regress each of the financial variables on lags of these global measures. That is, for each of the 56 unique financial variables, we estimate the following regression:

$$(1) \quad F_{ijt}^g = a_{ij}^g + \sum_{k=1}^{6} b_{ijk}^g Y_{t-k}^g + \sum_{k=1}^{6} c_{ijk}^g \pi_{t-k}^g + \eta_{ijt}^g.$$

Next, we take the matrix of residuals from equation (1), $\{\hat{\eta}_{ijt}^g\}$, and compute the first principal component. In what follows, we will refer to this estimate of the global FCI as the *GFCI*.

---

[10] We choose to use the series for implied equity volatility based on the S&P 100 for the United States because it extends back to 1986, while the better-known VIX (based on the S&P 500) is available only since 1990. Since 1990, their monthly correlation is 0.99.

[11] With the exception of the United States, credit data is only available quarterly, so we construct monthly estimates using linear interpolation.

[12] The results are similar when using monthly OECD industrial production for all eight countries instead of the coincident indexes for just the five countries.

A simple principal components analysis yields a set of orthogonal linear combinations of a group of variables in the order in which the resulting series explain the most variation in the data from which they are constructed. In this case, the first principal component of the 56 variables explains 22.4 percent of the variation in all of the data, suggesting the presence of a very important global factor.[13]

To help understand the properties of the GFCI, we look at both the loadings on the underlying 56 series and at the GFCI itself.[14] Specifically, to examine the drivers of the GFCI, we calculate the sum of the weights (or loadings) that apply to the different constituent series. Figure 1 plots these sums when we aggregate the loadings by indicator. The main conclusion from these calculations is that equity volatility and equity returns are dominant, while credit, the sovereign spread and the yield curve slope play very little role. (Since equity volatility usually rises when equity returns are negative, the difference in sign is what we would expect.) Put differently, the co-movement in stock prices and stock market volatility across the countries in our sample is much greater than for the other indicators we study.

Figure 1: Global Financial Conditions Index, factor loadings by indicator

Numbers are sums of the loadings for the first principal component of 56 financial series purged of cyclical variation. Source: Authors' calculations.

---
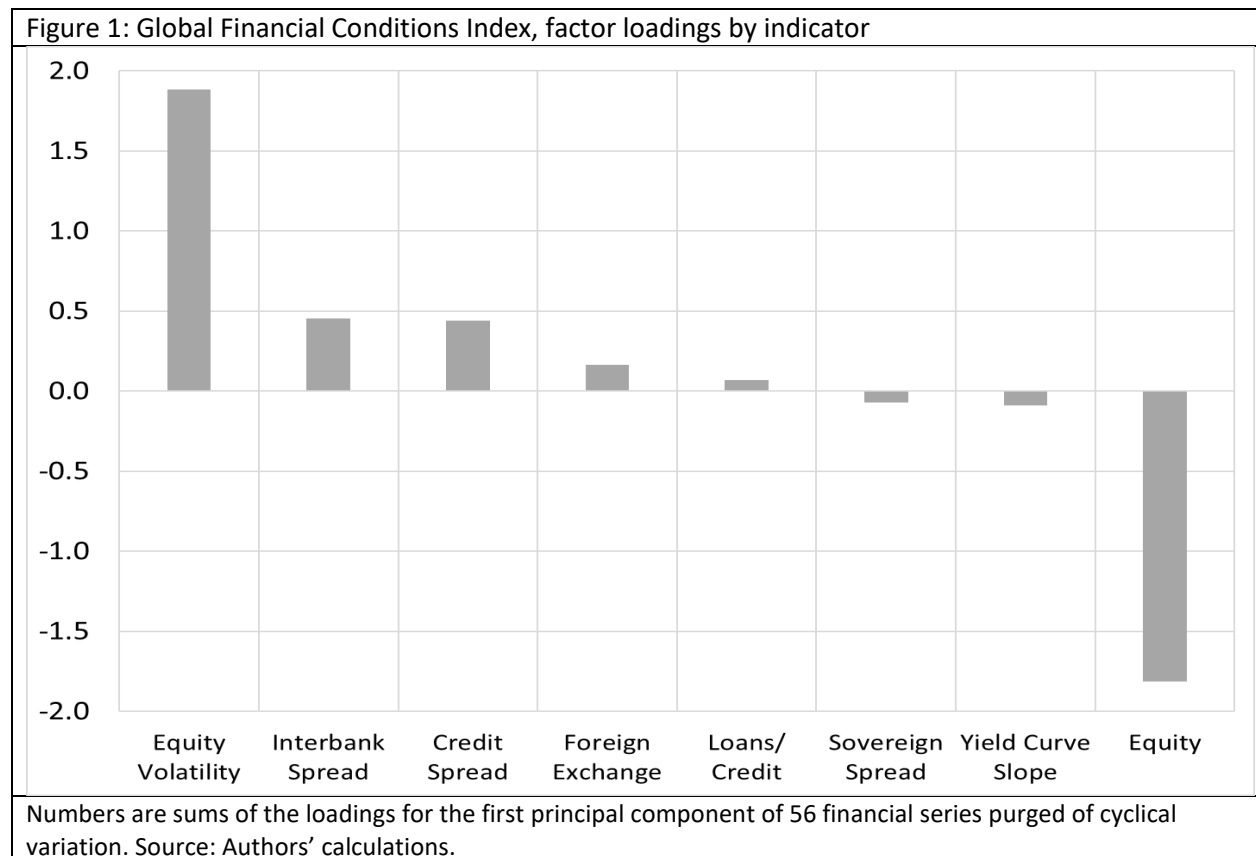
[13] The second global principal component accounts for a much more modest 9.3 percent of the variation in the data, so we do not analyze it.
[14] See Appendix D Table A4 for details.

Turning to the GFCI itself, Figure 2 plots a five-month centered moving average of our estimate. We have two observations. First, increases in the indicator clearly indicate periods of tighter financial conditions. Second, we note that spikes come on dates that are relatively easy to explain. These include the jumps in 1990, following the Iraqi invasion of Kuwait; in 1992, around the time of the ERM crisis; in August and September of 1998, during the collapse of Long-Term Capital Management; in August 2002, when equity markets dropped precipitously; in September 2008, when Lehman failed; and in autumn 2011, during renewed stress in the euro area.

Figure 2: Global Financial Conditions, five-month centered moving average, monthly

Source: Authors' calculations.
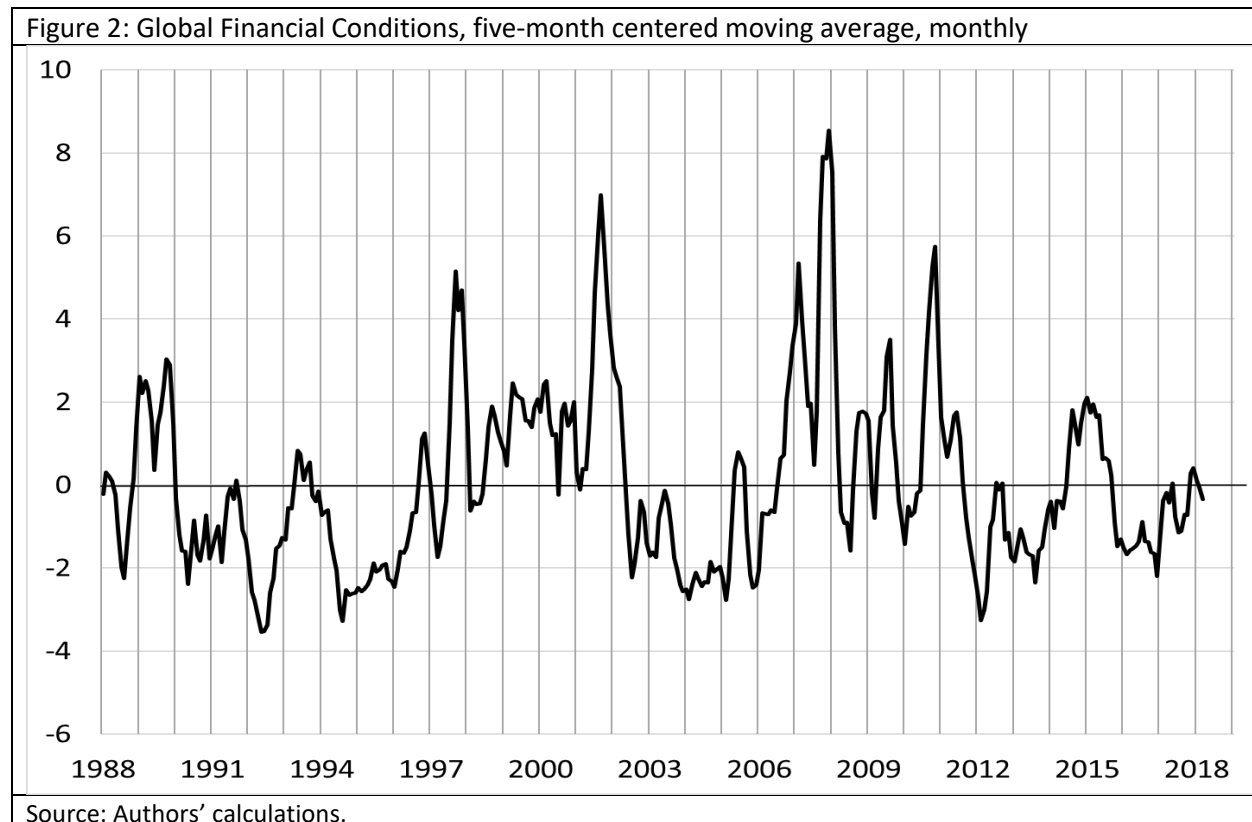
One natural question is whether there exists a clear relationship between global financial conditions and other observable factors, most notably monetary policy. One might expect that an (unexpected) increase in the policy rate would tighten financial conditions.[15] To assess this hypothesis, regressing the GFCI on a lag of itself and policy rates from our different countries. Surprisingly, at least to us, even prior to 2007 when U.S. interest rates were always away from the ELB, changes in the federal funds rate are not significantly correlated with the GFCI. For some of the other countries, we do find correlations (notably for Germany, Japan, and the United Kingdom), but the results are not uniform. The fact that

---

[15] See, for example, Miranda-Aggripino and Rey (2019).

much of the variation in the GFCI occurs around well-known events unrelated to monetary policy is likely responsible for these mixed outcomes.

B. Domestic Financial Conditions Indexes

Turning to domestic financial conditions in the eight countries in our sample, we follow the same procedure. That is, we take each country's set of financial variables (standardized to have mean zero and standard deviation one), and estimate the following set of regressions:

$$(2) \quad F_{ijt}^d = a_{ij}^d + \sum_{k=1}^{6} b_{ijk}^d Y_{t-k}^d + \sum_{k=1}^{6} c_{ijk}^d \pi_{t-k}^d + \eta_{ijt}^d$$

In equation (2), we replace the global activity and inflation variables in equation (1) with their domestic analogs. That is, we purge each financial variable of the *domestic* cyclical variation. For France, Germany, Japan, the United Kingdom, and the United States, we measure activity using the Conference Board's Coincident Index; for Italy, Sweden and Switzerland, we use industrial production from the OECD's main economic indicators.[16]

As before, we take the matrix of residuals from equation (2), $\{\hat{\eta}_{ijt}^d\}$, and compute principal components. This time, however, we do this only *within* countries, where there are either seven or eight variables. Looking at these, we see that the first component explains roughly 30 percent of the variation in country financial factors, while the second component explains an additional 20 percent. That is, the first two principal components together explain roughly half of the variation in the financial variables we use. Given that they both appear to be important, in what follows we study the first two principal components for each country, labeling them DFCI1 and DFCI2.[17]

---

[16] For both activity and inflation, we trim outliers (winsorize) by replacing the top and bottom 2½ percent of observations with the next lowest or highest observations. Given the size of our sample, that means we are replacing 18 data points in each country.

[17] In Appendix D, we report the factor loadings, as well as other relevant information, for both DFCI1 and DFCI2.

Figure 3: Domestic Financial Conditions Index (DFCI), loadings by indicator

A.　First domestic financial factor (DFCI1)
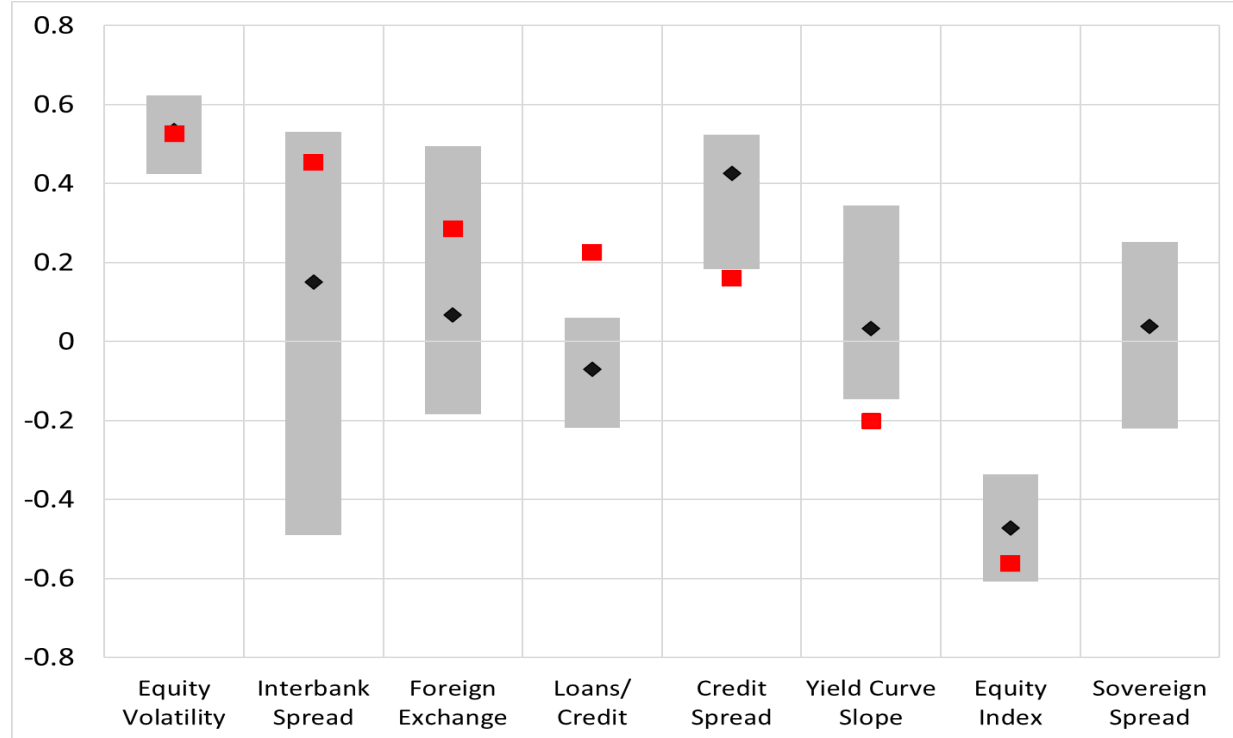
B.　Second domestic financial factor (DFCI2)
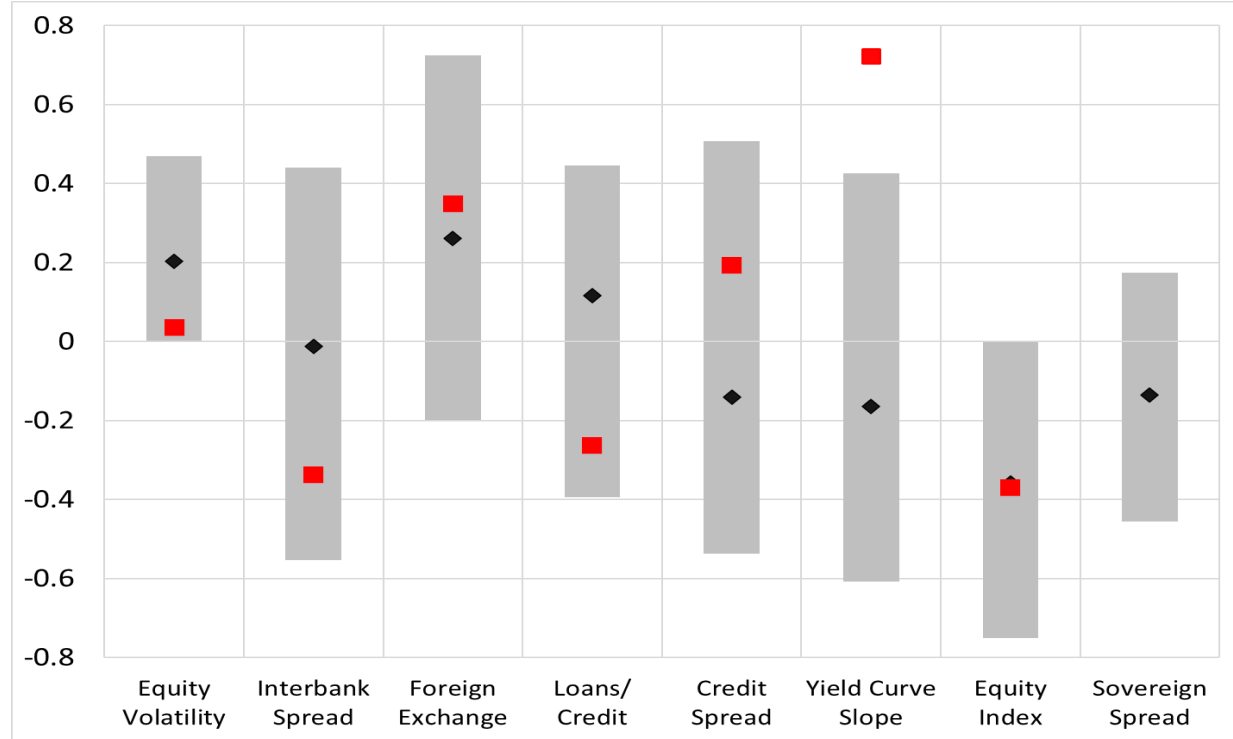
Notes: Plots are for the range of indicators. Gray bars represent the range for the seven countries excluding the United States; the black diamond is the non-U.S. average, and the red squares are the U.S. loadings. We reversed the signs for the DFCI2 loadings for France, Sweden and Switzerland, so that an increase in the DFCI indicates greater stress. Source: Authors' calculations.

As with the global version, we examine the loadings in Figure 3.[18] The top panel reports information for DFCI1 and the bottom panel reports the same for DFCI2. We separate information related to the DFCIs for the United States from that of other jurisdictions because the loadings for the United States are often different. Overall, the properties of DFCI1 are similar to those of the global indicator: note the consistent importance of equity volatility and the equity index. In fact, the simple correlation between GFCI and DFCI1 across countries has a median value of 0.74 (ranging from 0.82 in the United Kingdom to 0.46 in Italy). Even for economies that do not have large equity markets, the dominant factor underlying the GFCI (equity markets) also is an important factor in the first principal component of domestic FCIs. One reason could be that equity markets co-move during risk-on and risk-off periods.[19]

Turning to the second domestic financial index, there is substantial variation across countries. For example, the French DFCI2 has the largest loading on the exchange rate, for Japan it is the yield curve slope, and in Sweden it is the equity index. Furthermore, while increases in DFCI1 clearly indicate tightening financial conditions, the sign of DFCI2 varies across countries. Specifically, for the United States, Germany, Italy and the United Kingdom, DFCI2 is *positively* correlated with the GFCI, suggesting that an increase in DFCI2 represents tightening of financial conditions (just as with DFCI1). For Japan, it is roughly zero. And, for the other countries we study—France, Sweden, and Switzerland—the correlation between DFCI2 and GFCI is *negative*, implying that an increase represents an easing of financial conditions. To simplify the analysis that follows, we reverse the signs of the indexes for these three countries, so a higher value of DFCI2 always signals an increase in stress. [20]

We also note some features that differentiate the United States. For example, the loadings on the U.S. DFCIs are at or beyond the edge of the range (depicted by the gray bars) of the other countries' DFCIs in five instances, and close to the extremes in several other cases. Given the breadth, depth, and diversity of the U.S. financial system, we do not find these idiosyncrasies surprising.

---

[18] For full details, see Appendix D Table A5.

[19] See, for example, Loretan and English (2000), and Forbes and Rigobon (2002).

[20] We compute the correlation of the DFCI2s with the contemporaneous GFCI controlling for lagged DFCI1s. When the correlation is negative, we reverse the sign of DFCI2.

Figure 4: Domestic Financial Conditions Indexes

A.   First Domestic Financial Conditions Index (DFCI1)

B.   Second Domestic Financial Conditions Index
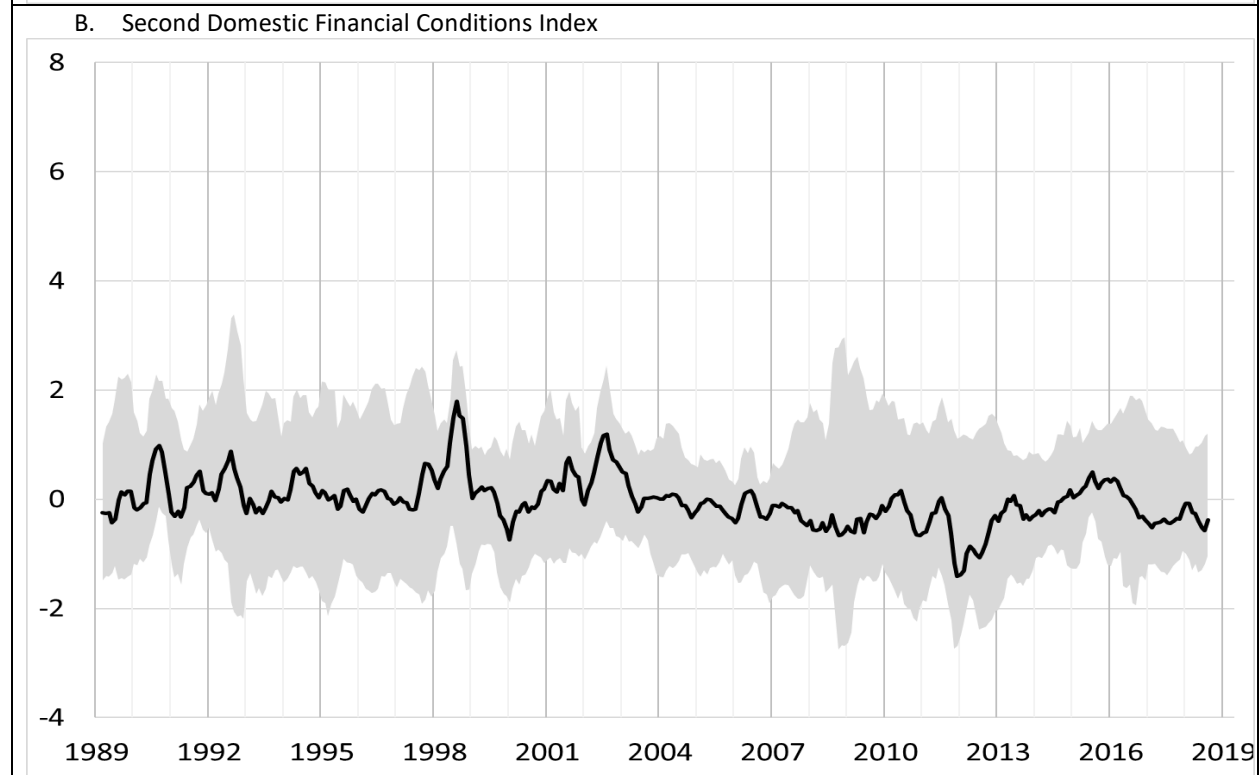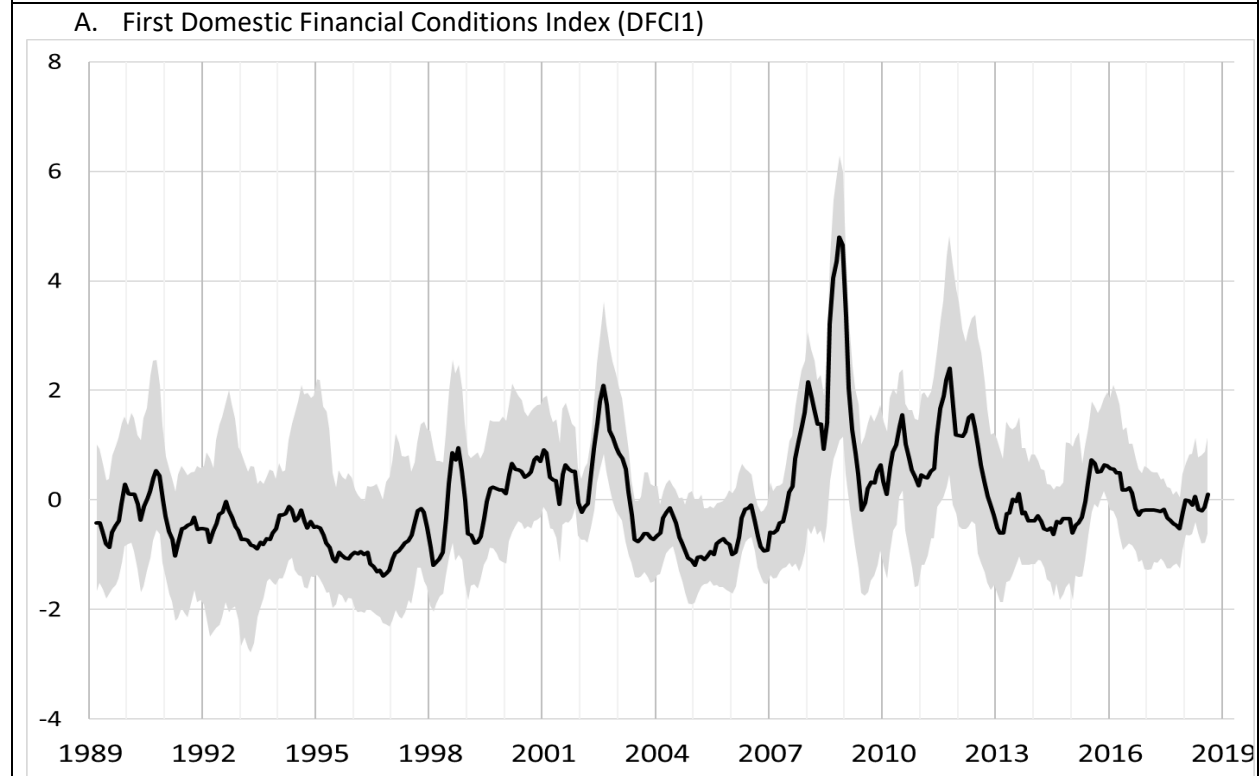
Notes: Figures are the five-month-centered moving averages of the minimum, maximum and median value of DFCI1 and DFCI2 computed across the eight-country sample on a month-by-month basis. We invert DFCI2 for France, Sweden and Switzerland so that in all the countries an increase represents greater stress.
Source: Authors' calculations.

Figure 4 depicts the evolution of the DFCIs over time, with DFCI1 in the top panel, and DFCI2 in the bottom. In each panel, we show the range of values (shaded in gray) across the countries in a given month, along with the median value (black line). For DFCI1, despite considerable variation of the median, the range around it is relatively small, while the median of the pairwise correlations across the eight country indexes is 0.58. For DFCI2, while the variation of the median is narrower, the range around it is wider, and the median correlation is close to zero. These patterns suggest that DFCI1 contains substantial common information, while DFCI2 appears to contain more idiosyncratic, domestic information.[21]

Figure 5 helps illustrate the differences between the DFCI1s and DFCI2s by comparing their medians with the GFCI. In each scatter plot, the GFCI is on the horizontal axis, while the DFCIs are on the vertical axis. The GFCI accounts for 74 percent of the variation in the median DFCI1, but only 2 percent of the median DFCI2. For these reasons, we treat DFCI2 as an indicator of country-specific stress conditions.

Having developed the GFCIs and DFCIs, in Appendix A, we evaluate their relationship with the policy rate, and assess their ability to forecast general economic activity and inflation. First, in Germany and the United States, after controlling for the DFCIs, policy rates do *not* have an independent role in forecasting activity. Second, across countries, the utility of the DFCIs for forecasting activity varies significantly, while (consistent with the impact of inflation's role as a policy target on its dynamics) the DFCIs typically do not forecast inflation.[22] Finally, regarding the impact of the policy rate on the DFCIs prior to 2007, the results are mostly ambiguous or insignificant.

---

[21] We also computed domestic financial conditions indexes that are orthogonal to the global index. A simple way to do this is to add the contemporaneous GFCI to equation (2), thereby purging each of the domestic financial variables of their relationship with the GFCI. The resulting linear combination of the residuals in the DFCI is purely domestic. The analysis of these orthogonalized measures leads to conclusions similar to the ones we report below.

[22] See Cecchetti et al. (2017).

Figure 5: Relationship of Domestic and Global Financial Conditions Indexes

A.   First Domestic Financial Conditions Index (DFCI1)

DFCI1 = − 0.008 + 0.37 x GFCI
R² = 0.74

Global Financial Conditions Index (GFCI) (x-axis)
First Domestic Financial Conditions Index (DFCI1) (y-axis)

B.   Second Domestic Financial Conditions Index (DFCI2)

DFCI2 = − 0.03 + 0.03 x GFCI
R² = 0.02

Global Financial Conditions Index (GFCI) (x-axis)
First Domestic Financial Conditions Index (DFCI1) (y-axis)
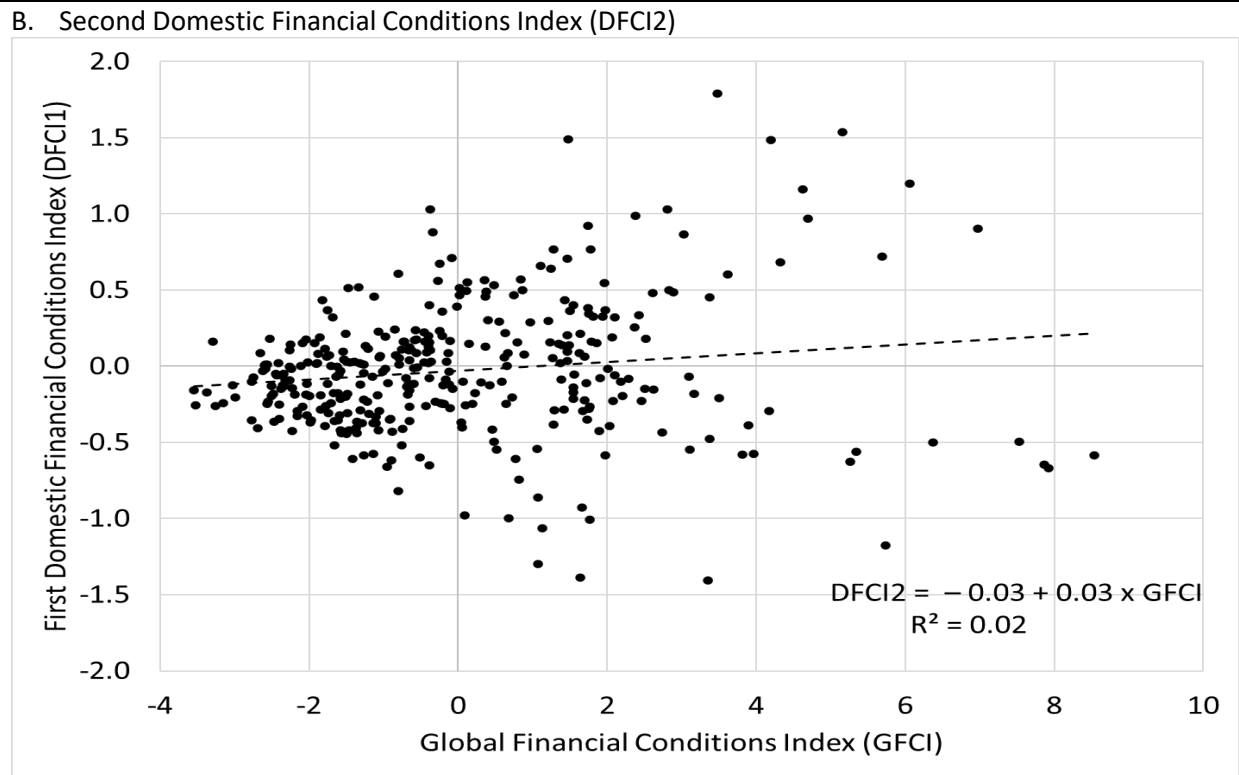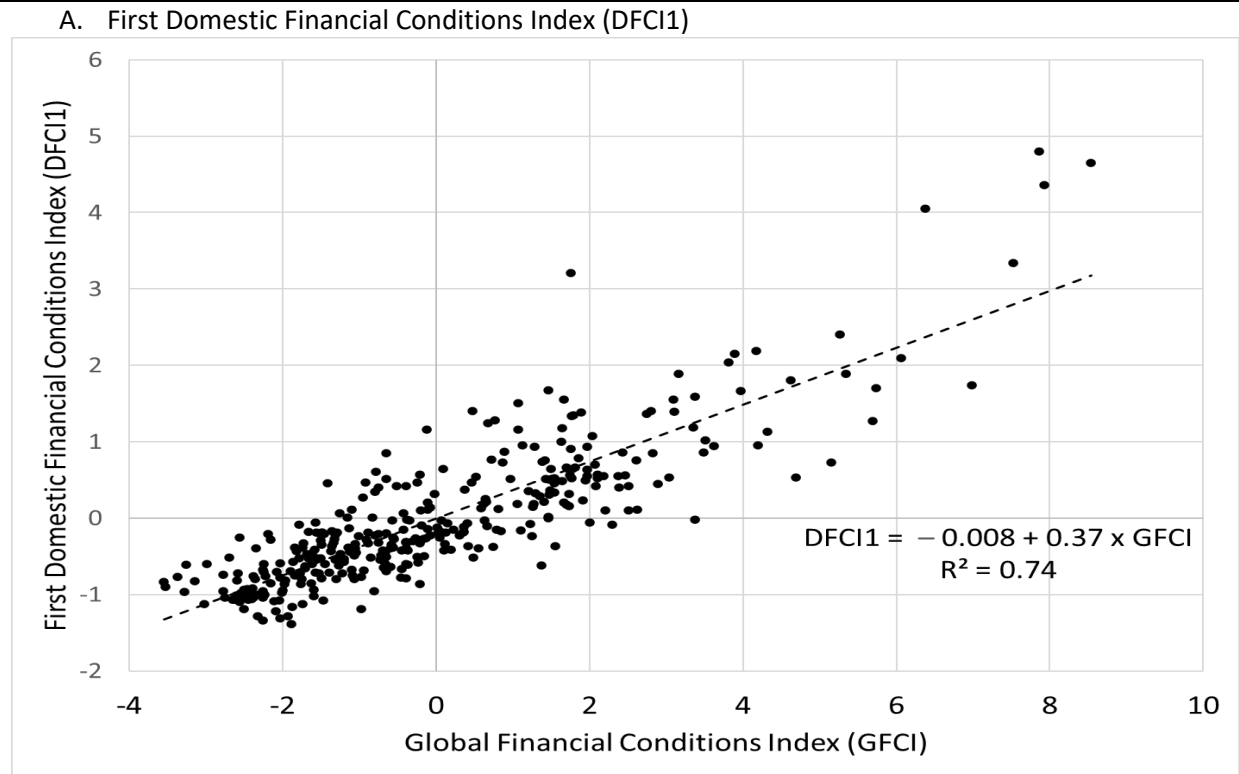
Notes: Plot is of the five-month centered moving average of the global financial conditions index and the five-month centered moving average of the median of the domestic financial conditions indexes. For France, Sweden and Switzerland, we reverse the sign of DFCI2 prior to computing the median.
Source: Authors' calculations.

IV.   New Monetary Policy Tools and Financial Conditions

We now turn to our study of the effect of new monetary policies on our global and domestic financial conditions indexes. To do so, we first develop indicators of the NMP tools for the eight countries. As we suggest in the introduction, we can further distinguish forward guidance and balance sheet policies into the following categories: date-contingent forward guidance, state-contingent forward guidance, quantitative easing (policy-driven expansion of the central bank balance sheet), and maturity extension.[23] In addition to these four variables, we also examine the influence of base money (scaled by nominal GDP) and negative nominal interest rates.[24] Of these six variables, we measure all but base money (M0) as binary (zero or plus one) or trinary (minus one, zero or plus one) indicators. The forward guidance and negative rate indicators equal one for the entire time that the policy is in place. The indicators for the balance sheet policies are *on* (equal one) only in months when there are announcements, while the time series of base money serves as a proxy for the continuing effects of such balance sheet policies. Although we do not directly address yield curve control, our guidance and balance sheet measures should capture some of its key effects. Appendix C reports the details of the construction of these NMP indicators.

With these measures in hand, we estimate the following equation:

$$(3) \qquad DFCI_{jt} = \alpha_j + \beta_j DFCI_{jt-1} + \gamma_j GFCI_t + \sum_{k=1}^{6} \sum_{l=0}^{3} \delta_{jkl} NMP_{jkt-l} + \xi_{jt}$$

In words, for each country *j,* we look at the impact of the contemporaneous and three lags of each of our measures of new monetary policies, subscripted by *k*, on the domestic FCIs (from both the first and second principal components). We control for lagged domestic financial conditions and for global financial conditions.

Obviously, equation (3) does not identify the effects of *exogenous* variation in new monetary policy tools. There exists a voluminous literature that seeks to identify such variation in order to assess the effectiveness of these policies.[25] The general finding is that both forward guidance and balance sheet

---

[23] We also examined changes in the mix of the central bank's balance sheet in the direction of less creditworthy or less liquid assets. We describe our "credit easing" indicator in the Appendix C. However, because these balance sheet mix measures frequently were introduced in periods of great financial distress, the results tended to be perverse (reflecting reverse causality). We do not report these results in the paper.

[24] We would prefer to use central bank assets or reserves, rather than base money. Unfortunately, these data are not consistently available over the sample period and for the countries that we study.

[25] See Bernanke (2020) for a survey of these studies.

policies are effective in easing financial conditions, usually defined in terms of the very short-term impact on long-term bond yields. Taking that conclusion as a given, equation (3) answers a different question: understanding that central bankers use new monetary policy tools when economic conditions or prospects are deteriorating, is the easing that they deliver powerful enough to offset that deterioration and actually lead to looser domestic financial conditions?

Table 1 addresses this question, stratified by country and type of new monetary policy. As before, we report the sum of the coefficients on the various NMP variables. Because policymakers only use the new tools when they want to stimulate the economy and raise inflation, the hoped-for sign is negative, meaning that the new monetary policies are powerful enough to ease financial conditions. When reporting the estimated coefficients, we use a red font to highlight estimates that have both the "wrong" sign and a t-statistic of at least 1.5.

Our first high-level takeaway from Table 1 is that the glass is half-full: in nearly a quarter of the possible cases (20 out of 84) new monetary policies demonstrate a statistically significant ability to ease financial conditions. Given that policymakers often used these tools in the face of powerful and persistent headwinds, this is evidence of central bankers' ability to affect financial conditions, even when constrained by the ELB and by global conditions.

The second high-level takeaway is that the glass is half-empty: in many cases, the new monetary policies were not sufficient to offset whatever other factors were leading to tighter domestic financial conditions. Indeed, in one sixth of the episodes, 14 out of 84 cases, financial conditions *tightened* in a statistically significant manner following implementation of one of the NMPs. To reiterate an earlier point, this does not mean that NMP tools were ineffective in easing financial conditions relative to what they would have been otherwise. What it means is that their impact was insufficient to offset other factors and deliver a net easing in financial conditions. In short: monetary policy as implemented was not enough.

Table 1: Impact of New Monetary Policy Tools on Domestic Financial Conditions								
A. First Domestic Financial Conditions Index (DFCI1)								
Tool	US	FR	DE	IT	JP	SW	CH	UK
Date-contingent Forward Guidance (FGD)	-0.47 (-3.54)	0.19 (0.94)	0.47 (2.73)	0.62 (3.08)		0.21 (0.97)		0.24 (0.85)
State-contingent Forward Guidance (FGS)	-0.42 (-2.61)	-0.23 (-1.52)	-0.22 (-1.47)	-0.20 (-1.55)	0.10 (0.64)			0.12 (0.97)
Quantitative Easing (QE)	1.47 (1.70)	-1.88 (-2.52)	-0.74 (-1.45)	-1.51 (-1.95)	-0.37 (-0.72)	0.82 (1.82)	-1.03 (-1.37)	2.29 (1.34)
Maturity Extension (ME)	-1.29 (-1.90)	1.82 (4.61)	1.08 (2.70)	0.58 (1.01)	-0.47 (-0.87)	-0.47 (-1.30)	1.89 (1.16)	-3.20 (-1.65)
Monetary Base (M0)	0.01 (0.16)	0.01 (0.96)	-0.02 (-1.00)	-0.01 (-0.46)	0.05 (0.90)	-0.001 (-2.61)	-0.001 (-0.29)	0.02 (1.50)
Negative Rates (NR)		-0.17 (-1.03)	-0.11 (-0.82)	-0.19 (-1.08)	0.09 (0.44)	0.02 (0.18)	0.39 (1.71)	
$\overline{R}^2$	0.72	0.87	0.85	0.73	0.64	0.85	0.72	0.85
B. Second Domestic Financial Conditions Index (DFCI2)								
Tool	US	FR	DE	IT	JP	SW	CH	UK
Date-contingent Forward Guidance (FGD)	0.34 (3.68)	0.15 (0.48)	-0.02 (-0.08)	-0.49 (-1.69)		0.39 (1.15)		-0.82 (-1.77)
State-contingent Forward Guidance (FGS)	0.40 (2.73)	-0.10 (-0.33)	-0.24 (-1.33)	0.09 (0.41)	0.11 (1.21)			0.19 (1.48)
Quantitative Easing (QE)	0.30 (0.46)	1.36 (1.33)	0.69 (1.24)	2.23 (1.97)	-0.36 (1.92)	0.41 (1.03)	-0.75 (-1.61)	0.45 (0.45)
Maturity Extension (ME)	0.08 (0.14)	-1.52 (-3.03)	-1.58 (-3.16)	-2.01 (-2.21)	0.30 (1.65)	0.10 (0.34)	0.93 (1.40)	0.07 (0.08)
Monetary Base (M0)	0.02 (0.20)	-0.07 (-4.37)	-0.05 (-2.93)	-0.004 (-0.16)	0.02 (1.05)	-0.0004 (-0.35)	-0.003 (-1.73)	-0.03 (-1.57)
Negative Rates (NR)		0.28 (1.59)	0.32 (2.39)	0.19 (0.64)	0.03 (0.26)	-0.05 (-0.44)	0.05 (0.36)	
$\overline{R}^2$	0.61	0.49	0.43	0.71	0.81	0.40	0.73	0.20

Notes: Table reports the results of estimating equation (3). Asymptotic t-ratios, computed using robust standard errors, are in parentheses. Yellow denotes a t-ratio of equal to or greater than 2.0, orange is a t-ratio of greater than 1.5 and less than 2.0, and the red font indicates the coefficient has the "wrong" sign. Gray means that the country did not use the tool, or that it is collinear with another tool. For the euro area countries, we use ECB assets in place of the monetary base. Source: Authors' calculations.

As an example of this problem, consider the estimated efficacy of date-contingent forward guidance

(FGD) in the euro area. From the first row in Table 1, as measured by DFC1, we can see that FGD is

associated with a *tightening* of domestic financial conditions in Germany and Italy. For a closer look, consider Figure 5 that links Italy's DFCI1 with euro-area date-contingent forward guidance (FGD). We judge that the ECB initiated FGD in mid-2013 and maintained it in some form until the summer of 2019. The period when FGD was in effect corresponds to the black lines in the figure, while the prior period (without FGD) is in blue. When FGD was initially put in place, financial conditions were more stressed (higher) than usual (see the dotted black line). Once in place, conditions are less volatile, and by the time the policy is withdrawn, conditions had eased. So, *visually*, the policy appears to work.

Figure 6: Financial Conditions in Italy (DFCI1), 2007 to 2019

Source: Authors' calculations.
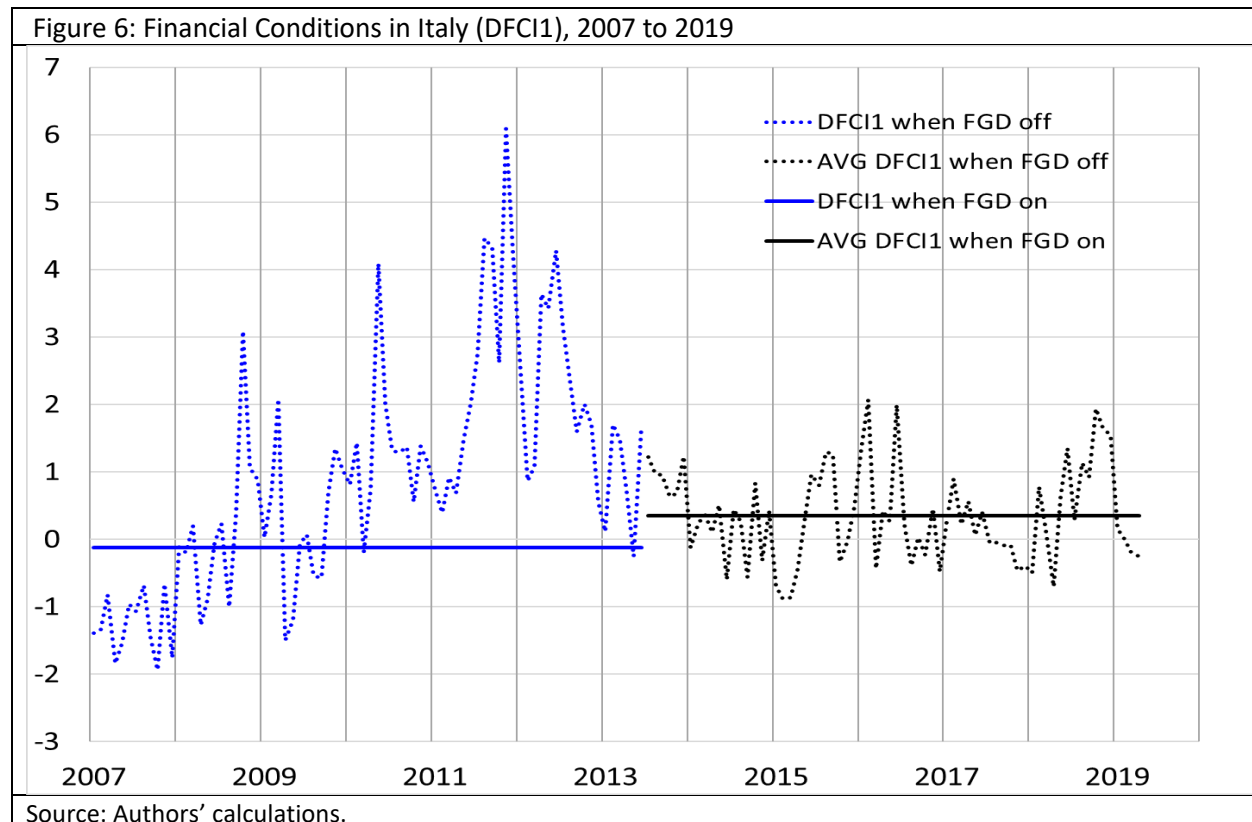
However, what a regression analysis does (loosely speaking) is compare average conditions when the policy was active to the average when the policy is not in place.[26] The solid lines in Figure 6 depict these average values. To make the picture readable we show only the post-2007 series, but we compute the average for the months with no FGD over the full regression sample starting in 1995. This highlights the nature of the problem. The last observation with policy in place is lower than when the policy started

---

[26] This would be exactly right if there was only a contemporaneous value of the NMP variable in the regression and no other controls. With other controls present, we need to extract these effects, but in this case doing so does not change the basic patterns in the data.

and below the full sample average of zero. However, this is not what the regression is computing; it is comparing the solid black line with the solid blue line.

The only way to address this issue within a regression context is to have enough controls to account for the decision to invoke the policy in the first place. We do not have sufficient data to do that. A bias of this sort is present in all estimates of equation (3) shown in Table 1. To judge the extent of the problem, we can look the average level of stress when policymakers invoke the different policies and see whether those that were initiated during periods with tighter conditions were more likely to run into the problem exhibited in Figure 6.

Figure 7 shows the result of this exercise. Each dot in the picture represents a country-tool pair (e.g. FGD in Italy). The x-axis shows the average level of DFCI1 at the time when a given country invokes the new tool. Thus, dots to the right of the origin indicate that stress was above the average level for that country between 1995 and 2019.

Figure 7: Level of Initial Stress and Policy Efficacy

Notes: Plot of the coefficients from panel A of Table 1 on the vertical axis and the averages of Table 2 on the horizontal axis. The use of negative rates is in blue. The dashed line is the regression line using all data points, including negative rates. Source: Authors' calculations.
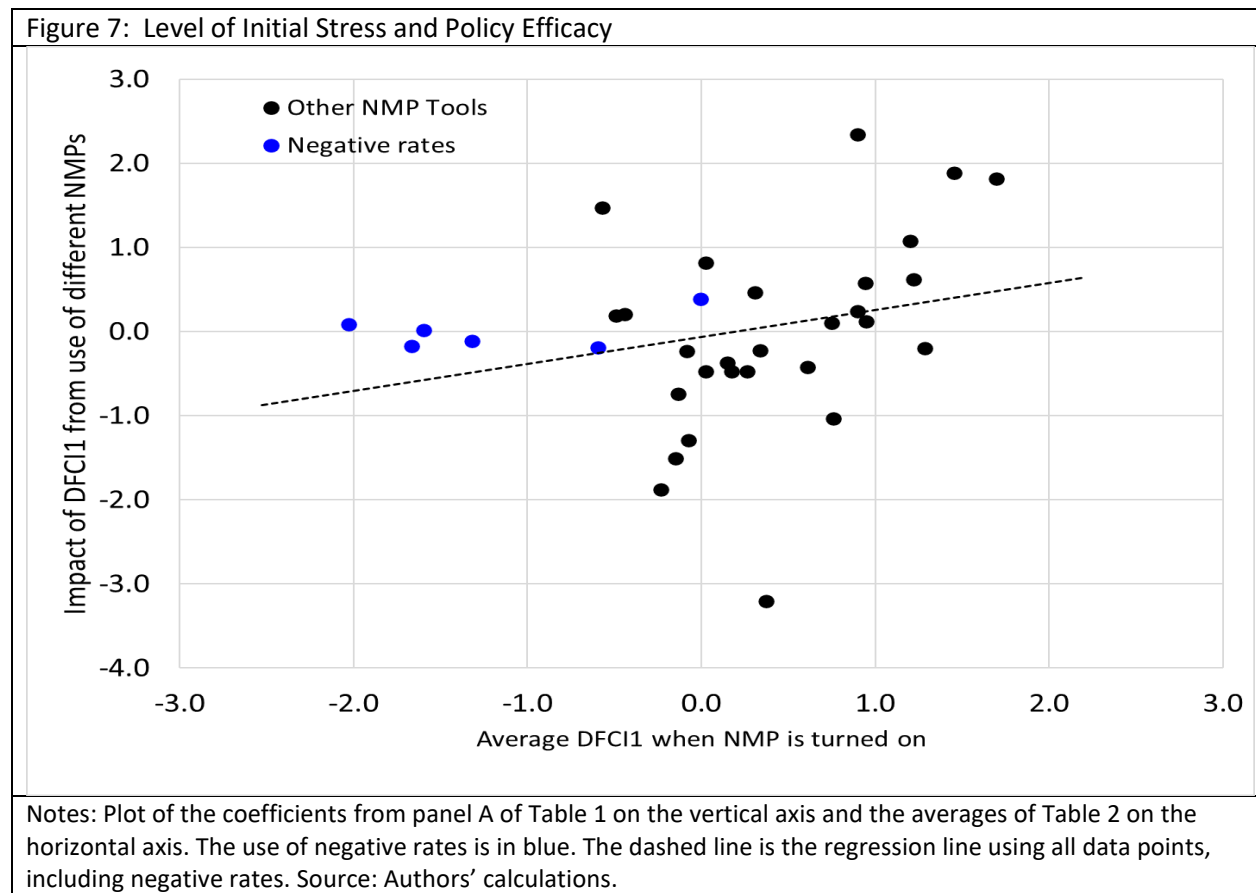
The average horizontal-axis value across all the dots in the figure is a bit over 0.14, meaning that conditions were slightly elevated relative to the sample average when the new tools were invoked. But the conditions that prevailed upon implementation differ across tools. Consider, for example, negative rates—depicted by the blue dots in Figure 7. In all but one case, financial conditions upon implementation were substantially *looser* than usual. For the black dots in the figure—those that cover forward guidance and balance sheet actions—average stress levels were notably higher (about 0.43) when the tools were tried.

The vertical axis in Figure 7 shows the regression coefficients from table 1 that measure the impact of each tool on DFCI1. We had expected these coefficients to be negative and yet many had the wrong sign. The overall message from the figure is that these perverse signs are more likely for the cases where a tool is deployed when stress levels were high. Given our observations regarding the Italian case in Figure 6, this outcome is not surprising: headwinds matter.

Generalizing from what we observe in Figure 7, Table 2 reports the percentile of average DFCI1 during the month when each country's central bank implemented the specific NMP. For example, the Federal Reserve initiated FGD when, on average, the U.S. DFCI1 was at its 65th percentile. On average across countries, central banks implemented FGS with financial conditions at the 72nd percentile. Excluding negative rates, the countries' central banks used NMP tools when financial conditions were at their 65th percentile.

	US	FRA	DEU	ITA	JPN	SWE	CHE	UK	Average Percentile by instrument
Table 2: Percentiles of DFCI1 when each NMP is initially implemented									
FGD	65.1%	31.2%	64.0%	83.2%	58.9%	43.2%		80.5%	60.9%
FGS	73.8%	46.9%	66.1%	84.2%	78.4%			81.5%	71.8%
QE	35.9%	42.1%	46.9%	51.0%	62.0%	56.5%	77.3%	80.5%	56.5%
ME	52.7%	86.6%	84.2%	79.8%	62.3%	56.5%	85.7%	68.2%	72.0%
NR		2.1%	16.4%	36.6%	1.7%	4.8%	56.3%		19.7%
Average percentile ex NR	56.9%	51.7%	65.3%	74.6%	65.4%	52.1%	81.5%	77.7%	65.3%
Notes: The table reports the percentiles of the distribution of the average value of DFCI1. Source: Authors' calculations.									

Returning to the negative interest rate (NR) tool, we can see in Figure 7 that in no instances did the implementation of negative rates have particularly powerful effects on financial conditions: the blue

dots are all relatively close to the zero impact level. One reason may be that central banks invoked NR policies when financial conditions already were loose, making it more difficult to generate further monetary accommodation. As Table 2 highlights, with the exception of Switzerland, central banks implemented NR polices when domestic financial conditions were much easier than the median in the 1995 to 2019 sample.

For all these reasons, we do not treat these regressions as refuting claims about the usefulness of NMP tools. Rather, we find the results informative precisely because the implementation of these policies remains likely to occur when economic and financial conditions are troubled. Consequently, analyzing their impact in these circumstances is still useful.

With this in mind, we make a few more observations about the results in Table 1. First, comparing across countries, France and Italy enjoyed a somewhat encouraging experience with new monetary policies. For France, four of the 12 policies "worked" (FGS and QE for DFCI1; in addition to ME and M0 for DFCI2). Similarly, in Italy four policies also appear to be successful to some extent (FGS and QE for DFCI1; as well as FGD and ME for DFC2). But in both cases, some of the policies were not sufficiently powerful to counteract global conditions. In France, this is the case for ME for DFCI1 and NR for DFC2; in Italy, the same applies to FGD for DFC1 and QE for DFC2. We note that for Germany, two of the policies eased financial conditions (ME and M0 for DFCI2). But, in three cases—FGD and ME for DFCI1 and NR for DFCI2—NMP was not sufficient to overcome tightening headwinds.

Looking at the ECB policies across the three countries of the euro area, there are some clear similarities. State-dependent forward guidance, quantitative easing and maturity extension all succeed in easing financial conditions to some degree.

For the United States, the experience with the new policy tools is mixed. In the six cases in which financial conditions changed significantly following the use of NMP tools, only three went in the "right" direction. And, while the mix of significant responses to NMP tools is somewhat better in France, Italy and the UK, evidence of effectiveness in Germany, Japan, Sweden, and Switzerland is spotty at best.

Looking at the results by policy instrument, arguably the most successful tool to affect domestic financial conditions was state-contingent forward guidance (FGS). Measured by DFC1, three of the six countries that implemented FGS experienced significant easing. This includes the United States, where

the Fed employed the "Evans rule" between December 2012 and March 2014.[27] In addition, the expansion of the monetary base—another proxy for quantitative easing—showed a significant and favorable impact in five countries (France, Germany, Sweden, Switzerland, and the UK). Date-contingent forward guidance (FGD) fared less well: it resulted in significantly easier financial conditions only in the United States.

In the United States, however, the there is little evidence of significant impact from balance sheet policies—quantitative easing (QE) and the monetary base (MB). Following the Lehman failure, when financial conditions were most stressed, many countries—including the United States—deployed balance sheet policies. Unless one dismisses the favorable conclusions of many event studies, this policy timing points to the previously highlighted endogeneity problem as an explanation for the "wrong" sign on QE for the United States. That sign also may reflect the collinearity between the implementation of QE and maturity extension (ME), which showed up favorably in the United States. Indeed, across countries, the correlation between these measures ranges from 0.62 in the euro area to 0.95 in Sweden (with the United States in the middle at 0.78). At the very least, this pattern makes it difficult to distinguish the effects of QE from those of ME. Indeed, in Table 1 the fact that the coefficients for QE and ME often appear with opposite signs makes their collinearity apparent.

Finally, again in contrast with research pointing to an expansionary impact from negative rates, there is *no* such evidence in our study.[28] Out of the 12 cases where central banks set negative rates, only three have statistical significance, and all three show the "wrong" sign. Again, this apparent lack of impact from negative rates is consistent with the message from Figure 7 that, virtually uniquely, this tool was employed only after financial conditions had turned favorable.

The discussion thus far has focused on looking at whether NMP tools were on average associated with statistically significant changes in financial conditions. Of course, we also care about the magnitudes by which the tools changed conditions. To gauge this, we first compute the long-run impact of the tools on DFCI1.[29] We then compare these estimates to two properties of the distribution of DFCI1 in each country, the distance from the 90th to the 70th percentile (black bar) and the distance from the 70th to

---

[27] The Evans Rule stated that the Committee will hold rates near zero at least until unemployment falls below 6.5% or inflation rises above 2.5%. DFCI2 showed a perverse outcome for FGS in the United States, but nowhere else. See Evans et al. (2012).

[28] For favorable assessments, see Eisenschmidt and Smets (2019) and Bernanke (2020).

[29] To compute the long-run impact, we divide the estimates in Table 1 by one minus the coefficient on the lagged dependent variable in our estimate of equation (3).

the 50ᵗʰ percentile (red bar). We note that the first of these is roughly twice the second, meaning that the DCFIs have "fat tails." Figure 8 reports the results of this exercise for state-based forward guidance (FGS) and for the combination of quantitative easing (QE) and maturity extension (ME). (Since QE and ME frequently occur together, we sum their impact.) We draw two conclusions from this exercise. First, in the United States and the euro area, forward guidance eases financial conditions by more than two-thirds of the distance from the 70ᵗʰ to the 50ᵗʰ percentile. Second, in some countries—Italy, Japan and the United Kingdom—the combination of QE and ME appears quite powerful.

Figure 8: Long-Run Impact of NMP tools on the First Domestic Financial Factor (DFCI1)

(Numbers in parentheses are the 70th percentile of DFCI1 for each country)

Notes: For the distribution of DFCI1 in each country, the figure plots the gap between the 50ᵗʰ and 70ᵗʰ percentiles as well as the gap between the 70ᵗʰ and 90ᵗʰ percentiles. It also shows estimates of the long-run impact on DFCI1 of implementing FGS as well as a combination of QE and ME. The number in parentheses below the name of each country is the 70ᵗʰ percentile of DFCI1 over the 1995 to 2019 sample. Source: Authors' calculations.

V.   Conclusion

Central banks have been ingenious in addressing the challenges posed by the ELB on nominal interest rates. Building on decades of research, they developed and refined a number of communications and balance sheet policies designed to provide further monetary accommodation when conventional policy tools are no longer available to stimulate the economy. Careful empirical research on the subject

generally concludes that these NMP tools do provide support to economic activity. This also appears to be one of the conclusions of the Federal Reserve's monetary policy framework review.[30]

We do not dispute these findings. Rather, we focus on the reduced-form effects of whether those policies effectively offset the headwinds buffeting advanced economies over the past decade. Our results counsel against complacency. In fewer than one-quarter of the cases in our sample were the NMP tools strong enough to ease financial conditions overall.

As mentioned earlier, one hangover from the pandemic is that long-term interest rates for the foreseeable future are likely to be very low. This will clearly limit the potential for old and new monetary policy tools to ease financial conditions and bolster economic outcomes. Fabo et al (2020) find that central banks analysis appears (on average) to be more optimistic about the efficacy of NMPs than external observers such as ourselves. The next downturn may provide a test of this optimism

In announcing its conclusion of its framework review, the Federal Reserve has been clear that policy accommodation is likely to remain in place for some time. However, they have been less clear in filling in the details of its reaction function going forward. Going forward, it is important that the FOMC provide a description of how new tools might be deployed in a future, conventional downturn. One of the points stressed by the 2016 USMPF report, "Language after liftoff," is that policy is most effective when financial market participants understand the Fed's reaction function and can re-price risk in anticipation of the Fed's actions.[31]

Our findings also suggest that such a plan should be prepared to deploy the new monetary policies early and aggressively when it is still feasible to stabilize prices and economic activity. The concerns—so prevalent a decade ago—that NMP tools would foster inflation risks—have proved unwarranted.[32] We view the limited success in easing financial conditions in the face of global headwinds as a justification for more activist policy, not less. It is even possible that more aggressive action would shorten the period of implementation of NMP tools, helping to limit financial stability risks.

The presence of global factors may limit the impact of policies implemented by an individual central bank. This means that economists and policymakers need to continue to address complementary policy

---

[30] See FOMC (2019).
[31] See Feroli et al (2017).
[32] See the October 2019 FOMC meeting minutes.

approaches for supporting economic activity and price stability when the next downturn hits. Monetary policy should not be the only game in town.

Finally, the results raise several questions for further consideration. Based on the evidence to date, no single tool stands out as being so powerful that it obviously should be deployed first. The experience with NMPs is so limited that we are not able to assess whether combined policies that involve simultaneous use of multiple tools (e.g. forward guidance and a balance sheet tool) would be most effective. Likewise, we are not able to assess how precisely identified monetary policy shocks feed into financial conditions and ultimately to the economy. Both steps in this transmission matter, especially since there could be financial stability risks that arise if the link to conditions is powerful, but transmission to the economy is less so. Perhaps the biggest takeaway from our analysis is that in the next recession, monetary policymakers should be humble about how much can be expected from NMP tools.

References

Bernanke, B. (2020). "The New Tools of Monetary Policy," American Economic Association Presidential Address, January.

Bernanke, B.S, M.T. Kiley, and J.M. Roberts (2019) "Monetary Policy Strategies for a Low-Rate Environment." Board of Governors of the Federal Reserve System Finance and Economics Discussion Series 2019-009.

Brainard, L., Federal Reserve Review of Monetary Policy, Strategy, Tools, and Communications: Some Preliminary Views, Speech at the Presentation of the 2019 William F. Butler Award, New York Association for Business Economics, November 26, 2019.

Brave, S.A. and D. Kelley, "Introducing the Chicago Fed's new adjusted National Financial Conditions Index," *Chicago Fed Letter*, Essays on Issues, Number 386, 2017.

Brayton, F., T. Laubach and D. Reifschneider, "The FRB/US Model: A Tool for Macroeconomic Policy Analysis," FEDS Notes, April 2014.

Cecchetti, S. G., M. Feroli, P. Hooper, A. Kashyap, and K. Schoenholtz (2017), Deflating Inflation Expectations: The Implications of Inflation's Simple Dynamics, U.S. Monetary Policy Forum.

Christensen, J.H.E. (2019). Yield Curve Responses to Introducing Negative Policy Rates," FRBSF Economic Letter, 2019-27, Federal Reserve Bank of San Francisco, October.

Chung, H. E. Gagnon, T. Nakata, M. Paustian, B. Schlusche, J. Trevino, D. Vilan, W. Zheng (2018). "Monetary Policy Options at the Effective Lower Bound: Assessing the Federal Reserve's Currency Policy Toolkit," Finance and Economics Discussion Series, 2019-003, Divisions of Research & Statistics and Monetary Affairs, Federal Reserve Board, Washington, D.C., January.

Committee on the Global Financial System (2019), "Unconventional monetary policy tools: a cross-country analysis," CGFS Papers No. 63, October.

Curcuru, S. E., S.B. Kamin, C. Li, and M. Del Giudice Rodriguez (2018), "International Spillovers of Monetary Policy: Conventional Policy vs. Quantitative Easing." Board of Governors of the Federal Reserve System International Finance Discussion Paper 1234.

De Fiore, F. and O. Tristani (2019). "(Un)conventional Policy and the Effective Lower Bound," BIS Working Papers no. 804, Bank for International Settlements, August.

Dell'Ariccia, G., P. Rabanal, D. Sandri (2018). "Unconventional Monetary Policies in the Euro Area, Japan, and the United Kingdom," *Journal of Economic Perspectives,* vol 32. No 4. Fall.

Eisenschmidt, J. and F. Smets (2019), "Negative Interest Rates: Lessons from the Euro Area," Central Banking, Analysis, and Economic Policies Book Series, in: A. Aguirre, M. Brunnermeier and D. Saravia (eds.), *Monetary Policy and Financial Stability: Transmission Mechanisms and Policy Implications*, Central Bank of Chile, p. 13-42.

Evans, C. L., J.D.M. Fisher, A. Justiniano, and J.R. Campbell (2012). "Macroeconomic Effects of FOMC Forward Guidance," *Brookings Papers on Economic Activity*, Spring.

Fabo B., Jancokova, M.,Kempf, E. and L. Pastor (2020). "Fifty Shades of QE: Conflicts of Interest in Economic Research", working paper University of Chicago.

Feroli, M. D. Greenlaw, P. Hooper, F.S. Mishkin, A. Sufi (2017). "Language After Liftoff: Fed Communication Away from the Zero Lower Bound," *Research in Economics*, vol 71.

Forbes, K. J. and R. Rigobon, (2002). "No contagion, only interdependence: measuring stock market comovements," *Journal of Finance*, Volume 57, no 5, October, p. 2223-61.

Goodfriend, M. and M. King (2015). Review of the Riksbank's Monetary Policy, Riksdagstrykeriet, Stockholm.

Goodhart, C. and J-C Rochet (2011). Evaluation of the Riksbank's Monetary Policy and Work with Financial Stability 2005-2010. Riksdagstrykeriet, Stockholm.

Greenlaw, D., J. Hamilton, E. Harris, and K. West, "A Skeptical View of the Impact of the Fed's Balance Sheet," U.S. Monetary Policy Forum, February 2018.

Hartmann, P. and F. Smets (2018). "The European Central Bank's Monetary Policy during Its First 20 Years," *Brookings Papers on Economic Activity,* Fall.

Hatzius, J., et al. (2019). "Fighting the Next Recession" US Economics Analyst Economic Research, Goldman Sachs, September.

Hatzius, J., P. Hooper, F.S. Mishkin, K.L Schoenholtz, M. W. Watson (2010). "Financial Conditions Indexes: A Fresh Look after the Financial Crisis," U.S. Monetary Policy Forum (Chicago: Chicago Booth Initiative on Global Markets.

Ito, T. "Japanese Monetary Policy: 1998-2005 and Beyond," in "Monetary policy in Asia: approaches and implementation," BIS papers no. 31, Bank for International Settlements, December 2006.

Kiley, M. (2019). "The Global Equilibrium Real Interest Rate: Concepts, Estimates, and Challenges." Board of Governors of the Federal Reserve System Finance and Economics Discussion Series 2019-076

Krishnamurthy, A., and A. Vissing-Jorgensen. 2011. "The Effects of Quantitative Easing on Interest Rates: Channels and Implications for Policy." *Brookings Papers on Economic Activity* 42 (Fall): 215–65.

Kuttner, K. (2018). "Outside the Box: Unconventional Monetary Policy in the Great Recession and Beyond," *Journal of Economic Perspectives,* vol 32. No.4, Fall.

Lombardi, D., P. Siklos, S. St. Amand (2018). "A Survey of the International Evidence and Lessons Learned About Unconventional Monetary Policies: Is A 'New Normal" in Our Future?," *Journal of Economic Surveys,* vol 32, no. 5.

Loretan, M. and W.B. English (2000), "Evaluation changes in correlations during periods of high market volatility," *BIS Quarterly Review*, June, pg. 29-36.

Miranda-Aggripino, S. and H. Rey, "U.S. Monetary Policy and the Global Financial Cycle", unpublished, 2019.

Miranda-Aggripino, S. and H. Rey, "The Global Financial Cycle After Lehman," forthcoming, *AEA Papers and Proceedings*, 2020.

Moessner, R., D-J. Jansen, J. de Haan (2015). Communication About Future Policy Rates in Theory and Practice: A Survey," DNB Working Paper 475, De Nederlandsche Bank, June.

Nakasone, H. (2017). "Evolving Monetary Policy – The Bank of Japan's Experience," Speech at the Central Banking Seminar, Federal Reserve Bank of New York, October.

Okina, K. and S. Shiratsuka (2004). "Policy Commitment and Expectation Formation: Japan's Experience Under Zero Interest Rates," *The North American Journal of Economics and Finance,* vol 15.

Ottanello, P and T. Winberry (2019). "Financial Heterogeneity and the Investment Channel of Monetary Policy" NBER Working Paper No. 24221.

Rossi, B. (2019). "Identifying and Estimating the Effects of Unconventional Monetary Policy: How to do it and what have we learned?" CEPR Discussion Paper DP14064, September.

Appendix A: Evaluating the Financial Conditions Indexes

There are two assumptions implicit in our evaluation of NMPs. The first is that the transmission of monetary policy to the economy is through financial conditions. The second is that our financial conditions indexes capture the relevant aspects of the financial system that matter for transmission. In this appendix, we investigate the plausibility of these assumptions.

We do so by exploring the relationship of the DFCIs with the policy rate, and by assessing their ability to forecast general economic activity and inflation. We proceed with three types of tests. First, we check whether monetary policy is mediated primarily through the DFCIs. Next, we ask whether conventional monetary policy moves our DFCIs. Finally, we see if the DFCIs forecast activity or inflation. (Recall that we normalize all FCIs, both global and domestic, such that an increase corresponds to a rise in stress.)

Starting with the first of these, we test whether lags of the policy rate influence activity or inflation, once we control for global and domestic financial conditions.[33] In the case of activity, we estimate the following simple relationship:

$$\Delta Y_{jt}^3 = \alpha_j + \beta_{jo}\Delta r_{jt}^3 + \sum_{k=4}^{9}\beta_{jk}\Delta r_{j,t-k}^3 + \sum_{k=4}^{9}\lambda_{jk}\Delta Y_{j,t-k}^3 + \sum_{k=4}^{9}\delta_{jk}^1 DFCI1_{j,t-k} + \sum_{k=4}^{9}\delta_{jk}^2 DFCI2_{j,t-k}$$

(A1)

$$+ \sum_{k=4}^{9}\theta_{jk}GFCI_{j,t-k} + \sum_{k=4}^{9}\phi_{jk}\Delta\pi_{j,t-k}^3 + v_{jt}$$

.

Since we measure activity and inflation as three-month changes, lags on activity, inflation and the financial conditions indexes are from 4 to 9. Furthermore, we use the three-month change in the policy rate. The test of our hypothesis—that lagged values of the policy rate changes have no incremental effects on activity and inflation—is that, except for β_0, the β's equal zero. We run this regression for both activity and inflation on the left-hand side, and for the two domestic financial conditions indexes separately and together.

---

[33] Since the regression in (3) includes the contemporaneous policy rate, we can think of it as part of a dynamic model in which policy has an immediate influence, but further effects are through financial conditions more generally. The structure is analogous to one of the equations in a vector autoregression with the policy rate shock ordered first.

Table A1 reports the results.[34] We shade in yellow the cases where we fail to reject the hypothesis that lagged policy rates do not influence activity. This corresponds to all cases where the p-values (in parentheses) exceed 0.10 for the joint F-test that the β's equal zero.

Table A1: Testing the independent impact of short-term policy rates on future activity and inflation						
Country	Activity			Inflation		
	DFCI1	DFCI2	Both	DFCI1	DFCI2	Both
United States	0.61 (0.72)	0.72 (0.64)	0.70 (0.65)	0.45 (0.84)	1.41 (0.21)	1.31 (0.25)
France	7.45** (0.00)	10.37** (0.00)	9.57** (0.00)	0.42 (0.87)	0.41 (0.87)	0.60 (0.73)
Germany	1.19 (0.31)	0.98 (0.44)	0.84 (0.54)	0.36 (0.90)	0.41 (0.87)	0.51 (0.80)
Italy	6.05** (0.00)	5.23** (0.00)	5.66** (0.00)	0.77 (0.59)	0.68 (0.66)	0.55 (0.77)
Japan	2.39** (0.03)	1.59 (0.15)	1.78 (0.10)	1.51 (0.17)	1.55 (0.16)	1.31 (0.25)
Sweden	0.98 (0.44)	3.42** (0.00)	0.60 (0.73)	8.82** (0.00)	11.27** (0.00)	8.11** (0.00)
Switzerland	1.40 (0.21)	1.99* (0.07)	1.82 (0.10)	0.12 (0.99)	0.22 (0.97)	0.15 (0.99)
United Kingdom	1.72 (0.12)	3.46** (0.00)	2.74** (0.01)	0.24 (0.96)	0.36 (0.91)	0.43 (0.86)

Notes: The table reports the F-statistic for the test that all lags of the policy rate are zero in the estimation of equation (3) over the sample from 1989:01 to 2019:04. P-values, based on robust standard errors, are in parentheses. A single star (*) is for test statistics with p-value between 5 and 10 percent, and two stars (**) is for cases where the p-value is less than 5 percent. Yellow denotes that the p-value exceeds 10 percent, so the hypothesis that the estimate is zero is not rejected. Source: Authors' calculation.

Starting with activity in the left panel of the table, the results are mixed. On the positive side: for Germany and the United States, after controlling for our DFCIs (which do not include the policy rate), we systematically fail to reject the hypothesis. In other words, for these countries, it appears that the DFCIs incorporate all the predictive information of the policy rates regarding future activity.

For the other countries, however, past interest rate changes have some predictive content even accounting for financial conditions. Where the p-values are less than 0.10, we can explicitly reject the null hypothesis that lagged policy rates are irrelevant for future activity. This is true in France and Italy; and to varying degrees, in Japan, Sweden, Switzerland, and the United Kingdom.

---

[34] We note that, results are nearly unchanged if we exclude the GFCI from the estimation.

Looking at inflation, except for Sweden, there is little or no evidence that policy rates matter, controlling for financial conditions. There are several reasons why policy rates could matter for activity or inflation even controlling for the information in our DFCIs. First, the FCIs may omit relevant financial channels through which policy is transmitted. We sought a consistent set of data over the full sample period for all countries: this standardization could mean that we have made an important omission. Second, given that most of the predictive power is for the activity measures—the Conference Board Coincident Index and industrial production—monetary policy may indirectly affect these measures through its influence on other variables. For instance, both activity measures could be sensitive to consumer spending that monetary policy influences in ways that our DFCIs do not fully capture. Third, the lag relationships between policy changes and financial conditions could be more complex than our regressions allow.

Turning to the second question, whether conventional policy influences the DFCIs, we restrict ourselves to the pre-crisis period (1989 to 2007) when the principal monetary policy tool in these countries was the policy interest rate (r). Accordingly, we estimate

$$\text{(A2) } DFCI1_{jt} = \varphi_j + \lambda_j DFCI1_{jt-1} + \rho_j GFCI_t + \sum_{i=0}^{6} \chi_i \Delta r_{jt-i} + \xi_{jt}$$

Equation (A2) includes both the current and six lags of the one-month change in the policy rate. Table A2 reports the results for the sum of the coefficients on the policy rate changes. In only 2 of 16 cases are interest rate increases associated with tighter financial conditions: namely, the United States and Sweden for DFCI1. By contrast, the results are perverse in one case for DFCI1 (Switzerland) and in three cases for DFCI2 (the United States, Germany, Switzerland and the U.K.).

Table A2: Examining the impact of the domestic policy rate on domestic financial conditions								
	First Domestic FCI				Second Domestic FCI			
Country	λ	ρ	$\sum_{i=0}^{6} \chi_i$	$\bar{R}^2$	λ	ρ	$\sum_{i=0}^{6} \chi_i$	$\bar{R}^2$
United States	0.34 (5.90)	0.22 (9.37)	1.21 (3.08)	0.60	0.74 (17.15)	0.05 (2.38)	-0.49 (-1.55)	0.63
France	0.55 (13.51)	0.19 (11.01)	-0.30 (-1.22)	0.77	0.39 (6.15)	0.20 (9.29)	-0.07 (-0.11)	0.49
Germany	0.48 (12.08)	0.25 (11.67)	0.03 (0.06)	0.77	0.33 (5.30)	0.16 (8.54)	-1.70 (-2.64)	0.40
Italy	0.63 (11.02)	0.13 (6.03)	-0.09 (-0.26)	0.60	0.22 (5.18)	0.24 (10.55)	-0.07 (-0.19)	0.64
Japan	0.28 (4.22)	0.20 (10.35)	0.20 (0.20)	0.48	0.8 (20.13)	-0.01 (-0.78)	0.81 (1.48)	0.70
Sweden	0.45 (9.14)	0.21 (11.73)	0.43 (3.53)	0.74	0.43 (7.24)	0.15 (7.93)	0.06 (0.92)	0.56
Switzerland	0.14 (2.92)	0.35 (15.27)	-0.70 (-1.51)	0.71	0.75 (16.80)	0.05 (3.74)	-1.01 (-3.40)	0.67
United Kingdom	0.30 (7.82)	0.25 (16.55)	0.11 (0.42)	0.79	0.07 (1.25)	0.13 (5.66)	0.63 (1.40)	0.31

Notes: Table reports the results of estimating equation (A2) over the sample from 1989:07 to 2007:06. T-ratios, based on robust standard errors, are in parentheses. Yellow denotes t-ratios equal to or greater than 2, orange is a t-ratio above 1.5. The red font indicates a coefficient with a t-ratio above 1.5 *and* a sign opposite to what we expect. Source: Authors' calculations.

The weak and perverse correlations in table A2 may reflect the same endogeneity problems we highlight in the main body of the paper. If central banks eased conditions during times of rising stress, that could depress these coefficients. We can remedy this problem by substituting well-identified monetary policy shocks in place of the simple change in the policy rate as the conventional monetary policy indicator.

For most of these countries, we do not have such a policy instrument. For the United States, we use the instrument constructed by Ottanello and Winberry (2019) to explore the impact of our conventional policy measure. When re-estimating equation (A2) with the Ottanello-Winberry policy shock, the coefficient sum for DCFI2 in table A2 switches signs and becomes insignificantly different from zero. The coefficient sum for DFCI1 is slightly lower compared to the one reported in the table, but the standard error falls slightly.[35]

---

[35] The sum of the coefficients on lags of the Ottanello and Winberry policy shock is +1.10 (t-ratio=1.80) for DFCI1 and +0.08 (t-ratio=0.20) for DFCI2.

Finally, we examine whether our domestic financial conditions indexes forecast activity or inflation. For this purpose, we estimate a simplified version of equation (A1):

$$\text{(A3) } \Delta Y_{jt}^3 = \alpha_j + \sum_{k=4}^{9} \lambda_{jk} \Delta Y_{j,t-k}^3 + \sum_{k=4}^{9} \delta_{jk}^1 DFCI1_{j,t-k} + \sum_{k=4}^{9} \delta_{jk}^2 DFCI2_{j,t-k} + \sum_{k=4}^{9} \theta_{jk} GFCI_{j,t-k} + v_{jt}$$

That is, using monthly data from 1989 to 2019, we examine the relationship of three-month changes in activity with its own lags, lags of domestic financial conditions, and lags of the global financial condition indicator. As before, the monthly lags are from 4 to 9. Table A3 reports the results of this exercise.

The results again differ across countries. For activity, domestic financial conditions have the expected effect in most countries, with only a few perverse signs. In the case of inflation, however, the evidence is far weaker as tighter conditions lower inflation in only three cases.

Table A3: The impact of domestic financial conditions on activity and inflation								
	Activity				Inflation			
Country	One DFCI		Both DFCI's		One DFCI		Both DFCI's	
	DFCI1	DFCI2	DFCI1	DFCI2	DFCI1	DFCI2	DFCI1	DFCI2
United States	-0.11 (-1.54)	0.10 (2.31)	-0.06 (-0.77)	0.10 (1.88)	0.06 (1.01)	-0.04 (-1.04)	0.02 (0.30)	-0.03 (-0.60)
France	0.05 (1.10)	-0.14 (-2.65)	-0.11 (-1.50)	-0.24 (-2.98)	-0.13 (-2.39)	0.22 (3.67)	0.01 (0.20)	0.23 (2.76)
Germany	-0.27 (-3.33)	0.12 (1.47)	-0.36 (-3.22)	-0.09 (-0.85)	0.01 (0.16)	0.03 (0.41)	0.06 (0.58)	0.07 (0.70)
Italy	-0.01 (-0.32)	0.07 (1.06)	0.07 (0.99)	0.16 (1.46)	-0.03 (-0.82)	0.08 (1.48)	0.02 (0.30)	0.08 (0.92)
Japan	-0.10 (-1.06)	0.14 (2.83)	-0.18 (-1.85)	0.15 (3.08)	0.16 (1.65)	0.15 (3.62)	0.12 (1.16)	0.14 (3.20)
Sweden	-0.36 (-4.12)	0.04 (0.52)	-0.41 (-4.30)	-0.11 (-1.33)	-0.16 (-2.19)	0.19 (2.96)	-0.09 (-1.13)	0.14 (2.01)
Switzerland	-0.26 (-2.90)	0.04 (0.77)	-0.31 (-3.28)	-0.02 (-0.45)	-0.31 (-2.94)	0.01 (0.27)	-0.36 (-3.00)	-0.06 (-1.12)
United Kingdom	-0.14 (-1.62)	0.02 (0.17)	-0.18 (-2.05)	-0.09 (-0.70)	-0.01 (-0.13)	-0.09 (-1.21)	-0.07 (-0.67)	-0.12 (-1.55)
Notes: The table reports sums of the coefficient estimates for the DFCIs on activity or inflation, with robust t-ratios, estimated over the sample from 1989:01 to 2019:04. Yellow denotes t-ratios equal to or greater than 2, orange is a t-ratio above 1.5. Red font indicates a wrong sign with a t-ratio above 1.5. Source: Authors' calculations.								

Summarizing these results for the United States, our proposed view of policy transmission is partially borne out. In particular, prior to the crisis, it appears that the primary channel for transmitting monetary policy was through financial conditions. As hypothesized, policy rate changes have little predictive

power once we account for domestic (and global) financial conditions (table A1). Moreover, policy rate changes alter DCFI1 in the expected direction (higher rates are associated with tighter conditions; table A2) and DCFI1 helps forecast activity (table A3).

In Germany, too, policy transmission runs principally through domestic financial conditions. In Sweden and Switzerland, transmission appears to run through DFCI1, the domestic factor most related to the global factor. However, in the other countries, the first step in our reasoning fails because policy rates still have some predictive power for activity, even accounting for our domestic financial conditions indexes.

Appendix B: Data Sources

This appendix describes all of the data we use, including sources and transformations.

1. Raw Data

A. Equity Prices:
All data are the daily closing price indexes:
- France: CAC40 (Source: Global Financial Database _FCHID)
- Germany: DAX (Source: Global Financial Database _GDAXIPD)
- Italy: MIB (Source: Global Financial Database _BCIJD)
- Japan: TOPIX (Source: Global Financial Database _TOPXD)
- Sweden: OMX (Source: Global Financial Database _OMXS30D)
- Switzerland: Switzerland Price Index (Source: Global Financial Database _SSMID)
- United Kingdom: FTSE All-Shares (Source: Global Financial Database _FTASD)
- United States: Wilshire 5000 (Source: FRED WILL5000IND)

B. Equity Volatility:
With the exception of the United States, all data are monthly standard deviations of daily returns computed from the equity price data above. For the United States, the data are the S&P 100 volatility index from FRED (VXOCLS).

C. Three-month interbank rate:
Data are monthly averages of daily data.
- France: OECD Main Economic Indicators (Source: FRED IR3TIB01FRM156N)
- Germany: OECD Main Economic Indicators (Source: FRED IR3TIB01DEM156N)
- Italy: OECD Main Economic Indicators (Source: FRED IR3TIB01ITM156N)
- Japan:
  - 1988 to 2001: Yen LIBOR (Source: FRED JPY3MTD156N)
  - 2002 to 2019: OECD Main Economic Indicators three-month interbank rates (Source: FRED IR3TIB01JPM156N)
- Sweden: OECD Main Economic Indicators (Source: FRED IR3TIB01SEM156N)
- Switzerland: OECD Main Economic Indicators (Source: FRED IR3TIB01CHM156N)

- United Kingdom: OECD Main Economic Indicators (Source: FRED IR3TIB01GBM156N)
- United States: Three-month LIBOR (Source: FRED: USD3MTD156N)

D. Three-month sovereign (Treasury Bill) rate:
   Data are monthly averages of daily data.
   - France: three-month Treasury Bill (Source Global Financial Database ITFRA3D)
   - Germany: three-month Treasury Bill (Source Global Financial Database ITDEU3D)
   - Italy: three-month Treasury Bill (Source Global Financial Database ITITA3D)
   - Japan: three-month Treasury Bill (Source Global Financial Database ITJPN3D)
   - Sweden: three-month Treasury Bill (Source Global Financial Database ITSWE3D)
   - Switzerland: three-month Treasury Bill (Source Global Financial Database ITCHE3D)
   - United Kingdom: three-month Treasury Bill (Source Global Financial Database ITGBR3D)
   - United States: three-month Treasury Bill (Source: FRED DTB3)

E. Long-term sovereign rate (approximately 10 year):
   - France: Long-term government bond from the OECD (Source: FRED IRLTLT01FRM156N)
   - Germany: Long-term government bond from the OECD (Source: FRED IRLTLT01DEM156N)
   - Italy:
     - 1988 to 1991M2: 10-year government bond yield (Source: Global Financial Data Base IGITA10D)
     - 1991M3 to 2019: Long-term government bond from the OECD (Source: FRED IRLTLT01ITM156N)
   - Japan: Long-term government bond from the OECD (Source: FRED IRLTLT01JPM156N)
   - Sweden: Long-term government bond from the OECD (Source: FRED IRLTLT01SEM156N)
   - Switzerland: 10-year Swiss Confederation Bond (Source: Swiss National Bank database CHF_10YEAR)
   - United Kingdom: Long-term government bond from the OECD (Source: FRED IRLTLT01GBM156N)
   - United States: 10-year constant maturity Treasury yield (Source: FRED DGS10)

F. Credit spreads:
- United States: Spread between the U.S. Baa corporate yield and the 10-year Treasury constant maturity yield (Source: FRED BAA10YM)
- From 1996 to 2019: Data are monthly averages of daily closing data on the ICE option-adjusted spread for the euro area, Japan, the United Kingdom, and the United States. For all European countries—France, Germany, Italy, Sweden and Switzerland—we use euro area data.
- Prior to 1996:
  - o For the United Kingdom and Europe, data are from the fitted value of the regression of the various spreads on the U.S. corporate yield spread above for the period from December 1996 to December 2006. These fitted values are extrapolated back to 1988.
  - o For Japan, data are the difference between the corporate bond yield and the three-month Japanese sovereign yield (Source: Bank of Japan).

G. Quantity of credit or loans:
With the exception of the United States, all data are a monthly interpolated version of the quarterly BIS total credit to the nonfinancial sector measured in local currency (see here). For the United States, we start with data for Federal Reserve H.8 Loans and Leases in bank credit (Source: FRED H8B1020NCBCMG). We adjust the April 2010 data point to account for a change in the categorization of consumer credit card lending by setting that data point to the mean growth rate in the rest of the data.

H. Nominal Exchange Rate:
All data are monthly narrow nominal effective exchanges from the BIS (see here).

I. Policy rates:
All data are monthly from the BIS (see here). For France, Italy and Germany after 1999, the policy rate is the common euro area rate. Beginning with the ECB's full allotment policy in October 2008, we substituted the standing facility rate for the main refinancing rate (see here).

J. Monetary base:
- France, Germany and Italy:
  - o From 1999 to 2019: Total ECB assets (Source: FRED ECBASSETS)
  - o Prior to 1999, we use the average growth rate from 1999 to 2019.
- Japan: Monetary Base (Source: Bank of Japan, see here)
- Sweden: Monetary Base (Source: Riksbank)
- Switzerland: Monetary Base (Source: Swiss National Bank, see here.)
- United Kingdom: Bank of England monetary base, spliced in May 2006. (Source: Bank of England, also available from FRED MBM0UKM)
- United States: FRB St. Louis adjusted monetary base (Source: FRED AMBSL)

K. Nominal GDP:
    For the United States, monthly nominal GDP data: 1988 to 1991 from Stock and Watson, 1992
    to 2019 from Macroeconomic Advisors. For the remainder of the countries, use linear
    interpolation to construct monthly data of quarterly nominal GDP from the OECD.

L. Consumer prices:
    Consumer price index from the OECD Main Economic Indicators (seasonally adjusted using the
    ARIMA X13 procedure in EViews), with the exception of the United States, which is the personal
    consumption expenditure price index excluding food and energy (FRED PCEPILFE). For the
    remainder of the countries, the data are from FRED and the codes are:
    • France: FRACPIALLMINMEI
    • Germany: DEUCPIALLMINMEI
    • Italy: ITACPIALLMINMEI
    • Japan: JPNCPIALLMINMEI
    • Sweden: SWECPIALLMINMEI
    • Switzerland: CHECPIALLMINMEI
    • United Kingdom: GBRCPIALLMINMEI

M. Economic Activity:
    a. Conference Board Coincident Index
    b. Industrial Production. Source is OECD Main Economic Indicator from FRED. Codes are:
        • France: FRAPROINDMISMEI
        • Germany: DEUPROINDMISMEI
        • Italy: ITAPROINDMISMEI
        • Japan: JPNPROINDMISMEI
        • Sweden: SWEPROINDMISMEI
        • Switzerland: CHEPROINDQISMEI (linearly interpolated from quarterly data)
        • United Kingdom: GBRPROINDMISMEI
        • United States: USAPROINDMISMEI

All data begin in January 1988 and end in April 2019, except for Swiss industrial production, which ends
in October 2018.

2. Transformed Data

Prior to analysis, we transform the data as follows (the letters in parentheses correspond to the sections of appendix B part 1 above):

- Equity: one-month log difference (A)
- Equity volatility: used as is (B)
- Interbank spread: Interbank rate minus the three-month sovereign (C-D)
- Yield curve slope: Long-term government bond minus three-month sovereign (E-D).
- Sovereign spread: for France, Italy, Sweden and Switzerland, we compute the difference between the 10-year sovereign rate and the German 10-year rate (both from E).
- Credit spread: used as is (F)
- Credit quantity/loans: one-month log difference (G)
- Exchange rate: one-month log difference (H)
- Policy rate: one-month or three-month difference (I)
- Monetary base: the three-month change in the ratio of the monetary base to nominal GDP (J divided by K)
- Inflation: three-month log difference of the price index (L)
- Activity: three-month log difference of either the coincident index or industrial production (M)

Appendix C: Measuring new policy tools

We wish to measure the impact of forward guidance, balance sheet policies, and the use of negative interest rates on financial conditions. To do this, we construct monthly indicators since 1989 that measure each of these new monetary policies (a file with the monthly indicator values is available on the same site with this paper). We base our measures on central bank source materials, ranging from minutes (FOMC) to press conferences (ECB) to monthly reports and speeches (BoE), as well as compilations by other researchers listed at the end of the appendix. While we seek to apply common classification standards across countries and time, in some cases, subjective judgments are unavoidable.

Starting with forward guidance, we distinguish conditional forecasts of the future-policy-rate path (Delphic guidance) from policy commitments that can be date- or state-contingent (Odyssean guidance). While Delphic guidance can be very useful in clarifying the central bank's reaction function, it is unlikely to be used differently as a policy tool in cyclical expansions and recessions. Instead, we focus on Odyssean guidance, typically at the effective lower bound for the policy rate. The idea is that a commitment to keep rates "low for longer" can influence expected future short-term rates, term premia and the discount rate that affects long-term asset prices more generally.

With the exception of the monetary base, our indicator variables are binary (zero or plus one) or trinary (minus one, zero, or plus one).

Our dummy variable for date-based forward guidance (FGD) takes on the value +1 when the source material indicates a time-based commitment, and zero otherwise. In the United States, an FGD value of +1 could reflect vague time indicators (e.g. "considerable period" or "measured pace") as well as specific date commitments ("at least until mid-2013"). Similarly, in the United Kingdom, the examples range from imprecise indicators ("for some time to come") to fairly specific ones ("over the summer"). The key is that there is a clear time dimension.

The indicator of state-based forward guidance (FGS) reflects a conditional commitment to keep rates "low for longer" at least until specific economic and financial conditions are satisfied. For example, in December 2012 in the United States, the FOMC expressed the view that a low target range for the policy rate would be: "appropriate at least as long as the unemployment rate remains above 6½ percent, inflation between one and two years ahead is projected to be no more than a half percentage point above the Committee's 2 percent longer-run goal, and long-term inflation expectations continue to be well-anchored." So long as such conditional commitments remain in place (based on repeated confirmation in minutes, reports or speeches), we code FGS each month as +1. Otherwise, it is 0.

Turning to balance sheet measures, we produced dummy variables for both size and mix. Starting with balance sheet size, our measure of quantitative easing (QE) corresponds to the *announcement* of periods when the central bank *exogenously* supplies reserves *beyond* the level needed to reach the target policy rate (typically close to the effective lower bound). QE takes on the value +1 *at the start* of these periods, and the value −1 when the central bank *begins* to shrink reserve supply exogenously. Otherwise, it is zero. We do <u>not</u> code balance sheet changes that represent *endogenous* responses to changes in reserve demand—such as the ECB's long-term refinancing operations with full allotment.

Because our QE measure is binary and records only the start of exogenous shifts in reserve supply, we also include in our metrics of balance sheet size a *continuous* indicator—namely, the three-month change of the monetary base (M0, scaled by nominal GDP for each country). For the euro area economies, we substitute the assets of the ECB for the monetary base. For the countries other than the United States, where *monthly* nominal GDP is unavailable, we scale using a linear interpolation of *quarterly* GDP.

To reflect policy changes regarding the balance sheet mix, we created two additional dummy variables, one for maturity extension (ME) and one for credit and liquidity easing (CE). By extending the maturity

of its government instrument portfolio, the central bank can shorten the average duration of assets available to the private sector. A desirable continuous metric for assessing the impact on financial conditions of this shift would be a duration-weighted measure of the central bank's bond portfolio. Lacking such a continuous measure on a monthly basis, we created a trinary measure (ME). We coded ME as +1 whenever the central bank announces the acquisition of bonds (which are assumed to be of longer duration than the portfolio) and −1 when the central bank announces that it will allow bonds to mature without replacement. Otherwise, it is set to zero.

A central bank also can affect credit and liquidity conditions by shifting the mix of its portfolio toward assets that are some combination of less liquid and less creditworthy. Accordingly, we created a trinary measure for credit and liquidity easing (CE) and coded it as +1 (−1) whenever the central bank announced the addition to (removal from) its portfolio of instruments that were either less liquid or creditworthy (or both) than central government liabilities. Otherwise, it is set to zero. Examples of less liquid or creditworthy assets range from mortgage-backed securities in the United States to equities in Japan. In practice, positive instances of CE frequently corresponded to periods of major financial disruption that prompted the central bank to substitute for dysfunctional private intermediation. Probably as a result, we found that CE often exhibited a *positive* correlation with tight financial conditions, consistent with reverse causality. Accordingly, we have excluded CE from the central findings reported in the paper. It would be wrong to conclude that credit and liquidity easing is ineffective as a tool for improving financial conditions in a period of systemic dysfunction, but that is not the policy goal on which this report focuses.

Finally, for those central banks that have set policy rates below zero, we constructed a "negative rate" binary indicator (NR) that takes on the value +1 whenever the policy rate is negative (and zero otherwise). While changes in the policy rate are included in our tests of new monetary policy tools, the purpose of including NR is to detect whether setting rates below the zero threshold has an independent impact on financial conditions. For example, allowing for negative policy rates might also lower expected future term premia.

In the process of constructing our measures of new monetary policy tools, we referred to the following work:

France, Germany, Italy (euro area): Moessner et al. (2015), Dell'Ariccia et al (2018), Hartmann and
        Smets (2018), Lombardi et al (2018);

Japan: Okina and Shiratsuka (2004), Ito (2006), Moessner et al. (2015), Nakaso (2017), Dell'Ariccia et al
        (2018), Lombardi et al (2018);

Sweden: Goodhart and Rochet (2011), Goodfriend and King (2015), Lombardi et al (2018);

Switzerland: Lombardi et al (2018);

United Kingdom: Moessner et al. (2015), Lombardi et al (2018);

United States: Moessner et al. (2015), Dell'Ariccia et al (2018), Kuttner (2018), Lombardi et al (2018).

Appendix D: Financial Conditions Index Factor Loadings

This appendix reports the factor loadings for the construction of the global financial conditions index and the domestic financial conditions indexes using the procedure described in text section II.

Table A4: Global Financial Conditions Index, Loadings on all Financial Variables									
	FR	**DE**	**IT**	**JP**	**SW**	**CH**	**UK**	**US**	**Sum**
Interbank Spread	0.12	0.05	0.03	0.01	0.08	-0.03	0.08	0.11	0.45
Yield Curve Slope	0.02	-0.02	0.00	-0.03	-0.02	-0.02	-0.03	0.00	-0.09
Equity	-0.23	-0.24	-0.21	-0.21	-0.22	-0.24	-0.23	-0.24	-1.81
Equity Volatility	0.26	0.24	0.22	0.19	0.23	0.25	0.27	0.22	1.88
Credit Spread	0.13*	0.13*	0.13*	0.07	0.13*	0.13*	0.13	0.12	0.31
Lending/Credit	0.01	-0.02	0.03	0.01	0.04	-0.01	-0.01	0.01	0.07
Exchange Rate	0.03	0.03	-0.01	0.12	-0.06	0.09	-0.05	0.01	0.16
Sovereign	0.01		-0.05		-0.04	0.01			-0.07
SUM	0.22	0.05	0.01	0.17	0.02	0.06	0.16	0.22	
Notes: The credit spread variable is the same for all continental European countries, so the loadings are denoted with an asterisk (*). The sum reported in that line of the table is for the four independent values. Source: Authors' calculations.									

Table A5: Domestic Financial Conditions Indices, loadings on domestic financial variables								
First Domestic Financial Conditions Index (DFCI1) Loadings								
	FR	**DE**	**IT**	**JP**	**SW**	**CH**	**UK**	**US**
Interbank Spread	0.53	0.33	-0.49	0.06	0.44	-0.17	0.35	0.45
Yield Curve Slope	0.33	-0.15	0.34	-0.11	-0.12	-0.04	-0.01	-0.20
Equity Index	-0.34	-0.50	-0.40	-0.61	-0.41	-0.59	-0.47	-0.56
Equity volatility	0.47	0.55	0.42	0.58	0.54	0.54	0.62	0.53
Credit Spread	0.52	0.52	0.41	0.18	0.49	0.37	0.48	0.16
Loans/Credit	0.06	-0.18	-0.22	0.00	0.05	-0.12	-0.08	0.23
Exchange Rate	-0.02	0.11	-0.15	0.50	-0.18	0.41	-0.18	0.29
Sovereign Spread	0.02		0.25		-0.22	0.11		
DFCI1 Summary Statistics								
Share of Variance (%)	32.7%	32.8%	25.3%	29.4%	29.2%	30.7%	34.0%	31.5%
Second Domestic Financial Conditions Index (DFCI2) Loadings								
	FR	**DE**	**IT**	**JP**	**SW**	**CH**	**UK**	**US**
Interbank Spread	-0.26	-0.15	0.44	0.43	-0.55	0.24	-0.22	-0.34
Yield Curve Slope	-0.32	0.10	-0.29	-0.61	-0.31	0.43	-0.13	0.72
Equity Index	-0.52	-0.37	-0.53	0.15	-0.60	-0.10	-0.54	-0.37
Equity volatility	0.29	0.19	0.47	-0.04	0.24	0.16	0.11	0.04
Credit Spread	-0.09	-0.41	0.07	0.51	-0.34	-0.54	-0.20	0.19
Loans/Credit	-0.21	0.45	0.33	0.39	-0.02	-0.39	0.26	-0.26
Exchange Rate	0.65	0.66	-0.13	-0.14	-0.20	0.27	0.73	0.35
Sovereign Spread	0.02		-0.29		0.17	-0.46		
DFCI2 Summary Statistics								
Share of Variance (%)	19.7%	18.5%	21.7%	21.6%	16.2%	16.6%	18.7%	18.8%

Notes: Table reports the loadings on the financial variables for the first two principal components that we use to construct DFCI1 and DFCI2. We also report the share of the variance in the financial variables explained by each of the principal components, and their correlation with the global financial conditions index (GFCI). Source: Authors' calculations.