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The Impact of Monetary Policy and Information Shocks on Financial Stability: Evidence from the U.S. and Europe

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Abstract

This study investigates the impact of *monetary policy shocks* and *information shocks* on financial stability using U.S. and Europe financial stress indexes as proxies. Results from Jordà's local projections show that *information shocks* consistently improve financial stability, while the effects of *monetary policy shocks* vary across indexes in timing and direction. The findings indicate that the composition of indexes plays a crucial role in shaping divergent responses. A preliminary components analysis suggests that indexes that give higher weight to leverage could display either a weaker long-term tightening or even a loosening of financial conditions in response to a *monetary policy shock*. Furthermore, the study reveals differences between the U.S. and Europe in the timing and direction of the response of financial stability to *monetary policy shocks*. Finally, it suggests that U.S. monetary policy does spill over to financial stability in Europe but shows no significant distinction in the response between *information shocks* and *monetary policy shocks*. These findings enhance our understanding of how monetary policy interacts with financial vulnerability, providing valuable insights for developing monetary policy frameworks that consider financial stability.

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1. Introduction

1.1 Background and Motivation

The strong growth in financial markets and financial fragility since the global financial crisis has triggered renewed interest in the interactions between monetary policy and financial vulnerability.

During the global financial crisis, aggressive monetary policy easing was introduced in advanced economies not only to protect economic activity but also to stabilize their financial systems. Such a move was a first since financial stability has historically been addressed by macroprudential policy, not monetary policy. However, the crisis aftermath urged the introduction of a monetary policy framework that explicitly recognizes that financial stability should feed into the monetary policy mandate. While the literature has yet to converge on a modeling framework that comprehensively captures inflation, output, and financial stability objectives in a realistic and empirically significant manner, it is in the process of attentively studying the relationship between the three.

More recently, the Covid-19 pandemic put world economies under stress and prompted expansionary monetary policy measures to contain the steep reduction in economic activity. Central banks then faced the challenge of gradually unwinding the extraordinary monetary stimulus deployed during the pandemic but were faced with unexpectedly high inflation. Aggressive rate hikes were introduced to tame inflationary pressure, raising questions on the potential disruption of economic recovery, risks of recession, and financial stability. In March 2023, 3 regional U.S. banks failed amid turbulence in the market. Shortly after, Swiss SIFI Credit Suisse was acquired by rival UBS in a government-brokered deal aimed at preventing the collapse of the Swiss giant and haltering a banking crisis. While it is too soon to study a possible relationship between such an instance of monetary tightening and financial institutions' stability, this event reminds us of the importance of exploring the interactions between monetary policy and financial vulnerability.

As a result of these developments, several recent studies have been addressing the question of whether monetary policy should respond to financial stability concerns. Among them, we find Adrian and Duarte (2018), Adrian and Liang (2016), and Borio and Zhu (2012). However, to address this question, it is essential to determine whether monetary policy affects financial stability at all. Saldías (2017), among others, answers the latter question by testing the impact of monetary policy shocks on the Average distance-to-default (ADD), a financial stability index. He finds that monetary policy shocks are effective in easing tight financial conditions but are only partially capable of containing the buildup of vulnerabilities. Jarocinski and Karadi (2020) also contribute to the argument by better defining monetary policy surprises. They contend that when central banks release announcements, they not only convey information about monetary policy but also about their outlook on the economy. These two types of information translate into shocks with intuitive and very different effects. Thus, they disentangle monetary policy surprises into *monetary policy shocks* and *information shocks* and conclude that the two have opposite effects on financial vulnerability proxied by the excess bond spread.

1.2 Research Questions and Contributions

Given the growing popularity of financial stress indexes as proxies for financial stability and recent findings on the information effect, this study combines these two aspects by examining the impact of *monetary policy shocks* and *information shocks* on various financial stability indexes. In particular, it addresses four questions:

- Do *monetary policy shocks* and *information shocks* have different impacts on financial stability proxied by financial stress indexes?
- Do they have the same impact on each financial stress index?
- Do they have similar impacts on financial stability in the U.S. and Europe?
- Do they spill over between the U.S. and Europe?

The first contribution of this study is that it considers the deconstruction of monetary policy surprises in *monetary policy shocks* and *information shocks* to examine the direct relationship between monetary policy and financial stability. While so far literature such as Gertler and Karadi (2015), Nakamura and Steinsson (2018), and Jarocinski and Karadi (2020) has mainly focused on the relevance of the information effect to assess the impact of monetary policy on real activity, this paper focuses on financial stability instead.

Another contribution of this study is that it examines the relationship between monetary policy and financial stability using several differently constructed financial stability indexes. While literature testing this relationship has often defined financial stability in terms of changes in share prices, interest rate spreads, nominal effective exchange rate, house price inflation, and bank deposit–loan ratio, it has only recently started using measures of overall distress in financial markets, such as financial stress indexes, as proxies for financial stability. More specifically, no literature tests the effects of *monetary policy shocks* and *information shocks* on composite financial stress indexes. This study exploits 4 financial stress indexes for the U.S. and 2 for Europe.

This study also contributes to the literature by testing the impact of *monetary policy surprises* on European financial stability. Literature to date has explored the question using U.S. data (Saldías (2017) also for Australia, Canada, and the U.K.), but less so for Europe. Jarocinski and Karadi (2020) have partly explored this question, but only on a European-Union-as-a-whole level. This study tests the impact of Eurozone *monetary policy surprises* on both country-level and Europe-as-a-whole financial stability. Additionally, it investigates the potential spillover effects of U.S. and Eurozone monetary policy on the financial stability of the two areas, focusing on determining whether *monetary policy shocks* and *information shocks* have distinct spillover effects.

Finally, this study contributes to the literature by considering potential non-linearities. Traditionally, this relationship has either been represented through Vector Autoregressive (VAR) models, ignoring possible non-linearities, or through non-linear Threshold Vector Autoregressive (TVAR) models and Markov-switching Vector Autoregressive (MS-VAR) models using a financial conditions variable as the transition variable. This study, instead, uses the highly non-linear Jorda's local projection method. Because this model is more robust to misspecification than standard methods, it can be useful as a heuristic check.

1.3 Results

The analysis conducted through Jordà's local projections contributes to a better understanding of the relationship between *monetary policy shocks*, *information shocks*, and financial stability as proxied by financial stress indexes in the U.S. and Europe. The key results are summarized below.

Firstly, both *monetary policy shocks* and *information shocks* have notable yet very different effects on financial stability. Specifically, *information shocks* consistently improve financial stability as measured by composite indexes, indicating positive impacts of central bank communication on stability. Conversely, the effects of *monetary policy shocks* are more nuanced, with different financial stress indexes responding differently in terms of timing and direction. After ruling out noise as the sole explanatory factor for such discrepancies across indexes, data on the decomposition of the National Financial Conditions Index (NFCI) and Adjusted National Financial Conditions Index (ANFCI) suggests that the composition of the indexes is likely a significant driver of the different impacts of *monetary policy shocks* on financial stability.

Furthermore, the study finds differences in the impact of *monetary policy shocks* and *information shocks* on financial stability between the U.S. and Europe. In Europe, *information shocks* have a delayed and prolonged impact on financial stability compared to the U.S., reflecting differences in central bank communication policies. Moreover, the impact of *monetary policy shocks* on financial stability exhibits distinct patterns in the U.S. and Europe, with financial stability consistently improving on impact in Europe but displaying more diverse responses in the U.S., depending on the index and its composition.

Regarding the spillover of U.S. monetary policy to Europe, the analysis indicates that U.S. monetary policy surprises influence European financial stability. However, in contrast with what was detected in same-country analyses, U.S. *monetary policy shocks* and *information shocks* impact European financial stability in the same way.

1.4 Outline

The rest of the study is organized as follows. Chapter II situates this study in the literature that links monetary policy to financial stability. Chapter III describes Jorda's local projections econometric model and the data used to perform the empirical study. Chapter IV discusses the results, and Chapter V concludes.

2. Literature Review

As noted, instances of financial fragility since the global financial crisis have triggered renewed interest in whether monetary policy has any effects on financial stability. Moreover, they prompted consideration on whether and how financial stability should be considered when designing a new monetary policy framework.

These questions prompted a clustering of literature in two macro groups: one that evaluates the potential implementation of financial stability objectives among the traditional monetary policy objectives and one that tests the direct relationship between monetary policy and financial stability. While this paper mainly adds to the literature of the latter group, many intuitions behind this relationship are rooted in the former group.

At the core of both groups, however, lies the correct identification of monetary policy shocks.

The literature review is organized as follows. The first section addresses the identification of monetary policy proxies. The second section analyzes the tension between monetary policy and macroprudential policies. The third section concludes and explores the direct relationship between monetary policy and financial stability.

2.1 Monetary Policy Proxies

This study shares the approach of literature that identifies monetary policy shocks through sign restrictions. In particular, it builds on Gertler and Karadi (2015), Nakamura and Steinsson (2018), and Jarocinski and Karadi (2020). In their work, they contend that when central banks release announcements, they not only convey information about monetary policy but also about their outlook on the economy. These two types of information translate into shocks with intuitive and very different effects. Thus, Jarocinski and Karadi (2020) disentangle monetary policy surprises into *monetary policy shocks* and *information shocks* through sign restrictions. In particular, they analyze the high-frequency co-movement of interest rates and stock prices in a narrow window around the policy announcement. They identify *monetary policy shocks* through a negative high-frequency co-movement between interest rate and stock price changes and *information shocks* through a positive co-movement. The main idea is that *monetary policy shocks* lower stock market valuation (higher discount rate due to higher interest rates, lower expected payoffs due to deteriorating outlook caused by policy tightening), while *information shocks* do the opposite. When markets interpret the tightening as a positive outlook of the central bank on the economy, they react positively.

2.2 Monetary Policy and Macroprudential Policies

Bernanke et al. (1999) were early contributors to studying the relationship between monetary and macroprudential policies. They propose a flexible approach that considers asset prices only if they affect the inflation-activity trade-off. Shortly after, Borio and Lowe (2002) emphasize the need to reevaluate the interaction between monetary policy and financial stability in response to the successful and consistent attainment of low inflation targets. Borio (2006) calls this the "paradox of credibility," where signs of unsustainable economic expansion are more likely to manifest as excessive credit and asset price increases rather than rising inflation. This paradox supports the notion of separating responsibilities, with monetary policy focusing on inflation and unemployment, while macroprudential policy addresses financial vulnerabilities.

Following the financial crisis, literature began incorporating financial stability into monetary policy models. Woodford (2010) proposes a Keynesian model incorporating financial intermediary frictions, while Woodford (2011) finds that financial crises should be explicitly taken into consideration when building inflation-targeting rules. Borio and Zhu (2012) suggest that developments in the financial sector and prudential regulation may have enhanced the risk-taking channel's prominence and argue that current macroeconomic frameworks cannot capture it. Gambacorta and Signoretti (2014) discover that monetary policy rules that respond to borrower balance sheets and loan supply in the event of supply shocks improve inflation and production stabilization even when financial stability is not an explicit objective. Kiley and Sim (2017) discover that monetary policy reacting to financial imbalances may not improve welfare. The response depends on the shock's source, which policymakers could struggle to identify on impact. Adrian and Duarte (2018) argue that optimal monetary policy always depends on financial vulnerabilities along with traditional variables.

In conclusion, there is a growing body of literature exploring whether and how monetary policy should take financial stability into consideration. On the one hand, the presence of financial frictions can lead to the buildup of vulnerabilities if left unaddressed. On the other, there are costs to using monetary policy for financial stability, such as inflation bias, moral hazard, and welfare reductions.

2.3 Monetary Policy and Financial Stability

A number of studies have tackled the relationship between monetary policy and financial vulnerability by focusing on the banking sector.

Angeloni et al. (2015) assess the effect of monetary policy on bank risk to test the existence of a risk-taking channel. They use a VAR model to document that monetary expansions induce banks to take up more risk. Jiménez et al. (2014) discover that a lower overnight interest rate drives poorly capitalized banks to approve more loan applications to ex-ante risky enterprises and to commit higher loan volumes with fewer collateral requirements. Ciccarelli et al. (2015) discover that a monetary policy shock on GDP and prices is amplified through the credit channel via the balance sheets of consumers, companies, and banks. Buch et al. (2014) distinguish responses to monetary policy shocks across different types of banks and loan risk categories. They find that small domestic banks increase their exposure to risk following an expansionary shock, while large domestic banks do not.

This study shares with this literature the direct approach in testing whether monetary policy influences financial stability but innovates through the use of a more comprehensive proxy, namely financial stability indexes. These composite indexes gather information not only from the banking sector but also from money markets, debt and equity markets, and the shadow banking sector. The decision to deploy such an index is based on recent literature and the theory of monetary policy transmission. For instance, Adrian and Liang (2016) discuss in detail how monetary policy links to financial stability mainly through four sectors: non-financial, asset markets, banking, and shadow banking.

Another set of studies that have contributed to documenting the impact of monetary policy on financial stability is the literature exploring the non-linear relationship between monetary policy, output, inflation, and financial stability. The intuition is that output growth and inflation react differently to monetary policy shocks across different financial regimes. Those studies also show that the response of financial conditions to monetary policy shocks can vary under different financial regimes.

Blinder (1987), Bernanke and Gertler (1989), and Bernanke et al. (1994) pioneered work on financial market frictions and non-linearities. They establish that negative shocks to monetary policy tend to be amplified by weak credit market conditions and thus produce longer recessions. They also document potential asymmetric responses to monetary easing or tightening during upturns and downturns, setting the stage for future literature to examine how monetary policy shocks can create or alleviate financial stress events differently under low and high financial stress regimes.

Balke (2000) was among the first to test the impact of monetary policy shocks on output using a TVAR model characterized by different financial regimes. Using U.S. data, he found evidence of non-linear effects of credit conditions on the transmission mechanism and showed that the effects of monetary shocks were stronger under a tight credit conditions regime than in a standard credit conditions regime.

Calza and Sousa (2006) found similar results for the Eurozone. They investigated whether output and inflation respond asymmetrically to credit shocks in the euro area and found evidence of threshold effects related to credit conditions in the economy.

Saldías (2017) uses a Bayesian TVAR model to analyze the non-linear relationship between monetary policy and financial stress and its effects on the transmission of shocks to output. His findings suggest that the effects of monetary policy shocks on output growth are stronger during normal times than during times of financial stress.

Threshold models, however, are not the only non-linear models employed in the empirical literature to explore the relationship between monetary policy, output, inflation, and financial stability. Ramey (2016) tests the impact of monetary policy shocks on industrial production, CPI, and excess bond premium spread through a proxy Structural Vector Autoregressive (SVAR) model, then explores the results' robustness in a non-linear Jordà local projection framework. She finds significant differences in the results of the two frameworks and argues that a likely reason is that we can no longer well identify monetary policy shocks.

This study shares with this literature the utilization of Jordà's local projection framework but addresses the issue of identification of monetary policy shocks by exploiting the decomposition of monetary policy surprises proposed by Jarocinski and Karadi (2020).

Another set of studies is the one that examines the direct impact of monetary policy on financial stress in a non-linear fashion.

Li and St-Amant (2010) examine the non-linear relationships between financial stress, monetary policy, and the economy through a TVAR model with Canadian data. They show that contractionary monetary policy increases financial stress regardless of the initial financial regime, while monetary policy easing shows a significant but weaker effect.

Similarly, Fry-McKibbin and Zheng (2016) apply a TVAR model to the U.S. for the period prior to the introduction of unconventional monetary policies in 2008. They find evidence that large expansionary monetary shocks increase the likelihood of the economy exiting a high financial stress regime.

Atanasova (2003) finds evidence for the U.K. by estimating a TVAR in which the dynamics switch between credit-constrained and unconstrained regimes. Results document that monetary policy tightening deteriorates credit conditions.

Avdjiev and Zeng (2014) also employ a TVAR methodology to examine the non-linear interactions among credit market conditions and monetary policy but use a double-threshold model instead of a single-threshold one. Their results indicate that the strength of the effects of monetary policy shocks on credit market conditions is similar across weak, moderate, and strong economic performance.

Saldías (2017) tests the ability of monetary policy to "get in the cracks" by estimating a TVAR model which tests the impact of monetary policy shocks on the Average Distance-to-Default (ADD). In contrast to its findings for output, the paper shows that monetary policy shocks are effective in easing tight financial conditions but are only partially capable of containing the buildup of vulnerabilities. In other words, monetary policy has a stronger effect in stabilizing the financial system when the system is already under stress.

This study shares with this literature the deployment of a non-linear model but innovates through the use of Jorda's local projections, by testing additional indexes of financial vulnerability, by extending the analysis to Europe, and by exploring possible spillovers.

3. Empirical Approach

3.1 Econometric Method

The econometric model used to capture non-linearities between monetary policy and financial vulnerability is Jordà's (2005) local projection method. Following Ramey (2016), the following regressions are estimated:

$$z_{t+h} = \theta_h \ shock_t + control \ variables + \epsilon_{t+h}$$

The z variable is the variable of interest and represents a proxy of financial stability. Several different financial stress indexes will be deployed as z variable, some of which are weekly and some are monthly.

When the z variable is weekly, the control variables include 8 weekly lags of the shock, of the variable of interest z itself, and of the Cboe Volatility Index (VIX). When the z variable is monthly, the same control variables include 12 monthly lags. The difference in lags is due to limitations in computing power when working with weekly data, but 8 weeks of lags are still consistent with the two months used by Ramey (2016). In addition, again following how Ramey (2016) performs Jordà's local projections method when using monetary policy shocks data from Gertler and Karadi (2015), I do not include current values of the variable of interest z and the VIX, so I am not imposing the recursiveness assumption. In other words, both monthly and weekly lags for the variable of interest z and the VIX start at time -1 and not at time 0.

The $shock_t$ variable, better discussed in the Data section, represents a shock post a monetary policy announcement at time t. Three different types of shocks will be tested: monetary policy surprises and their decomposition into *monetary policy shocks* and *information shocks* as defined in Jarocinski and Karadi (2020). The shocks will be from U.S. monetary policy when the z variable is for the U.S. and from Eurozone monetary policy when the z variable is for Europe, except when testing for spillovers.

The coefficient θ_h gives the response of z at time t+h to a shock at time t.

The error term ϵ_{t+h}, with the exception of horizon h = 0, will be serially correlated since it is a moving average of the prediction errors from t to t+h. Hence, the standard errors must be adjusted for serial correlation, which is done in this case using the Newey-West (1986) correction.

While the literature shows that the most common way to estimate the impulse responses to a shock uses non-linear functions of the estimated VAR parameters, such a method has limitations. The VAR strategy is optimal across all horizons if it adequately captures the data-generation process. However, if the VAR is misspecified, the specification errors will be compounded at each horizon. Jordà (2005) proposed his local projection method for predicting impulse responses to overcome this issue. The central idea of this method is to compute impulse response functions without the need for specification and estimation of the underlying multivariate dynamic system. Instead of estimating impulse responses based on non-linear functions of the reduced form parameters, Jordà estimates regressions of the dependent variable at horizon t+h on the shock in period t. It then uses the coefficient on the shock as the impulse response estimate.

Local projections offer several distinct advantages in empirical analysis. Firstly, their estimation can be accomplished through straightforward regression techniques, utilizing commonly available regression packages. Secondly, local projections exhibit greater resilience to potential model misspecifications compared to alternative methods. Thirdly, they facilitate analytic inference, whether applied jointly or point-wise. Lastly, local projections readily accommodate the exploration of highly non-linear and flexible specifications, which may be impractical to incorporate within a multivariate framework.

Since the Jordà method for calculating impulse response functions imposes few restrictions, the estimates are sometimes less precise and erratic. Nevertheless, this procedure is more robust than standard methods, so it can be helpful as a heuristic check. Moreover, it allows for easy incorporation of state-dependence. While it is out of the scope of this study, it could be interesting to introduce it according to financial stress regimes.

3.2 Data

The dataset includes weekly and monthly data for the U.S. and Europe.

Monthly data on monetary policy surprises and their decomposition into *monetary policy shocks* and *information shocks* is taken from Jarocinski and Karadi (2020) (poor man's sign restrictions dataset). I calculated weekly data on monetary policy surprises and their decomposition using daily *monetary policy surprises* from Jarocinski and Karadi (2020), deploying the "poor man's sign restriction" and then summing daily shocks into weekly. The U.S. dataset goes from 1990 to 2016, while the Eurozone one goes from 1999 to 2016.

Financial vulnerability is proxied through 4 indexes for the U.S. and 2 indexes for Europe, where three out of four U.S. indexes are updated weekly, and European indexes are updated monthly. The indexes, which are better analyzed below, are the Chicago Fed NFCI and ANFCI, the St. Louis Fed Financial Stress Index (STLFSI), the Cleveland Fed Systemic Risk Indicator (SRI), the European Central Bank (ECB) Country-level Index of Financial Stability (CLIFS), and the Asian Regional Integration Center Financial Stress Index (ARICFSI). Regarding the CLIFS, which is available at a country level for all countries in Europe, only the indexes for countries that have been part of the Eurozone since 1999 are tested. NFCI and ANFCI data is available from 1971, STLFSI data from

1993, SRI from 2008, CLIFS from as early as 1970 but depends on availability, and ARICFSI from 1995 for the U.S. and from 1999 for Europe.

The VIX, which is used as a control variable for all regressions, both for Europe and the U.S., is taken from Cboe. The index, often used in literature as a control, is a daily computation designed to produce a measure of constant, 30-day expected volatility of the U.S. stock market. It is calculated using real-time, mid-quote prices of S&P500 call and put options. I use closing values of the index and compute weekly and monthly VIX data by taking the beginning-of-week and beginning-of-month values. Such an approach is deployed since the index is used as a control variable.

Weekly financial vulnerability data is regressed on weekly shocks and weekly control variables, while monthly data is regressed on monthly shocks and monthly control variables. Time series are adjusted to match. When financial vulnerability data is available for wider time windows than monetary policy surprises, only financial vulnerability data for the monetary policy window are considered. For the SRI, which shows the opposite case since data is only available from 2008, only shocks since that date are considered in the regression.

In the following sections, the datasets for proxies of monetary policy and financial stability are analyzed in depth.

3.2.1 Monetary Policy

U.S.

An updated version of the Jarocinski and Karadi (2020) U.S. dataset computed through "poor man's sign restrictions" is used as the proxy of U.S. monetary policy. This dataset contains three different types of shocks: *monetary policy surprises*, namely the change in the three-month fed funds future after a Federal Open Market Committee (FOMC) announcement, and their split into *monetary policy shocks* and *information shocks*.

Jarocinski and Karadi (2020) study asset-price changes around 240 FOMC announcements between 1990 and 2016 and define them as *surprises*. Their interest rate surprise metric is the change in the three-month fed funds future, and their stock price surprise metric is the change in the S&P500 in a window of 10 minutes before and 20 minutes after the FOMC announcement. After plotting the surprises in the three-month fed funds futures against the S&P500 stock index, where each dot represents one FOMC announcement, they show that many positive surprises in interest rates are followed by positive surprises in the stock market and many negative surprises in interest rates are followed by negative surprises in the stock market. Since this result is not what textbook economics would imply, as discussed in the literature review, they attribute these "wrong-signed" stock market responses to FOMC announcements to some shock that occurs systematically at the time of the central bank policy announcements, but that is not standard monetary policy. They define it *information shock*. In other words, when the co-movement between interest rate change and stock market change is positive, they define the *monetary policy surprise* as an *information shock*. In contrast, when the co-movement is negative, they define it as a *monetary policy shock*. They then proceed to provide these shocks at a monthly frequency.

Since some of the financial vulnerability variables that will be deployed are updated weekly, I updated Jarocinski and Karadi 's (2020) dataset by providing *monetary policy surprises*, *monetary policy shocks*, and *information shocks* also in a weekly frequency. To do so, I applied the same methodology discussed above. In correspondence with the 240 FOMC announcements, when the co-movement between interest rate change and stock market change is positive, I defined the monetary policy surprise as an *information shock*. In contrast, when it is negative, I defined it as a *monetary policy shock*. Then, I clustered the shocks in a weekly format by summing up all shocks that happened in the same week. Since not all weekly financial vulnerability proxies are updated on the same day of the week (e.g. Chicago Fed's NFCI is updated every Friday, while Cleveland Fed's SRI is updated every Tuesday), the weekly clustering is adapted to match the frequency of financial vulnerability data. For each week in which there was no FOMC announcement, the dataset displays a surprise of 0.

The results are a weekly and a monthly dataset that include U.S. *monetary policy surprises*, *monetary policy shocks*, and *information shocks*. The weekly or monthly dataset is employed in the regressions according to the frequency of the dependent variable z.

Europe

As a proxy of Eurozone monetary policy, I used an updated version of the Jarocinski and Karadi (2020) Eurozone *monetary policy surprises* dataset computed through "poor man's sign restrictions. This dataset contains three different shocks: *monetary policy surprises*, namely the change in the EONIA interest rate swaps with maturities of one month up to two years following an ECB Governing Council monetary policy meeting, and its decomposition into *monetary policy shocks* and *information shocks*.

The methodology Jarocinski and Karadi (2020) used to perform the deconstruction of the monetary policy surprises is the same as above. They study asset-price changes around 280 ECB policy announcements from 1999 to 2016. In this case, however, their metric of the interest rate surprise is the change in the EONIA interest rate swaps with maturities of one month up to two years, and their metric of the stock price surprise is the change in the EURO STOXX 50 in a window of 30 minutes around press statements and 90 minutes around press conferences, both beginning 10 minutes before and ending 20 minutes after the event (the press conference lasts about an hour). Again, they attribute "wrong-signed" market responses to *information shocks* and "correctly signed" market responses to *monetary policy shocks*. They then proceed to provide these cleaned shocks at a monthly frequency. They also highlight that more than 40% of the data points are wrong-signed stock market responses. This is even more than in the U.S., and the authors conclude that it is in line with the more transparent communication policy of the ECB.

Once again, I updated the dataset into weekly shocks using the abovementioned methodology. I performed "poor man's sign restrictions" on each of the 280 ECB policy announcements by testing the co-movement of the EONIA interest rate swaps and the EURO STOXX 50 and summed all surprises and shocks that happened in the same week.

The results are a weekly and a monthly dataset that include Eurozone *monetary policy surprises*, *monetary policy shocks*, and *information shocks*. The weekly or monthly dataset is used in the regressions according to the frequency of the dependent variable z.

3.2.2 Financial Stability Indexes

As proxies for financial stability, I use a set of financial stress indexes computed by different institutions. While the goal of each index is to represent the financial conditions of the reference country or region, they all consider different variables and deploy different aggregation methods. Thus, even if each index is a good proxy of financial vulnerability, they provide distinct perspectives on the state of financial conditions by incorporating specific elements while excluding others. The sections that follow delve into the specifics of each individual index, providing a comprehensive examination of their composition and how they uniquely capture financial conditions.

Chicago Fed National Financial Conditions Index

The National Financial Conditions Index published by the Chicago Fed offers a weekly overview of financial conditions in the United States. It provides valuable insights into money markets, debt and equity markets, as well as both traditional and "shadow" banking sectors. The NFCI is complemented by the ANFCI, which takes into account the effects of economic activity and inflation.

The NFCI and the ANFCI are weighted averages of 105 financial activity measures, each expressed relative to their sample averages and scaled by their sample standard deviations. In the ANFCI, each measure is cleaned for the effects of economic activity and inflation before calculating the index.

Both the NFCI and ANFCI are designed to have an average value of zero and a standard deviation of one, based on historical data from 1971. Positive NFCI and ANFCI values indicate tighter-than-average financial conditions, while negative values signify looser-than-average financial conditions.

Both indexes are comprised of subindexes. The NFCI comprises three subindexes: risk, credit, and leverage. The ANFCI also includes an adjustments component. Increases in risk, tighter credit conditions, and declining leverage are associated with a rise in the

NFCI and ANFCI. Positive subindex values indicate tighter-than-average conditions in the corresponding aspect of financial conditions, while negative values suggest the opposite.

St. Louis Fed Financial Stress Index

The St. Louis Fed Financial Stress Index is a weekly indicator that measures the level of financial stress in the markets and is available since 1993. It is constructed using 18 different weekly data series, which include seven interest rate series, six yield spreads, and five other indicators. Positive values indicate an elevated level of financial stress, and negative values indicate a lower level.

During 2022, the STLFSI consistently indicated lower-than-average levels of financial market stress, while other measures suggested tightening financial market conditions. An analysis revealed that the 90-day forward-looking SOFR rate, instead of the backward-looking rate used at the time, better reflected financial market expectations for federal funds rate changes and their implications on asset prices and yields. Hence, the STLFSI4 introduced this modification.

Comparing the STLFSI4 (the latest version) with the previous STLFSI3, it was observed that the two versions closely tracked each other until early February 2022. From that point, as the FOMC prepared to raise its policy rate to combat high inflation, the correlation between STLFSI3 and STLFSI4 began to decline, and the new measure of the STLFSI shows moderately higher financial market stress during the current tightening episode compared to the previous version.

Cleveland Fed Systemic Risk Indicator

The Cleveland Fed Systemic Risk Indicator is a measure constructed to assess systemic risk in U.S. financial services, with a specific focus on the banking system. It goes back to 2008, is updated weekly, and utilizes data on 64 U.S. banks and financial intermediaries listed in the State Street Global Advisors' SPDR S&P Bank ETF.

The SRI is computed using two key measures of insolvency risk: the average distance-to-default (ADD) and the portfolio distance-to-default (PDD). The ADD represents the market's perception of the average risk of insolvency among the sample of 64 representative banking institutions. It is calculated by calculating the distance-to-default for each bank in the sample using data on its equity, liabilities, and options prices on its stock. These individual bank measurements are then averaged using State Street Global Advisors' portfolio weights. On the other hand, the PDD captures insolvency risk for a weighted portfolio of the same 64 banking institutions. It is calculated using options on an exchange-traded fund that reflects the overall banking system: the State Street Global Advisors' SPDR S&P Bank ETF.

The SRI focuses on the difference, or spread, between ADD and PDD. When the spread narrows, it shows that the banking system's overall insolvency risk is rising and approaching the average insolvency risk of individual financial institutions. This narrowing spread reflects market perceptions of an imminent systematic disruption within the banking system. A decrease in either the ADD or the PDD signifies the market's perception of an increase in average insolvency risk in the banking sector. When the PDD approaches the ADD (narrowing of the spread), it suggests fragility within the banking system, even if both measures are positive.

ECB Country Level Index of Financial Stability

The Country Level Index of Financial Stability is a monthly updated country-specific financial stress index created by the ECB for 27 E.U. countries starting as early as 1964. The CLIFS includes six, mainly market-based, financial stress measures that capture three financial market segments: equity markets, bond markets, and foreign exchange markets. In addition, when aggregating the sub-indexes, the CLIFS takes the co-movement across market segments into account. However, it is important to note that this index does not directly take into consideration the banking sector.

In interpreting the CLIFS index, positive values indicate an elevated level of financial stress in a given country, and an increase in the index suggests a greater degree of strain. Conversely, negative values indicate lower financial stress and reductions imply reduced strains and vulnerabilities in the financial sector.

For this study, the CLIFS is only considered for countries that are part of the Eurozone, hence directly connected to Eurozone *monetary policy surprises*. Moreover, only countries that have been part of the Eurozone since 1999 have been considered. Hence, the dataset goes from 1999 to 2016 for the following countries: Belgium, Germany, Ireland, Spain, France, Italy, Luxembourg, the Netherlands, Austria, Portugal, and Finland. Additionally, the index is converted in log terms.

Asian Regional Integration Center Financial Stress Index

The Asian Regional Integration Center Financial Stress Index is an index that measures the degree of financial stress in several economies, regions, and subregions, covering the four major financial markets: the banking sector, the foreign exchange market, the equity market, and the debt market. The components of the ARICFSI are then aggregated using the variance-equal weights and principal component analysis. It is updated monthly and is available from 1995 for 25 countries and world regions. This study uses its U.S. and Europe versions. Similarly to other indexes, positive values indicate an elevated level of financial stress, and negative values indicate a lower level. Increments and reductions indicate upward and downward trends in financial stress.

4. Empirical Results

4.1 Monetary Policy and Financial Stability

4.1.1 U.S.

Figure 1 presents the impulse responses of the NFCI and ANFCI to *monetary policy surprises*, *monetary policy shocks*, and *information shocks*. The first thing to note is that, as expected, the plots highlight that the poor man's sign restriction on the high-frequency co-movement of interest rates and stock prices clearly separates two different shocks. Indeed, had the stock market response around the policy announcement been uninformative about the effect of the announcement itself on financial stability, the impulse response functions would be the same in all three columns. As we can see both for the NFCI and the ANFCI, this is not the case. Indeed, both the NFCI and the ANFCI show very different responses to *monetary policy shocks* and *information shocks*. I next discuss the impulse responses in more detail.

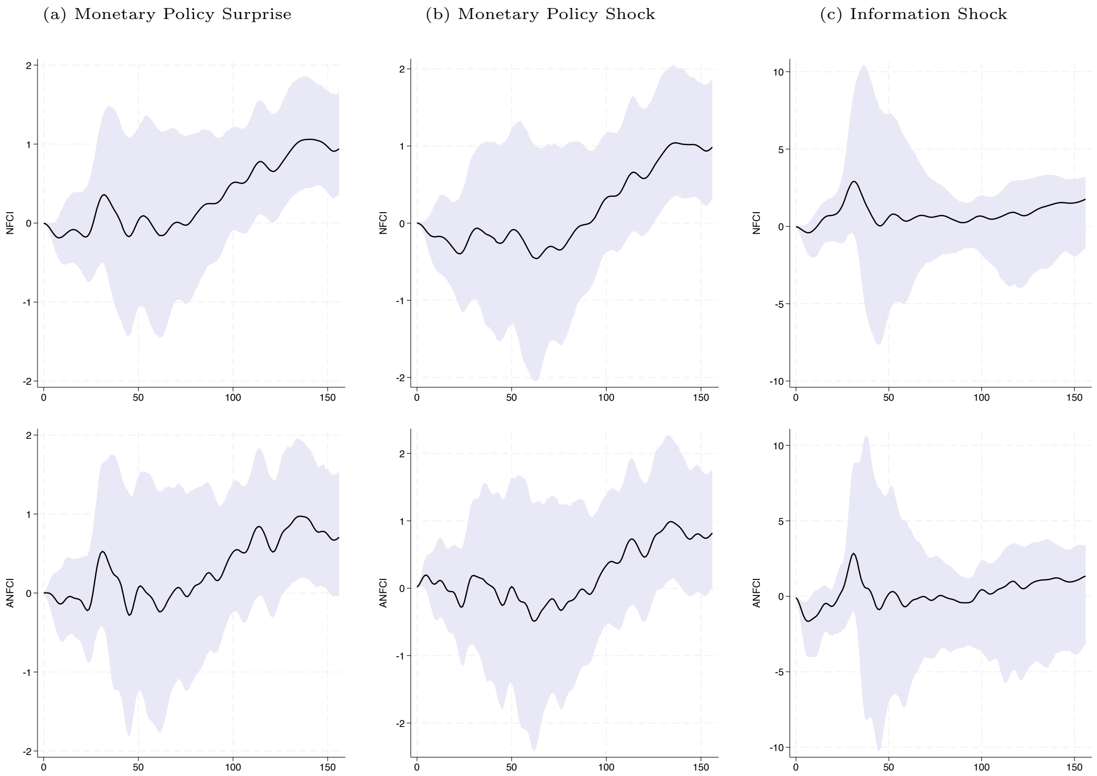
When looking at the second column, we realize that the NFCI does not respond to a *monetary policy shock* on impact. In the long run, the NFCI increases by roughly one unit after the first 2 years and a half, indicating a tightening of financial conditions. The ANFCI shows the same long-term tightening response to a *monetary policy shock* after 2 years and a half and additionally displays a tightening of financial conditions on impact.

However, looking at the third column, we see very different responses of financial vulnerability to *information shocks* instead. Indeed, the NFCI shows no significant response to an *information shock* whatsoever, and the ANFCI shows a loosening of financial conditions on impact (instead of the tightening it displayed in response to a *monetary policy shock*) and no significant response in the long run.

Overall, the long-term dynamics of both the NFCI and the ANFCI are consistent with results obtained by Saldías (2017) when he tests the impact of monetary policy on financial stability proxied through the ADD. Monetary policy tightening leads to tighter financial conditions that persist for several years. Being the NFCI and the ANFCI composite indexes as the ADD is, such a resemblance in long-term dynamics is reasonable. For what concerns on-impact dynamics, while the NFCI shows none whatsoever, the impulse response of the ANFCI is consistent with Jarocinski and Karadi (2020), who detect on-impact tightening of financial vulnerability in response to *monetary policy shocks* and on-impact loosening of financial vulnerability in response to *information shock* (but no long term impact). Such a difference in the on-impact response of the NFCI and the ANFCI is likely connected to the different composition of the two indexes, where the

ANFCI removes the variation in its individual variables attributable to economic activity and inflation, probably leading to a more evident on-impact response.

Figure 1: Impulse Response Function of NFCI and ANFCI to 100bps Shocks



Note: The panel shows impulse response functions according to Jordà's local projections framework to shocks of 100 bps to monetary policy surprises, monetary policy shocks, and information shocks. The black line corresponds to the impulse response, the confidence bands are 90% wild bootstrap confidence bands, and both are measured in the vertical axis in number units of the index, which are the specific of this measure. A positive value denotes an increase in financial stress. The horizontal axis measures the weeks after the shock.

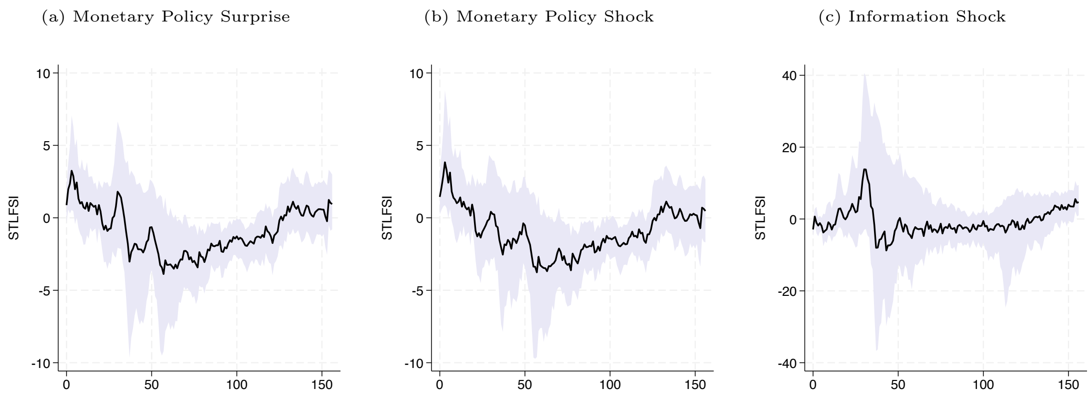
These results suggest not only that *monetary policy shocks* and *information shocks* have different impacts on financial stability (as argued by previous literature), where generally the first tighten financial conditions and the second have either the opposite effect (or no effect), but also that this impact seems to differ and happen at different times according to the proxy of financial vulnerability used. Indeed, even comparing two very similarly constructed indexes like the NFCI and the ANFCI, we obtain different results, especially on impact. This conclusion strengthens the hypothesis that *monetary policy shocks* and *information shocks* have an impact on financial stability proxied through financial stress indexes, but such an impact can be very different according to the financial stress index used. To further explore this hypothesis, I then perform the same analysis for additional and differently computed financial stress indexes.

Figure 2 presents the impulse responses of the St. Louis Fed Financial Stress Index to the same three shocks analyzed above. Once again, the graphs indicate a strikingly different response of financial stability to *monetary policy shocks* and *information shocks*.

While the STLFSI increases on impact (indicating tightened financial conditions) and loosens in the long run in response to a *monetary policy shock*, it tightens on impact and has no significant response in the long run in response to an *information shock*.

While the on-impact response of the STLFSI to both *monetary policy shocks* and *information shocks* and the long-run response to an *information shock* are consistent with those of the ANFCI and with Jarocinski and Karadi (2020), the long-run response to a *monetary policy shock* is quite different from what found by literature and is perhaps unexpected. Indeed, textbook economics would either suggest no long-run impact on financial variables that proxy financial stability, as found by Jarocinski and Karadi (2020), or a tightening of financial conditions in the long run, as found by Saldías (2017) and in the ANFCI.

Figure 2: Impulse Response Function of STLFSI to 100bps Shocks



Note: The panel shows impulse response functions according to Jordà's local projections framework to shocks of 100 bps to monetary policy surprises, monetary policy shocks, and information shocks. The black line corresponds to the impulse response, the confidence bands are 90% wild bootstrap confidence bands, and both are measured in the vertical axis in number units of the index, which are the specific of this measure. A positive value denotes an increase in financial stress. The horizontal axis measures the weeks after the shock.

As previously mentioned, a possible explanation for a long-term response rather than an on-impact one is found in the difference between proxying financial stability through individual financial variables (e.g.the excess bond premium like in Jarocinski and Karadi (2020)) and a composite index (e.g. the ADD like in Saldías (2017)). Being the STLFSI a composite index which gathers 18 different variables, it is perhaps reasonable to see a difference in the timing of the impact.

However, what is striking is the opposite long-term response to a *monetary policy shock*, where the STLFSI loosens instead of tightening. Firstly, it is important to recall that the STLFSI has recently been found to systematically underestimate the tightness of financial conditions with respect to other indexes. While it was updated from STLFSI3 to STLFSI4 to better reflect real financial stress, it still provides more optimistic outlooks than other indexes. This could potentially influence the long-term dynamic we see and is connected to the variables and the methods of aggregation deployed in the composition of the index. Secondly, as the St. Louis Fed itself stressed in the paper which introduces the index, while making use of a weekly index allows for a better representation of significant developments in the financial markets, which occur more frequently than monthly, the trade-off for a higher-frequency index is greater volatility, and thus, perhaps, noise.

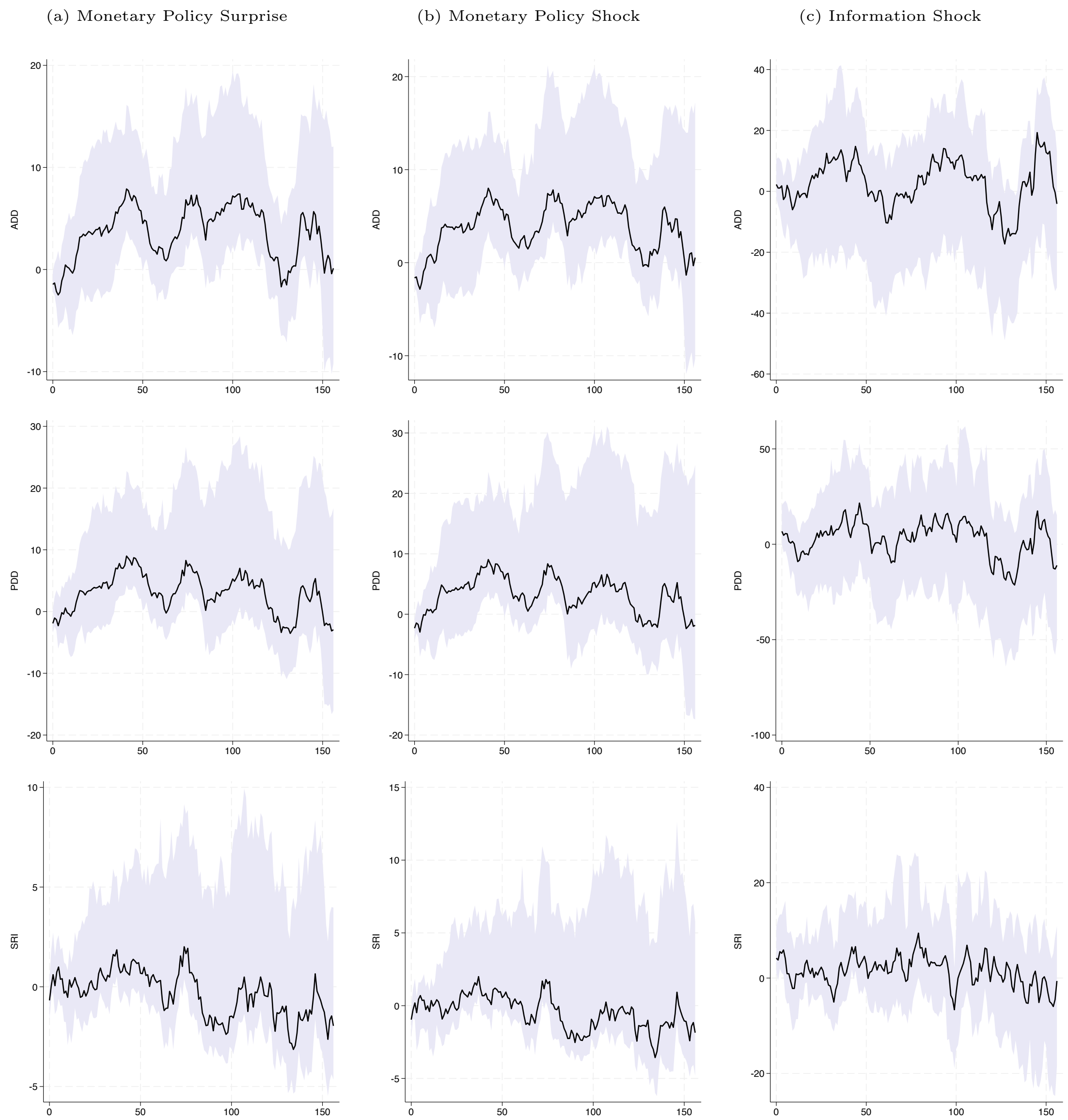
In order to evaluate this last possibility, I also performed the analysis on monthly STLFSI, which was aggregated by taking a simple average of weekly STLFSI data. Figure A.1 in the appendix shows the impulse response on the monthly STLFSI to the usual three shocks. Looking at the second column, we see that monthly STLFSI does not seem to react on impact to *monetary policy shocks*, contrarily to weekly STLFSI, and increases in the long run, indicating tightened financial conditions, again opposing the result obtained through weekly STLFSI. The third column, showing the impulse response to *information shocks*, roughly confirms results seen through weekly STLFSI.

These results help us speculate that noise and frequency of the financial vulnerability index also have a part in explaining the impact of monetary policy. That said, the NFCI and ANFCI both were weekly but still displayed tightened financial conditions in the long run. This further suggests that what we should look into is the composition of the indexes themselves to explain the different impacts of monetary policy on financial stability since *monetary policy shocks* and *information shocks* could differently impact the different components of the indexes.

Figure 3 presents the impulse responses of the Cleveland Fed ADD, PDD, and SRI. Once more, the graphs reveal a notable disparity in the way financial stability responds to *monetary policy shocks* and *information shocks*. ADD, PDD, and SRI all fall on impact in response to a *monetary policy shock*, indicating a tightening of financial conditions consistent with the literature. On the other hand, all three measures increase on impact in response to an *information shock*, indicating an improvement in financial conditions, again consistent with the literature. However, similar to the findings observed in the STLFSI, the long-term response of financial conditions represented by the ADD and the PDD appears to exhibit a positive reaction to a *monetary policy shock*, indicating better financial conditions. This outcome, as discussed, is counterintuitive.

All possible explanations for the positive long-term impact of *monetary policy shocks* on the STLFSI also apply to the ADD and PDD. We can expect this counterintuitive result to be either the result of noise due to the high frequency of data or due to the composition and aggregation method of the ADD, PDD, and SRI indexes themselves. In particular, it is important to recall that the ADD, PDD, and SRI only gather information on the financial stability of the banking sector, while previous indexes considered other sectors as well (equity, debt, money, forex). Additionally, it is worth noting that while this result is significant, the wild bootstrap confidence bands in response to monetary policy shocks are skewed. While it is common for confidence bands to exhibit slight asymmetry when using the wild bootstrap method, this case is quite significant. A preliminary analysis done through a Shapiro-Wilk test at a 5% significance level suggests that the skeweness could be due to non-normality of residuals.

Figure 3: Impulse Response Function of ADD, PDD, and SRI to 100bps Shocks



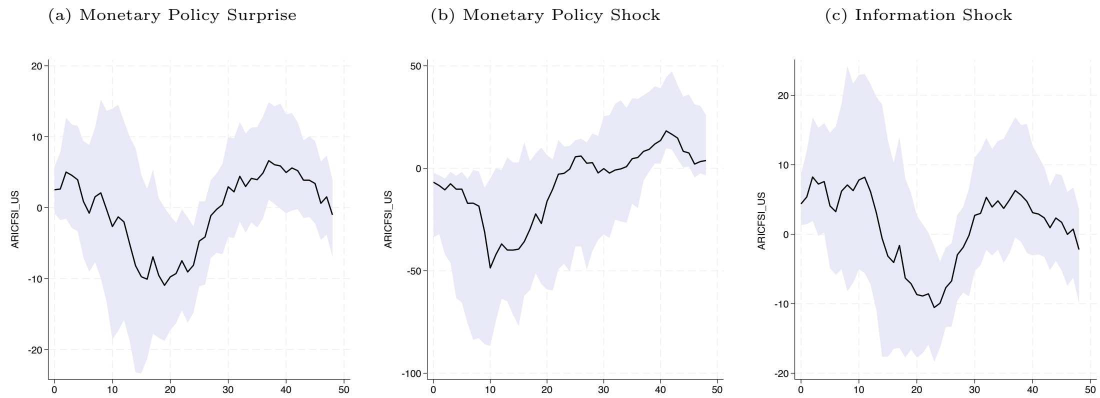
Note: The panel shows impulse response functions according to Jordà's local projections framework to shocks of 100 bps to monetary policy surprises, monetary policy shocks, and information shocks. The black line corresponds to the impulse response, the confidence bands are 90% wild bootstrap confidence bands, and both are measured in the vertical axis in number of standard deviations to the distress barrier, which are the specific of this measure. A positive value denotes a decrease in financial stress. The horizontal axis measures the weeks after the shock.

Given the substantial variability observed in the impulse response of ADD, PDD, and SRI depicted in Figure 3, it is prudent to observe the impact of monetary policy and information shocks on monthly ADD, PDD, and SRI as well. These considerations are also relevant since Saldías (2017) regressed the monthly ADD on monetary policy shocks (that were however differently defined and not cleaned for the information effect) and obtained a long-term tightening of financial conditions rather than a long-term loosening as I obtain with weekly data. Figure A.2 in the appendix shows the impulse response of monthly

ADD, PDD, and SRI to the three shocks. Once again, monthly variables were calculated by taking a simple average of weekly values. Results show a long-term tightening of financial conditions in response to *monetary policy shocks*, and a long-term loosening of financial conditions in response to *information shocks*, consistently with Saldías (2017).

Figure 4 presents the impulse responses of the Asian Regional Integration Center Financial Stress Index to the standard three shocks. Interestingly, while the difference between the response to *monetary policy shocks* and *information shocks* also persists for the ARICFSI U.S. index, the results on impact are again the opposite of what could be expected and of what was previously found by literature. Indeed, the index falls on impact in response to a *monetary policy shock* indicating an improvement in financial conditions. In contrast, the index increases on impact in response to an *information shock*, indicating a worsening of financial conditions. In the long run, however, results reflect a worsening of financial conditions in response to a *monetary policy shock*, and a loosening of financial conditions in response to an *information shock*. While we argued that similar findings

Figure 4: Impulse Response Function of ARICFSI US to 100bps Shocks



Note: The panel shows impulse response functions according to Jordà's local projections framework to shocks of 100 bps to monetary policy surprises, monetary policy shocks, and information shocks. The black line corresponds to the impulse response, the confidence bands are 90% wild bootstrap confidence bands, and both are measured in the vertical axis in number units of the index, which are the specific of this measure. A positive value denotes an increase in financial stress. The horizontal axis measures the months after the shock.

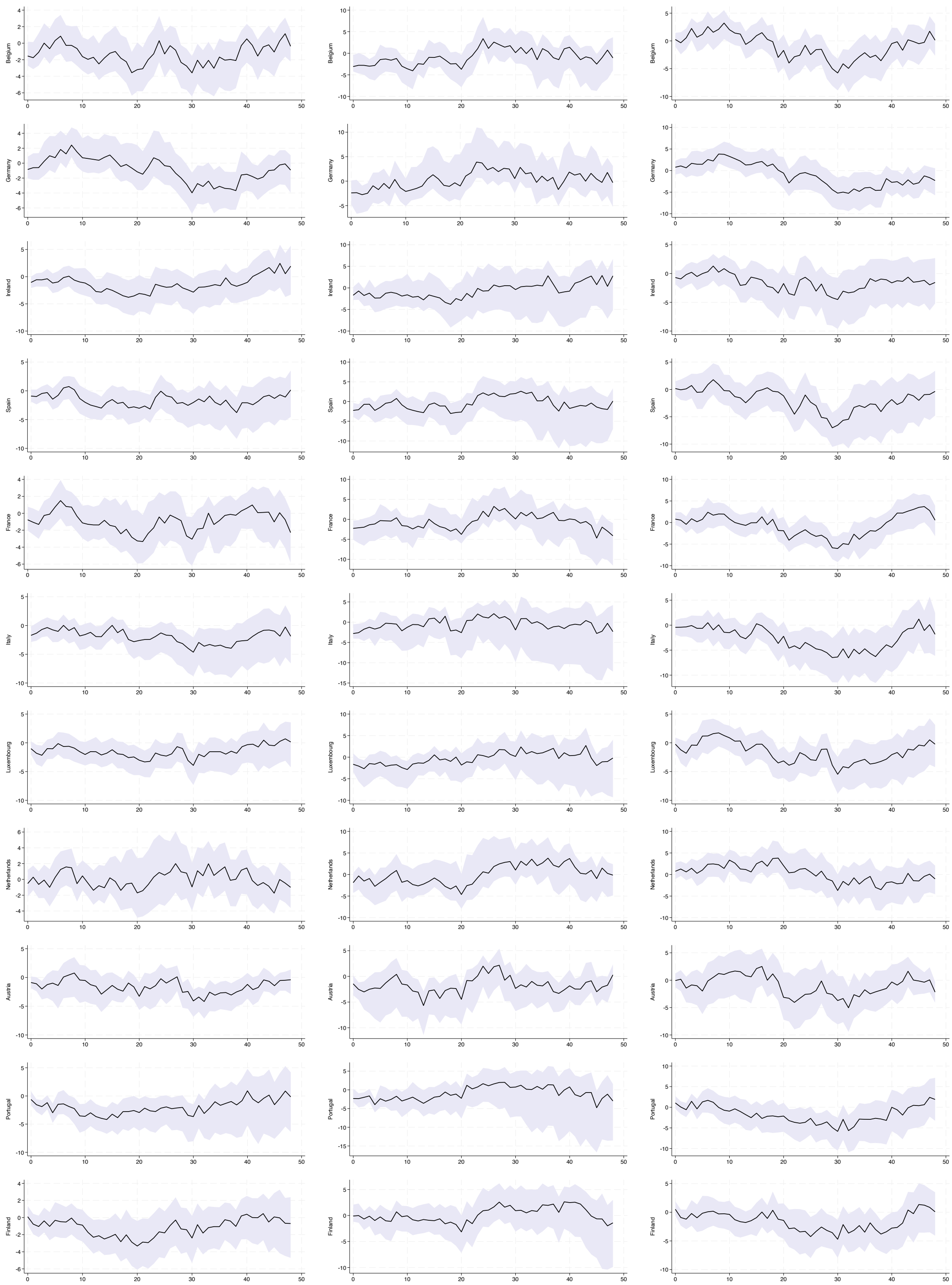
could be the result of some noise caused by the utilization of high-frequency weekly data, the ARICFSI is a monthly index. These conflicting results are particularly interesting and strengthen the hypothesis that differences in the composition of indexes matter a lot when examining the impact of monetary policy on financial stability, to the point that they could lead to opposite conclusions.

4.1.2 Europe

Figure 5 presents the impulse responses of the CLIFS index for the 11 European countries that joined the Eurozone in 1999 to the usual three shocks. Again, the impulse

Figure 5: Impulse Response Function of CLIFS to 100bps Shocks

(a) Monetary Policy Surprise (b) Monetary Policy Shock (c) Information Shock



Note: The panel shows impulse response functions according to Jordà's local projections framework to shocks of 100 bps to monetary policy surprises, monetary policy shocks, and information shocks. The black line corresponds to the impulse response, the confidence bands are 90% wild bootstrap confidence bands, and both are measured in the vertical axis in log units of the index, which are the specific of this measure. A positive value denotes an increase in financial stress. The horizontal axis measures the months after the shock.

response to *monetary policy shocks* is significantly different to the response to *information shocks*. Interestingly, the responses are roughly equally shaped for all 11 countries.

Looking at the second column, it is possible to see that the on-impact response to a tightening shock in monetary policy is a loosening of financial conditions for all countries except for Finland, which exhibits no on-impact response. Additionally, only Belgium and Germany display tightened financial conditions in the long run (barely significantly). All other countries either display no long-term effect or sustained loosened conditions for up to 2 years after the shock. This result, resembling what was seen for the on-impact response of the ARICFSI of the U.S., might once again seem counterintuitive. However, it is actually consistent with the findings of Jarocinski and Karadi (2020) for Europe. Additionally, this result is only barely significant, suggesting that in Europe, *monetary policy shocks* are only relatively impacting financial stability.

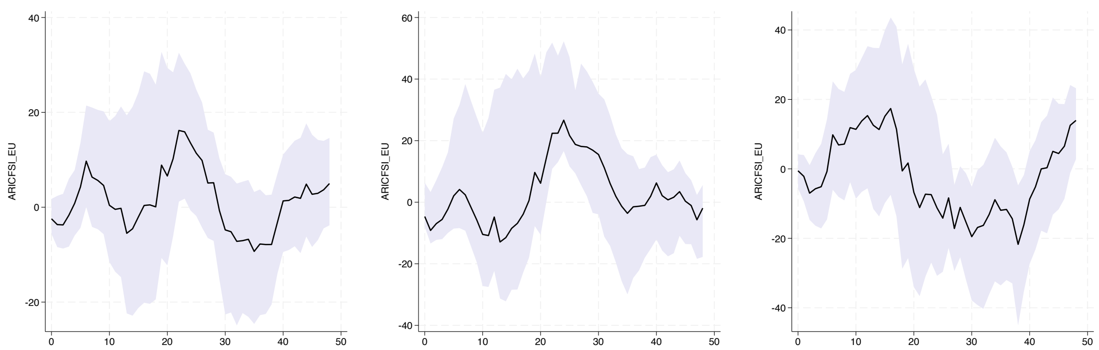
However, looking at the third column, it is clear that not the same can be said about *information shocks*. Indeed, financial conditions significantly loosen in response to an *information shock* in most countries. This result is also more evident than it was for the U.S., a conclusion that is in line with the European Central Bank's more transparent communication policy with respect to the FED's.

In order to continue exploring the relevance of index composition when assessing the impact of monetary policy on financial stability, I perform the same analysis on the ARICFSI for Europe, which includes both Eurozone and non-Eurozone countries.

Figure 6 presents the impulse response of the ARICFSI of Europe to the usual shocks. Once again, and quite strikingly, the response to the *information shock* and the *monetary policy shock* of the ARICFSI is quite different. This result serves as the last robustness check in the perimeter of this study to conclude that *information shocks* lead to different

Figure 6: Impulse Response Function of ARICFSI EU to 100bps Shocks

(a) Monetary Policy Surprise (b) Monetary Policy Shock (c) Information Shock



Note: The panel shows impulse response functions according to Jordà's local projections framework to shocks of 100 bps to monetary policy surprises, monetary policy shocks, and information shocks. The black line corresponds to the impulse response, the confidence bands are 90% wild bootstrap confidence bands, and both are measured in the vertical axis in number units of the index, which are the specific of this measure. A positive value denotes an increase in financial stress. The horizontal axis measures the months after the shock.

impacts on financial stability than *monetary policy shocks* do. Additionally, the results confirm the behavior of financial stability in response to *information shocks*, highlighting a strong loosening in financial conditions after roughly 2 years and a half after impact.

However, they display a different behavior of financial stability in response to *monetary policy shocks* with respect to what was seen with CLIFS. Indeed, the on-impact loosening to the shock is not significant, and there is a strikingly significant tightening of financial conditions roughly 2 years after impact. While this result is detected for the U.S., it is the first time such a significant tightening has been detected for Europe. It is important to keep in mind that the ARICFSI of Europe does not include Eurozone countries only, and the CLIFS indexes analyzed were for Eurozone countries only. Nevertheless, this result strengthens the hypothesis that looking into the composition of different indexes of financial vulnerability could display strikingly different impacts of *monetary policy shocks* on the different components, which are however all supposed to serve as proxies of financial vulnerability. This finding suggests that financial vulnerability does not always react in the same way in response to *monetary policy shocks*, while it tends to be more consistent in response to *information shocks* across all indexes.

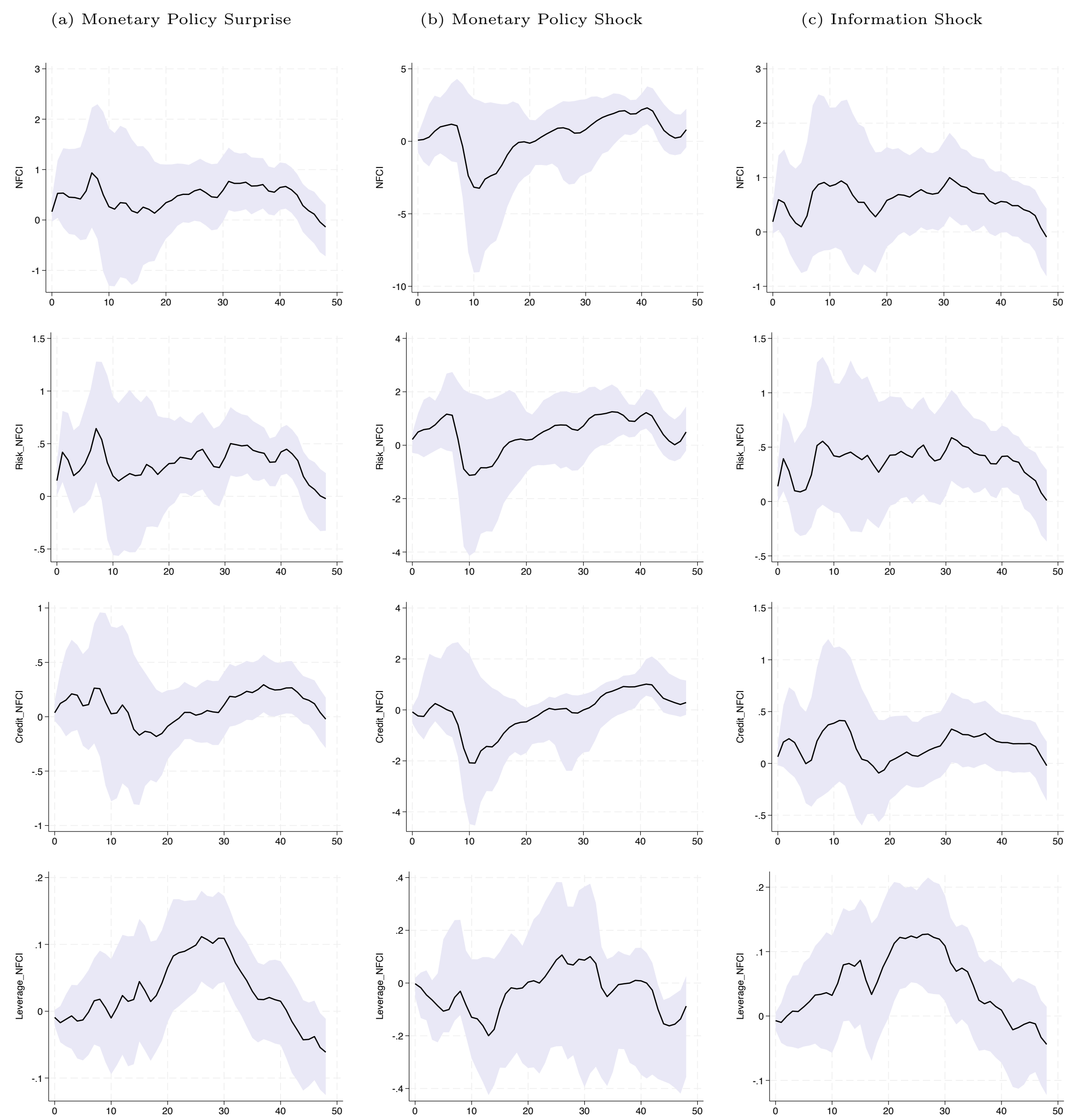
4.1.3 Monetary Policy Shocks and Index Composition

In the previous two sections, we have come to a few conclusions. Firstly, *monetary policy shocks* and *information shocks* have different impacts on financial stability, no matter what proxy of financial stability is used. This result was evident for both the U.S. and Europe. Secondly, both in the U.S. and Europe, even if with different timing, financial conditions loosen in response to an *information shock*. In other words, *information shocks* have a clear-cut impact on financial stability proxied by a composite index. This is a useful result since its unilateral character across all indexes allows central banks to predict how financial stability will react to announcements that focus on sharing information.

However, we found conflicting results when it comes to the impact of *monetary policy shocks* on financial stability. We discussed how they could be partly attributable to noise but also found evidence suggesting that noise might not be the only explanation. In particular, we argued that a likely driver of the conflicting impacts of *monetary policy shocks* on financial stability is the composition of the various indexes. A *monetary policy shock* could have a tightening effect on certain variables used to compute the index and a loosening effect on other variables included in the aggregation. Alternatively, it could have a tightening on certain variables and no effect on others or delayed effects on different variables at different times. In other words, data suggests that there is no clear-cut impact of a *monetary policy shock* on financial stability as proxied by a composite index. This conclusion prompts further research on the impact of *monetary policy shocks* on individual components of the various financial stability indexes. In the absence of data for each index, I only perform this test on the components of the monthly NFCI and ANFCI.

Figure 7 presents the impulse response of the monthly NFCI and its components to the three shocks. In order to obtain monthly NFCI, weekly data is aggregated through simple average. While such a method undoubtedly leads to some data loss (which is probably what leads to a differently shaped response to *information shocks* with respect to weekly data), it is possible to see that the impulse response to *monetary policy shocks* still closely resembles the one obtained for weekly NFCI in Figure 1. In particular, there seems to be no on-impact response to a *monetary policy shock*, but tightening of financial conditions

Figure 7: Impulse Response Function of Monthly NFCI and its Components to 100bps Shocks



Note: The panel shows impulse response functions according to Jordà's local projections framework to shocks of 100 bps to monetary policy surprises, monetary policy shocks, and information shocks. The black line corresponds to the impulse response, the confidence bands are 90% wild bootstrap confidence bands, and both are measured in the vertical axis in number units of the index, which are the specific of this measure. A positive value denotes an increase in financial stress. The horizontal axis measures the months after the shock.

roughly 3 years after impact. Interestingly, however, we see that not all components react in the same direction to the *monetary policy shock*. While the risk and credit subindexes both increase, indicating a tightening of financial conditions, the leverage subindex falls, indicating a loosening of financial conditions at roughly the same time.

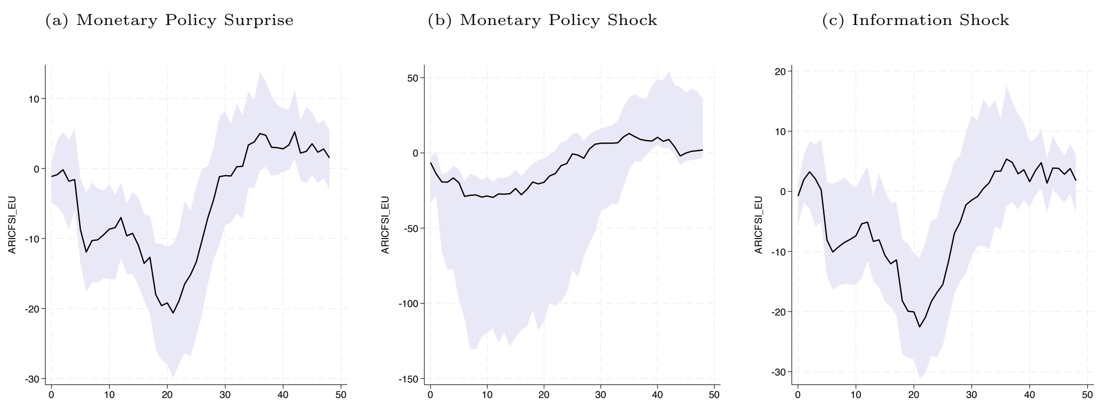
This result strengthens the hypothesis that *monetary policy shocks* could have different impacts on different variables indicating financial vulnerability (credit, risk, and leverage in this case) and that while looking at them on a composite level through a financial stress index could give a quick outlook, a more detailed analysis of the impact on the components could be insightful. For instance, it is possible to argue that composite indexes that give higher weight to leverage will display either a weaker long-term tightening of financial stress in response to a *monetary policy shock* or even a loosening of financial conditions. While it is outside of the scope of this study, it would be interesting to compare the weight given to leverage by the STLFSI and the ARICFSI of the U.S. (which display long-term loosening of financial conditions) and see if it is less than the one attributed by the NFCI and ANFCI (which display long-term tightening of financial conditions).

Figure A.3 in the appendix presents the response of the monthly ANFCI to the three shocks and leads to similar conclusions to the ones made on the NFCI. Once again, monthly ANFCI is computed by aggregating weekly data through simple average.

4.2 Spillovers of U.S. and Eurozone Monetary Policy

Figure 8 presents the response of the ARICFSI of Europe to 100bps U.S. shocks. While it is immediately clear that, perhaps not surprisingly,*monetary policy surprises* in the U.S. have a spillover effect on the financial stability of Europe, the differences in response to *monetary policy shocks* and *information shocks* are not striking. Indeed, while

Figure 8: Impulse Response Function of ARICFSI EU to US 100bps Shocks



Note: The panel shows impulse response functions according to Jordà's local projections framework to shocks of 100 bps to monetary policy surprises, monetary policy shocks, and information shocks. The black line corresponds to the impulse response, the confidence bands are 90% wild bootstrap confidence bands, and both are measured in the vertical axis in number units of the index, which are the specific of this measure. A positive value denotes an increase in financial stress. The horizontal axis measures the months after the shock.

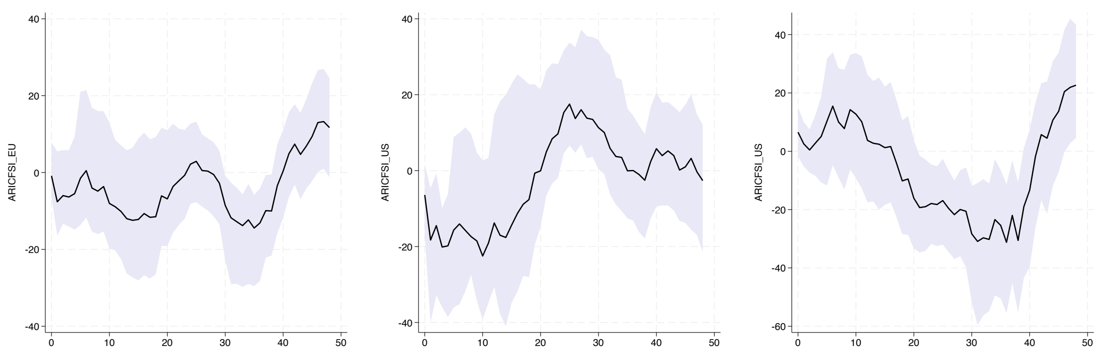
there is more uncertainty around the response of the ARICFSI to a *monetary policy shock* (confidence bands are wider and even skewed, possibly due to non-normality of residuals), the shape is roughly the same.

Firstly, looking at the second column, it is possible to see that after an on-impact and sustained loosening of financial conditions, the economy eventually tightens, but the result is only barely significant. This dynamic seems to resemble the response that individual countries' CLIFS had to Eurozone *monetary policy shocks* and is consistent with the idea that U.S. monetary policy does spill over to Europe. Similarly, looking at the third column, a relevant loosening of financial conditions is detected in response to an *information shock*. This result resembles both in terms of timing and size the response that ARICFSI had to Eurozone *monetary policy shocks* but happens earlier, is stronger, and disappears sooner. Interestingly, European financial conditions seem to react to both *monetary policy shocks* and *information shocks* in the U.S. by improving, and only tightening in response to a *monetary policy shock* in the long run.

Figure 9 presents the response of the ARICFSI of the U.S. to 100bps shocks in the Eurozone. Perhaps unexpectedly, the results indicate that a tightening *monetary policy shock* in the Eurozone first loosens but then tightens U.S. financial conditions. *Information shocks* in the Eurozone, on the other hand, lead to loosened U.S. financial conditions. While the literature has long proven the presence of spillovers of U.S. monetary policy to Europe, the opposite is not as well documented. Hence, for the purpose of robustness checks, I also analyzed the impulse response of weekly NFCI and ANFCI to Eurozone shocks.

Figure 9: Impulse Response Function of ARICFSI US to EU 100bps Shocks

(a) Monetary Policy Surprise (b) Monetary Policy Shock (c) Information Shock

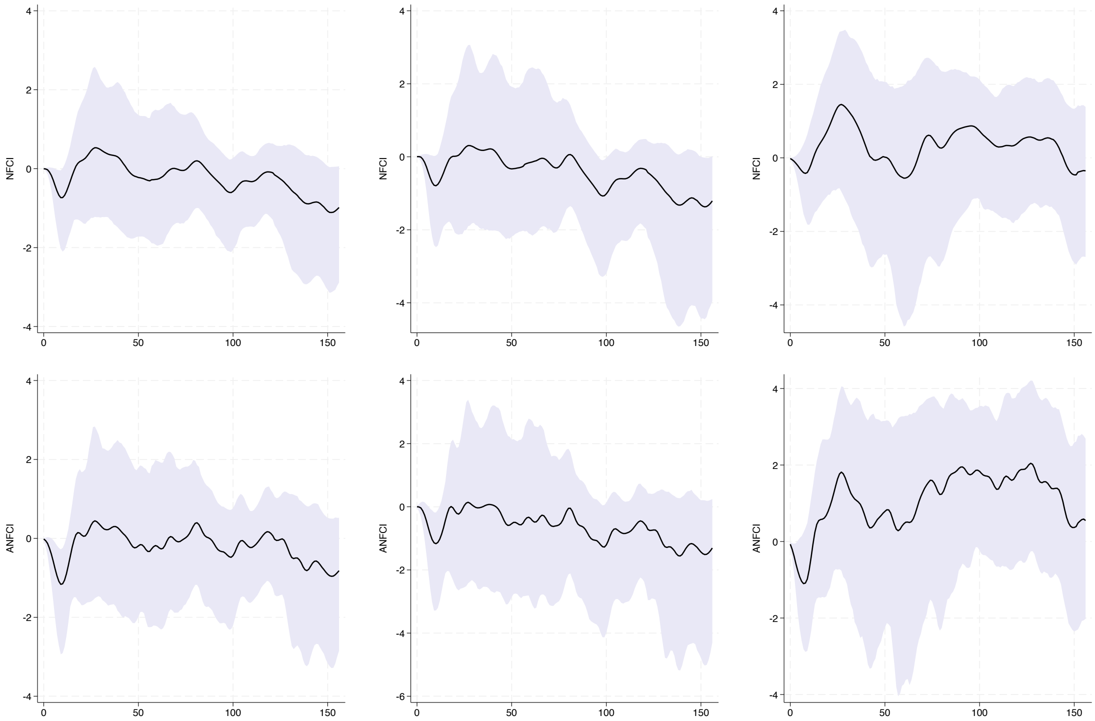


Note: The panel shows impulse response functions according to Jordà's local projections framework to shocks of 100 bps to monetary policy surprises, monetary policy shocks, and information shocks. The black line corresponds to the impulse response, the confidence bands are 90% wild bootstrap confidence bands, and both are measured in the vertical axis in number units of the index, which are the specific of this measure. A positive value denotes an increase in financial stress. The horizontal axis measures the months after the shock.

Figure 10 presents the response of the NFCI and ANFCI to 100bps shocks in the Eurozone. In these graphs, not only is there no clear difference in the impact of *monetary* *policy shocks* and *information shocks* on the two indexes, but there seems to be no significant impact of Eurozone monetary policy on U.S. financial stability overall. This final result is more consistent with the literature than what was found through the ARICFSI, once again potentially pointing to the importance of analyzing the components of these composite indexes. Since the ARICFSI also seemed to give the most conflicting results when regressed on same-country shocks, further research on the specific response of the components of the ARICFSI could be useful.

Figure 10: Impulse Response Function of NFCI and ANFCI to EU 100bps Shocks

(a) Monetary Policy Surprise (b) Monetary Policy Shock (c) Information Shock



Note: The panel shows impulse response functions according to Jordà's local projections framework to shocks of 100 bps to monetary policy surprises, monetary policy shocks, and information shocks. The black line corresponds to the impulse response, the confidence bands are 90% wild bootstrap confidence bands, and both are measured in the vertical axis in number units of the index, which are the specific of this measure. A positive value denotes an increase in financial stress. The horizontal axis measures the weeks after the shock.

5. Conclusions

Through an analysis across four U.S. and two European financial stress indexes, this study found that *monetary policy shocks* and *information shocks* have different impacts on financial stability independently of the proxy index used for financial vulnerability. However, this study concludes that the impact of *monetary policy shocks* and *information shocks* is not consistent across all indexes, neither in strength nor in direction. It suggests that a driver for conflicting impacts is the different composition of the indexes. By comparing results for the U.S. and Europe, this study also suggests that the impact of *information shocks* and *monetary policy shocks* on financial stability is different in the two regions in terms of timing and sometimes direction. Finally, the study finds no significant difference in the impacts of U.S. *monetary policy shocks* and *information shocks* on European financial stability. I will now go into detail about each finding.

Firstly, this study finds that in both the U.S. and Europe, financial stability as proxied by composite indexes consistently improves in response to *information shocks*. However, this result is at times more significant or stronger than others and happens at different periods after impact across indexes. The different timing of the response suggests the need for further investigation into the individual components of the indexes. Nevertheless, this unidirectional response of financial stability to information shocks can aid central banks in predicting the reaction to policy announcements.

Concerning *monetary policy shocks*, no unidirectional response is available. Not only do different financial stability indexes react to *monetary policy shocks* at different times, but also in opposite ways. This study strongly suggests that the driver for conflicting impacts is the composition of the various indexes. A preliminary NFCI components analysis shows that the leverage subindex loosens in the long run in response to a *monetary policy shock* while the credit and risk subindexes tighten. This result suggests that indexes that give higher weight to leverage could display either a weaker long-term tightening or even a loosening of financial conditions in response to a *monetary policy shock*.

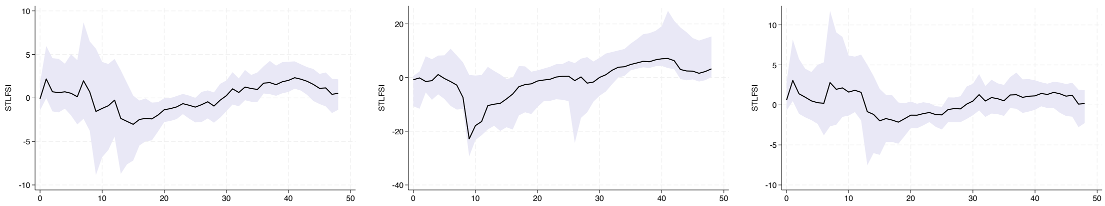
Furthermore, this study provides significant evidence supporting the findings of Jarocinski and Karadi (2020) regarding the differential reactions of the U.S. and Europe to *monetary policy surprises*. *Information shocks* in Europe have a later and more prolonged impact on financial stability compared to the U.S., reflecting the ECB's more transparent communication policy. Moreover, the on-impact effect of *monetary policy shocks* exhibits distinct patterns between the U.S. and Europe, with financial vulnerability consistently loosening in Europe but displaying a varied response in the U.S. depending on the index.

Finally, a spillover analysis of U.S. monetary policy to Europe reveals no significant difference in the response to *monetary policy shocks* and *information shocks*.

A. Appendix

Figure A.1: Impulse Response Function of Monthly STLFSI to 100bps Shocks

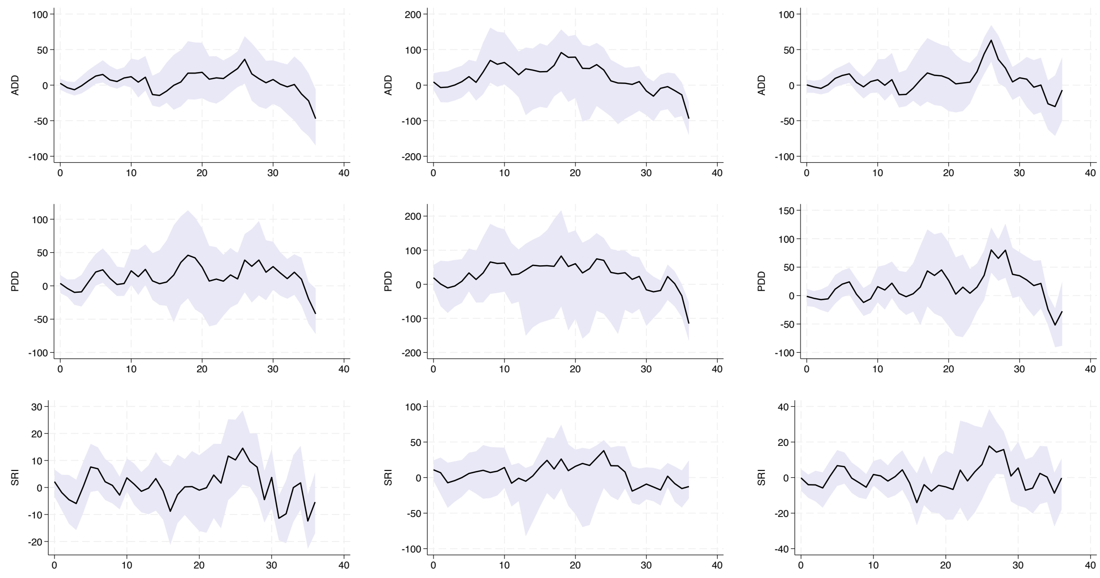
(a) Monetary Policy Surprise (b) Monetary Policy Shock (c) Information Shock



Note: The panel shows impulse response functions according to Jordà's local projections framework to shocks of 100 bps to monetary policy surprises, monetary policy shocks, and information shocks. The black line corresponds to the impulse response, the confidence bands are 90% wild bootstrap confidence bands, and both are measured in the vertical axis in number units of the index, which are the specific of this measure. A positive value denotes an increase in financial stress. The horizontal axis measures the months after the shock.

Figure A.2: Impulse Response Function of Monthly ADD, PDD, and SRI to 100bps Shocks

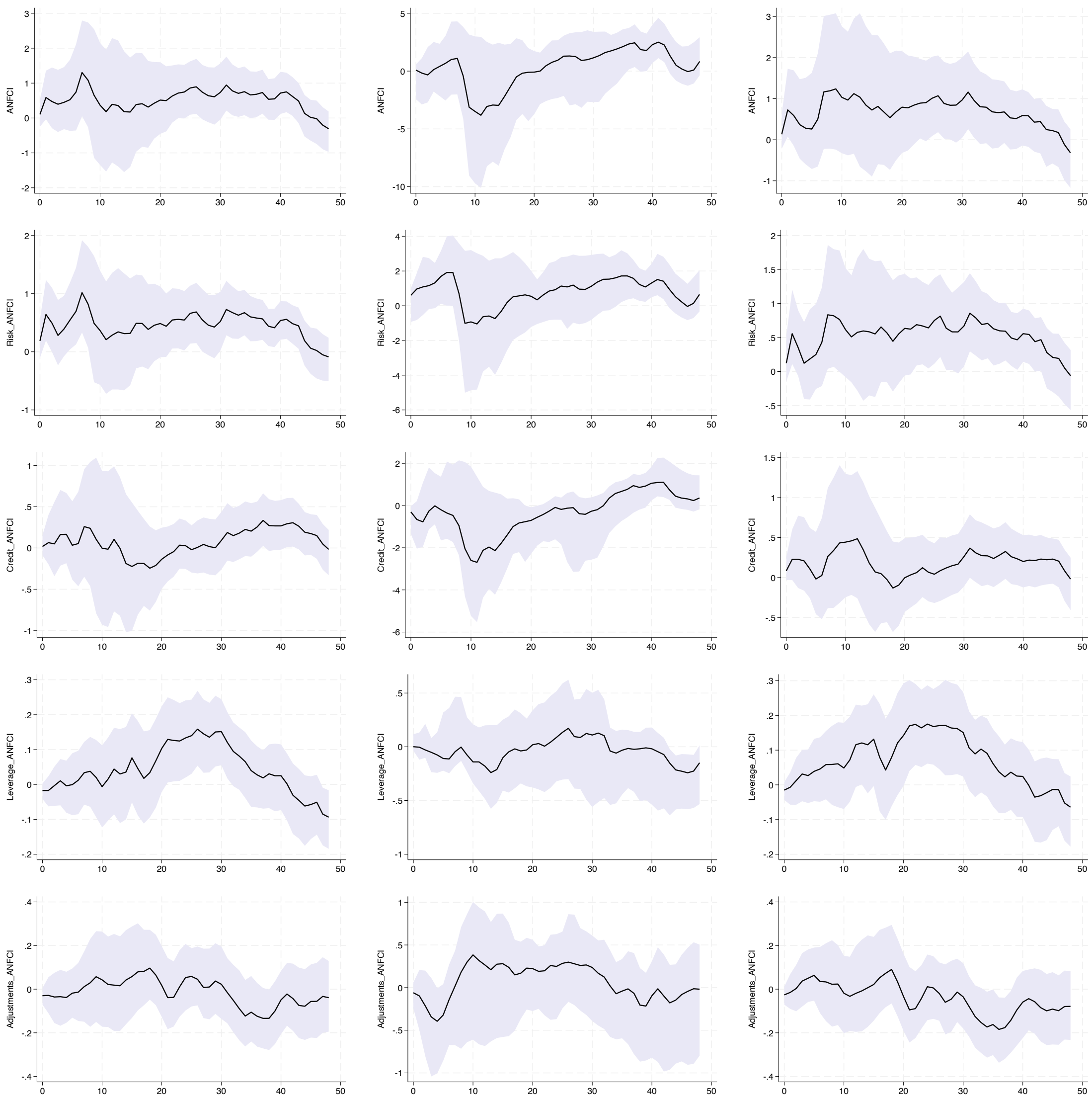
(a) Monetary Policy Surprise (b) Monetary Policy Shock (c) Information Shock



Note: The panel shows impulse response functions according to Jordà's local projections framework to shocks of 100 bps to monetary policy surprises, monetary policy shocks, and information shocks. The black line corresponds to the impulse response, the confidence bands are 90% wild bootstrap confidence bands, and both are measured in the vertical axis in number of standard deviations to the distress barrier, which are the specific of this measure. A positive value denotes a decrease in financial stress. The horizontal axis measures the months after the shock.

Figure A.3: Impulse Response Function of Monthly ANFCI and its Components to 100bps Shocks

(a) Monetary Policy Surprise (b) Monetary Policy Shock (c) Information Shock



Note: The panel shows impulse response functions according to Jordà's local projections framework to shocks of 100 bps to monetary policy surprises, monetary policy shocks, and information shocks. The black line corresponds to the impulse response, the confidence bands are 90% wild bootstrap confidence bands, and both are measured in the vertical axis in number units of the index, which are the specific of this measure. A positive value denotes an increase in financial stress. The horizontal axis measures the months after the shock.

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