The Effects of Macroprudential Policy Announcements on Systemic Risk

(Preliminary and Incomplete - Please do not circulate)

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We construct a new dataset of macroprudential policy announcements for the United Kingdom and estimate their effect on systemic risk, using a high-frequency identification approach. First, by examining a sample of the largest UK-listed banks, we identify macroprudential policy announcement shocks that were unanticipated by the financial markets. Second, we study the effects of market-based macroprudential policy surprises in a local projection. We find that a perceived macroprudential policy tightening contributes to a substantial reduction in systemic risk in the short run, with effects persisting for several months. The reduction is mostly attributed to the reaction in equity and bond markets.

Keywords: Macroprudential Policy, Systemic Risk, High-Frequency Identification, Policy Announcements.

JEL Classification: E58, G14, G18, G21.

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1 Introduction

Since the Great Financial Crisis (GFC), central banks and other financial authorities increasingly employed macroprudential tools to achieve financial stability. Unlike monetary policy and its target of price level stability however, macroprudential policy and its aim of achieving financial stability is a more elusive concept. The term macroprudential policy itself covers an umbrella of different tools including tools to improve the solvency of lenders, lender liquidity, as well as measures to enhance the resilience of borrowers. Moreover, financial stability is not an easily defined variable that can be used to measure the effectiveness of any policy. It is therefore often challenging to study how effective macroprudential measures are in achieving their goal. We propose to answer this question by evaluating the effectiveness of macroprudential policy announcement 'surprises' in reducing systemic risk.

We employ an event-study high frequency identification scheme to isolate exogenous macroprudential policy 'surprises'. We then study the impact of these surprises on systemic risk using local projection methods and a range of systemic risk indicators. Using a high-frequency approach for identification and daily systemic risk data allows us to control for (a) any anticipatory effects that financial markets might have already factored in before the policy was announced; and (b) endogeneity problems where macroprudential policy might have responded to market conditions.

We find that macroprudential policy announcements can reduce systemic risk in the near-term, specifically in the (financial) equity and bond markets. These results are robust to a number of specifications and different systemic risk measures.

We contribute to the literature in three ways. Firstly, as part of our analysis, we construct a database of macroprudential policy announcements in the UK encompassing a wide range of UK and international macroprudential authorities. Our database includes several macroprudential policy measures including capital, liquidity and housing measures and is available at daily frequency.

Secondly, using event study methodology, we identify a novel series of unanticipated macroprudential policy 'surprises', analogue to the monetary policy literature[1], which we can use to study the impact of macroprudential policy. This is in contrast to previous literature which often identifies macroprudential shocks using a narrative approach (e.g. Richter et al. (2019)) within a monthly frequency (e.g. Meuleman & Vennet (2020)). While this identification scheme allows for a very wide range of measures to be taken into account for a cross section of countries, our high-frequency identification approach ensures that the macroprudential shocks are unexpected and therefore not anticipated and already priced into market expectations.

[1] Some examples for high-frequency identification for monetary policy shocks are Gürkaynak et al. (2005), Gertler & Karadi (2015), Nakamura & Steinsson (2018), Jarociński & Karadi (2020), Cesa-Bianchi et al. (2020), and Miranda-Agrippino & Ricco (2021)

Finally, our paper presents new evidence on the impact of macroprudential policy shocks on systemic risk, a key financial stability measure. We use the Composite Indicator of Systemic Stress (CISS) (Hollo et al. 2012) to measure systemic risk which accounts for risks and interlinkages within 5 different segments of financial markets. Previous papers have explored a more narrow definition of systemic risk by focusing on bank risk specifically. For example, Meuleman & Vennet (2020) also examine the link between macroprudential policy and systemic risk, as measured by the individual bank's marginal expected shortfall (MES). Our work differs from theirs in three important dimensions. First, in contrast to the bank-specific MES our measure of systemic risk encompasses different dimensions of market stress, so that it can account for a broader effect on systemic risk beyond stress in bank equity markets. Secondly, while they use monthly data, our daily high-frequency approach should alleviate endogeneity concerns to a maximum degree. Finally, rather than looking at an aggregate series of macroprudential policy announcements, our identification strategy carefully selects macroprudential policy shocks, which are unanticipated and exogenous to the state of the economy. Similarly, Altunbas et al. (2018) also find that macroprudential policy, in particular when tightening, is effective in reducing bank risk.

Besides the few papers that looked at systemic risk, a larger fraction of papers have studied the role of macroprudential policies in terms of lending spreads (e.g. Meeks (2017)), credit growth (e.g. Claessens et al. (2013), Cerutti et al. (2017), or Kuttner & Shim (2016) for housing), or macro outcomes (e.g. Richter et al. (2019)). However, in those papers a macroprudential tightening is often associated with a drain on economic growth in the short-term as lending is temporarily reduced in response to an increase in capital, loan-to-value (LTV) or loan-to-income (LTI) requirements. Looking at systemic risk instead allows us to explore the benefits of macroprudential tightening and how effective it is in fulfilling its primary objective, financial stability.

Our paper also relates to the literature on central bank communication and the market reaction to specific macroprudential policy announcements. As we highlight in Section 3 only very few macroprudential announcements are actually unanticipated and can therefore be used to identify the effect of macroprudential policy. This is also confirmed by Flannery et al. (2017) who analyse the market reaction to stress test announcements and find no discernible effect, or Harris et al. (2019) who find no strong market reaction to financial stability reports and conclude that most information was already anticipated. Bruno et al. (2018) also find that markets did not react strongly if policies were not perceived to be binding.

The remainder of the paper is structured as follows: Section 2 introduces the data for the construction of the macroprudential announcement series and several systemic risk measures. Section 3 lays out how we identify macroprudential policy 'surprises'. Section 4 explains our local projection methodology to identify the effect of a macroprudential announcement shock on systemic risk, and presents the results and several robustness checks. Finally, Section 5 concludes. Additional material is reported in the Appendix.

2 Data

2.1 Dataset construction

In contrast to monetary policy announcements, there is no easily available measure of the macroprudential policy stance in the UK at a daily frequency. To address this issue, we compile a macroprudential announcement dataset, which consists of 44 macroprudential policy measures that were taken from 1 January 2009 to 31 December 2019. We use the ECB's monthly Macroprudential Policies Evaluation Database or MaPPED, which provides details of more than 2000 macroprudential policy actions taken in 28 EU member states from 1995 to 2017. The dataset covers a large range of macroprudential policy instruments, including capital-based, asset-based or liquidity-based policy measures.

We expand this dataset along several dimensions: As MaPPED's coverage for the United Kingdom is only provided until 2015, we update MaPPED so that it covers macroprudential policy announcements made post 2015. These announcements come from a range of sources, namely Financial Stability Reports, Prudential Regulation Authority Supervisory and Policy Statements, Financial Policy Committee Policy Statements, Basel III and European Banking Authority publications.

Secondly, we upgrade MaPPED from monthly to daily frequency, so we can identify shocks more precisely. This means we look at each announcement and pin down the exact date when they were first made public. Finally, the listed macroprudential policies are country-specific and therefore do not always contain macroprudential policy announcements that are common across all EU member states, for example the publication of Basel III or the assessment methodology and additional loss absorbency requirements that apply to Global Systemically Important Institutions (G-SII). We ensure that our database includes both country-specific as well as wider international announcements related to macroprudential policy in the UK.

In total, we collect 44 macroprudential policy announcements which we can categorise into different instrument types; i.e. capital, liquidity, housing, leverage, levy, or other macroprudential measures (see Figure A.1 in the Appendix). For example, 12 of the macroprudential policy announcements we collect pertain to capital measures (capital requirements, capital conservation buffers, countercyclical capital buffers) and 6 of the announcements concern liquidity measures (liquidity coverage ratio and net stable funding ratio).

2.2 Financial firms

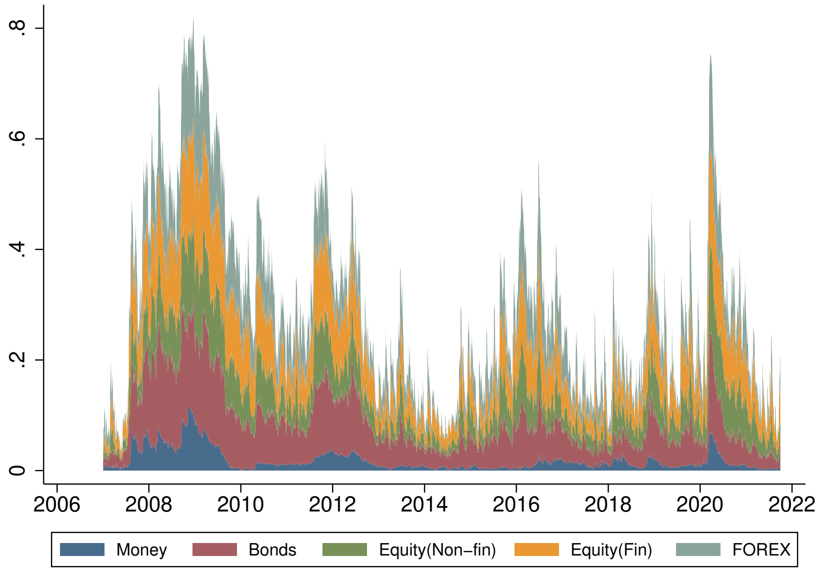
To examine whether the macroprudential policy announcements in our dataset were unanticipated by financial markets, we asses the equity returns of the six largest London Stock Exchange (LSE) listed banks against the returns of a broad market index. Data on equity prices, volumes, market capitalisations and CDS spreads for these securities has been obtained from Bloomberg. Consistent with Gregory et al. (2013), the broad market index has been proxied by the FTSE All Share Index, which comprises around 600 companies that trade on the LSE. The six banks in our analysis are Barclays, HSBC, Lloyds Banking Group, NatWest Group (RBS), Santander UK and Standard Chartered. There are two main reasons why we focus on these six banks. First, they are the participating banks in the Bank of England's annual cyclical stress test and in 2018 (together with Nationwide Building Society) accounted for around 80% of the outstanding stock of PRA-regulated banks' lending to UK households and businesses. Hence, we conjecture that these banks must be more directly affected by new macroprudential policy measures than other financial market participants. Secondly, their shares tend to be very frequently traded and are more liquid than other financial securities.

2.3 Systemic risk indicators

To assess the impact of macroprudential policy shocks on systemic risk in the UK, we use a daily indicator of contemporaneous stress in the financial system named the Composite Indicator of Systemic Stress (CISS) developed by Hollo et al. (2012). CISS measures the current level of frictions, stresses and strains in the financial system and condenses them into a single statistic of financial instability. The specific aim of the CISS is to emphasise the systemic nature of existing stresses in the financial system, where systemic stress is interpreted as an ex-post measure of systemic risk, (i.e. risk which has materialised already (Hollo et al. 2012)). We chose the UK CISS for several reasons. First, CISS is a composite indicator that combines market based financial stress measures coming from 5 different segments of the financial markets. These segments concern money markets, bond markets, equity markets (financials and non-financials) and foreign exchange markets as shown in Figure 1. Secondly, different from other financial conditions indices, CISS focuses on the systemic dimension of financial stress.[2] And thirdly, from a statistical point of view CISS has been shown to not suffer from look-ahead bias, which occurs when information that would not have been known during the period being analysed is used and can lead to inaccurate results. Additionally, CISS is sufficiently robust to outliers and can be updated on a daily basis (Chavleishvili & Kremer 2021).

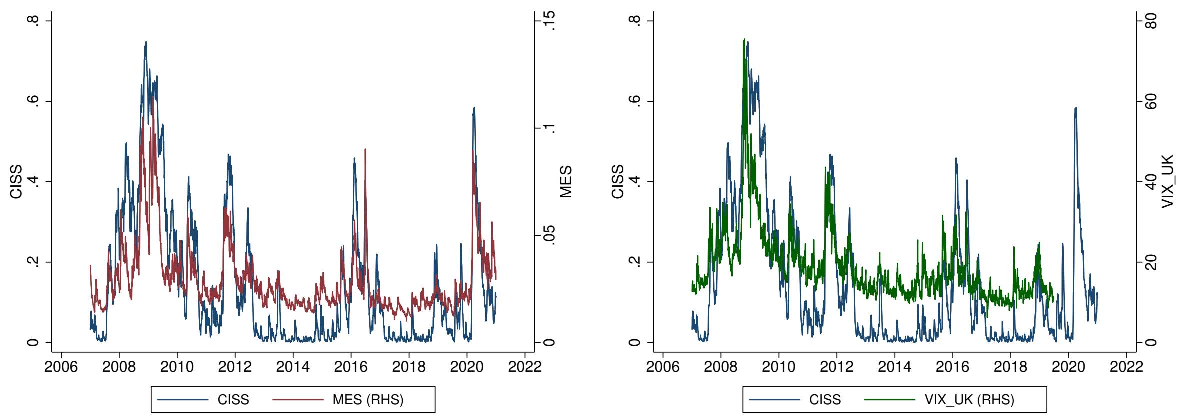
[2]What makes CISS a systemic measure is the statistical methodology used in aggregating financial stress coming from all 5 of these segments, which assigns more weight on days were stress is elevated in several markets simultaneously.

Figure 1: Decomposition of CISS



Since CISS is not the only indicator of systemic stress provided at a daily frequency, as a robustness check we also test our results against another popular market-based indicator of systemic risk. Namely, the Marginal Expected Shortfall (MES) developed by Acharya et al. (2010). MES measures an individual bank's marginal contribution to the overall tail risk in the banking system. Formally, the MES of a financial institution represents the expected equity loss of a bank's stock price conditional on a large shock to the financial system (what is known as a tail event).

Figure 2: CISS vis-à-vis other Financial (In)stability Indicators



We proceed by computing the MES measure for each of the 6 individual banks in our analysis (see Appendix A.3 for more details). We then take a weighted average of the estimated MESs, with weights assigned according to banks' market capitalisation. The left panel of Figure 2 plots the weighted average MES estimate over time. MES is elevated in times of well-known financial stress periods such as the Great Financial Crisis, the European Sovereign Debt crisis, Brexit and more recently the Covid-19 crisis. Moreover, the left panel of Figure 2 shows that there is a great degree of co-movement between CISS and MES, thus indicating that MES is a good systemic risk proxy.[3] However, while MES moves similarly to CISS during times of economic stress, the time series can be quite different outside of peak crisis times. The contemporaneous differences are a reflection of the fact that while MES only captures systemic stress in the banking sector, CISS encompasses a much broader structure of financial markets, which accounts for stress in bond and FOREX markets as well.

Additionally, we conduct robustness checks against another well-known financial conditions indicator, namely the FTSE100 Implied Volatility Index, VIX^{UK}. While VIX^{UK} is not a systemic risk measure, it is often seen as a way to gauge market sentiment, and in particular the degree of risk aversion and uncertainty among stock market participants. To the extent that the level of risk aversion in the stock markets is likely to be high in periods of elevated systemic risk, we think of VIX^{UK} as a suitable financial instability/stress variable for our analysis.[4] However, unlike CISS, which is a composite financial instability measure, VIX^{UK} measures the options-implied volatility in equity markets and does not consider other financial markets, such as the interbank, bond and FOREX markets. Moreover, since VIX measures the options-implied volatility of FTSE100 returns, it is more susceptible to global shocks that affect the large international companies that make up this index. For these reasons we do not think of VIX as a substitute for systemic risk in the UK, but rather as a complementary indicator of financial instability.

3 Identifying macroprudential policy 'surprises'

For our identification strategy, we borrow from the monetary policy literature and turn to financial market data to identify macroprudential policy innovations unrelated to the state of the economy (Kuttner 2001, Gürkaynak et al. 2005, Gertler & Karadi 2015, Nakamura & Steinsson 2018, Jarociński & Karadi 2020, Cesa-Bianchi et al. 2020, Miranda-Agrippino & Ricco 2021). However, unlike in the monetary policy literature where monetary policy shocks are identified through high-frequency changes in the short term interest rate futures, there is no financial instrument that trades based on macroprudential policy. Nonetheless, to the extent that some of the macroprudential policy announcements in our dataset are unanticipated, they could still have an impact on bank equity prices and bank CDS spreads, which are most closely related to expected future bank profitability and expected probability of bank default.

[3]The full sample correlation coefficient between CISS and MES is 0.862.

[4]The FTSE100 Implied Volatility Index Series (30 day) is available on Bloomberg.

3.1 Macroprudential policy transmission channels to stock prices

In this subsection we look at how a tightening macroprudential policy announcement may effect bank equity prices using a simplified Consumption CAPM asset pricing model. Suppose an investor can freely buy or sell a security, at a price p_t. Denote by x_{t+1} the payoff that this asset yields in period $t+1$. Denote by ξ_t the amount of the asset the investor chooses to buy and by e_t the investor's endowment at time t. The investor's problem becomes:

$$\max_{\xi} u(c_t) + E_t[\beta u(c_{t+1})] \text{ st}$$

$$c_t = e_t - p_t \xi$$

$$c_{t+1} = e_{t+1} + x_{t+1}\xi$$

Substituting the constraints into the objective, and setting the derivative with respect to ξ equal to zero, we obtain the first-order condition for an optimal consumption and portfolio choice:

$$p_t u'(c_{t+1}) = E_t\big[\beta u'(c_{t+1} x_{t+1})\big]$$

This equation expresses the standard marginal condition for an optimum: $p_t u'(c_{t+1})$ is the loss in utility if the investor buys another unit of the asset; $E_t\big[\beta u'(c_{t+1} x_{t+1}\big]$ is the increase in (discounted, expected) utility the investor obtains from the extra payoff at t+1. The investor continues to buy or sell the asset until the marginal loss equals the marginal gain.

$$p_t = E_t\Big[\beta \frac{u'(c_{t+1})}{u'(c_t)} x_{t+1}\Big]$$

Let us define the stochastic discount factor $m_{t+1} \equiv \beta \frac{u'(c_{t+1})}{u'(c_t)}$. Then the asset price formula can simply be expressed as:

$$p_t = E_t(m_{t+1} x_{t+1}) \tag{1}$$

Moreover, we separate all possible future events ('states of the world') into two sets. One set contains one single 'bank default' event (D), the other contains all other (no bank default) events (ND). Let us denote the probability of bank default by $prob^D$. Let E^D and E^{ND} denote expectations conditional on the default and no-default events, respectively. Let us assume for simplicity that the investor's payoff in the case of bank default is some known constant, x^D_{t+1}.[5] We can now write the asset pricing equation in (1) as follows:

$$p_t = (1 - prob^D) E_t^{ND}(m_{t+1} x_{t+1}) + prob^D E_t^D(m_{t+1}) x^D_{t+1} \tag{2}$$

[5]Assume $E_t^{ND}[x_{t+1}] > x^D_{t+1}$ (i.e. expected future payoff conditional on no default is greater than future payoff in the event of bank default).

Applying a simple covariance formula, we can separate equation (2) into three terms:

$$p_t = (1 - prob^D)\Big[E_t^{ND}(m_{t+1})E_t^{ND}(x_{t+1}) + Cov^{ND}(m_{t+1}, x_{t+1})\Big] + prob^D E_t^D(m_{t+1})x_{t+1}^D \quad (3)$$

$$p_t = \underbrace{(1 - prob^D)\frac{E_t^{ND}[x_{t+1}]}{R_{t+1}^f}}_{\text{Discounted PV of future payoffs (ND)}} + \underbrace{(1 - prob^D)\ Cov^{ND}\big(m_{t+1}, x_{t+1}\big)}_{\text{-Risk premium (ND)}} + \underbrace{prob^D \frac{x_{t+1}^D}{R_{t+1}^f}}_{\text{Discounted PV of future payoffs (D)}} \quad (4)$$

where R_{t+1}^f denotes the gross risk-free return at time t+1, i.e. the inverse of the expected discount factor.[6] A macroprudential policy announcement may be affecting all three terms in equation (4) through four different channels:

Reduction in future bank expected profitability: To the extent that tightening macroprudential polices such as capital and leverage requirements limit bank's ability to extend credit, the latter may have a negative effect on future bank profitability. From a shareholder's perspective, this is equivalent to a reduction in the discounted present value of future payoffs conditional on no bank default (i.e. a reduction in $E_t^{ND}[x_{t+1}]$). Equation (4) indicates that holding everything else constant, this channel of transmission of macroprudential policies would lead to a reduction in bank equity prices.

Reduction in bank probability of default: Macroprudential policies aim to reduce the probability and severity of future episodes of systemic stress. This means that they have a direct impact on banks' probability of default, $prob^D$. Holding everything else equal, equation (4) shows that a reduction in probability of bank default increases bank equity prices.

Reduction in risk premium: Since macroprudential policies aim to make individual banks safer and increase the resilience of the financial system to future shocks, they may have a significant impact on how non-risk-neutral investors perceive these banks. In other words, macroprudential policies that aim to reduce banks' riskiness and their procyclicality may have a role to play in reducing the covariance between expected future payoffs and consumption (i.e. $\big|Cov^{ND}\big(m_{t+1}, x_{t+1}\big)\big|$ falls). Equation (4) shows that this would have a positive effect on prices, ceteris paribus.[7]

Central Bank information effects: A tightening macroprudential policy announcement may simultaneously convey information about macroprudential policy and the central bank's assessment of the economy's risk environment. If this is the case, we should

[6] We are assuming the unconditional and the conditional risk-free rates are equivalent

[7] We are assuming here that there is a positive correlation between future payoffs and consumption.

expect macroprudential policies to affect not only the discounted future bank profitability conditional on no bank default ($i.e. E_t^{ND}[x_{t+1}]$), but also the probability of bank default, $prob^D$ and potentially the risk premium term in equation (4). For example, a pessimistic communication of the financial risks that motivated the macroprudential authority to introduce a new policy measure may send panic signals in the markets. This would manifest itself as a reduction in the discounted present value of future payoffs (ND) term as well as an increase in the risk premium, which would have a downward impact on bank equity prices.

Overall, the way in which macroprudential policy announcements affect stock prices will depend on which of these channels dominates. For now, we will ignore the effect that macroprudential policy announcements have on equity risk premia and only look at the effects of macroprudential policy announcements on the first and third term.[8] As observed in equation (4) there are two factors that will impact the overall effect of macroprudential policies on bank equity prices (i.e. future expected bank profitability versus probability of default). As explained above, these two factors may have an opposite effect on bank equity prices. One way to disentangle these effects is to look at the joint responses of bank equity prices and a market-based variable of bank probability of default. Since CDS spreads price in a firm's probability of default and loss given default, we use CDS spreads as a proxy for bank default probability. The CDS spread is a relatively pure pricing of default risk of the underlying entity (Zhang et al. 2009).

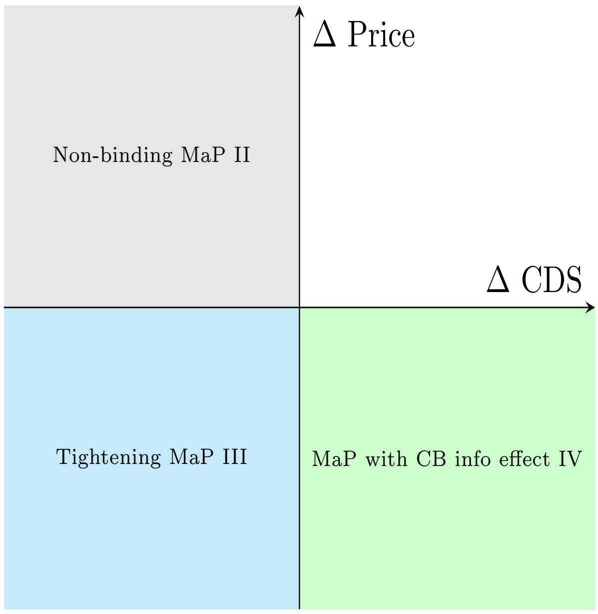


Figure 3: Equity price vs. CDS spreads effects from a surprise MaP tightening

Figure 3 shows the joint impact on equity prices and CDS spreads from a tightening macroprudential policy announcement. Quadrant III (in light blue) depicts tightening

[8]We are working on incorporating the asset price effects of macroprudential policy announcements through the risk premium term using market-based indicators.

macroprudential policies that are associated with a reduction in bank equity prices as well as a reduction in probability of default. For this to be the case, it must be that the reduction in expected future bank profitability (which has a negative effect on equity prices) exceeds the reduction in default probability (which has a positive effect on equity prices). Quadrant II (in light grey) depicts tightening macroprudential policies that were met by an increase in equity prices and a reduction in CDS spreads. This could be the case if in the aftermath of a tightening macroprudential policy announcement, the reduction in bank probability of default outweighs the reduction in the expected future bank profitability. This could also be the case if a tightening macroprudential policy announcement is considered to be non-binding and therefore have no effect on future bank expected profitability. Non-binding macroprudential policy announcements may reveal to the markets that banks are 'safer' than expected, which would put downward pressure on their perceived probability of default. Lastly, the announcements that fall in Quadrant IV (in light green) are announcements that not only generate a reduction in bank equity prices, but are also associated with an increase in perceived bank probability of default. This could be the case if tightening macroprudential policy announcements also contain information about the underlying risks that motivated the regulatory authority to undertake these measures. These risks may include an increase in the likelihood of bank default. We think of these announcements as tightening announcements that contain additional Central Bank information effects.

In this paper, to identify macroprudential policy shocks we employ event study techniques, which bracket a short window before and after a macroprudential policy announcement. The event study methodology allows us to think of macroprudential policy shocks as days where cumulative abnormal returns and/or CDS spreads of a portfolio that consists of stocks from the 6 largest LSE-listed banks are significantly different from zero. In other words, our macroprudential policy shocks are days when financial markets were significantly surprised in the aftermath of a macroprudential policy announcement.

3.2 Event study methodology

For our event study, we follow a standard methodology and compare equity returns and/or CDS spreads in the 'event window' versus an estimation window. The estimation window represents equity returns and/or CDS spreads during 'normal times'. We designate the date of each macroprudential policy announcement as $\tau = 0$. The estimation window covers the period from 261 days before the publication to 2 days before the publication. The event window brackets the window before and after the announcement. The event window is chosen to be short enough to exclude any non-macroprudential policy related news, and long enough for the information to be assimilated by the markets.[9] The estimation window is chosen following Bruno et al. (2018) and Armour et al. (2017).

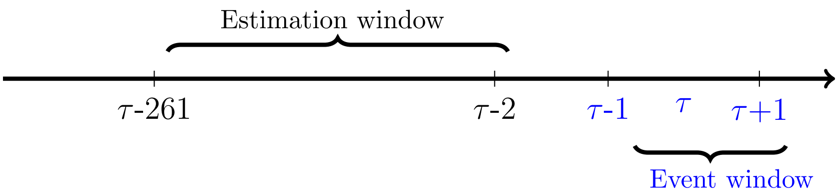


Figure 4: Event study timeline

Abnormal returns: To begin with, we start with a simple market model in the estimation window. The α and β coefficients are estimated from an ordinary least squares (OLS) regresion of each bank's daily stock returns, $R_{i,t}$ on the daily returns of FTSE All Share Index, $R_{m,t}$.[10]

The abnormal returns in the event window are computed as the difference between the realized stock returns and expected returns based on the market model:

$$\widehat{AR}_{i,t} = R_{i,t} - \underbrace{(\widehat{\alpha}_i + \widehat{\beta}_i R_{m,t})}_{\text{Expected Return}} \tag{5}$$

Our next step is to cumulate abnormal returns over the event window $(\tau - 1, \tau + 1)$:

$$\widehat{CAR}_{i,t} = \sum_{t=\tau-1}^{\tau+1} \widehat{AR}_{i,t} \tag{6}$$

We then average the cumulative abnormal returns across the number of LSE-listed banks, N, in our analysis:

$$\widehat{CAAR}_t = \frac{1}{N} \sum_{i=1}^{N} \widehat{CAR}_{i,t} \tag{7}$$

And finally, we test (parametrically and non-parametrically) whether the cumulative average abnormal returns in the event window are significantly different from zero.

Abnormal change in CDS spreads: We follow Flannery et al. (2017) and Harris et al. (2019) and estimate an abnormal change in CDS spreads as the residual from the following regression:

$$\Big(\frac{CDS_{i,t}}{CDS_{i,t-1}} - 1\Big) = \alpha_i + \beta_i \Big(\frac{CDX_{i,t}}{CDX_{i,t-1}} - 1\Big) + \epsilon_{i,t} \tag{8}$$

where $CDS_{i,t}$ is the CDS spread for bank i on trading day t and CDX is the CDS spread

[9] We have included the day before the announcement in the event window, so that we can account for potential leakage of information the day before the press statement by regulators.

[10] To address any endogeneity concerns, we have filtered out the returns of Barclays, Santander UK, Lloyds, RBS, Standard Chartered and HSBC from the FTSE All Share benchmark. This is done by re-weighting the daily returns of all other constituents of FTSE All Share by market capitalisation, so that the banks in our analysis are excluded from the benchmark.

for the ITRAXX Europe investment grade index. We proceed by calculating abnormal chnages in CDS spreads over the event window in a similar fashion to equations (6) and (7) and test their significance under the normality assumption.

3.3 Event Study Results

Our tests show that 19 out of 44 macroprudential policy event days significantly affected banks' stock market returns. However, it would be naive to claim that all 19 of these responses were solely driven by macroprudential policy announcements and no other important economic news that could have been released on the day. To address this issue we rely on Factiva, which is a digital archive of global news that covers a great number of financial news sources worldwide. We provide Factiva with search words such as 'banks', 'financials', 'unemployment', 'monetary policy', 'earnings' and 'inflation' and check whether any other economic signals occurred on the same day as our macroprudential policy events.

We find that 11 of our macroprudential policy event dates have been contaminated by other financial news. For instance, while it is true that on 19 January, 2009 the Financial Service Authority made a statement announcing new rules on minimum core Tier 1 capital ratios, it is also true that all banking shares in the UK collapsed in the aftermath of RBS announcing the biggest corporate losses in history.[11] To the extent that these other economic events would render our macroprudential policy events endogenous, we exclude these dates from our sample of unanticipated macroprudential policy events.[12] Our final sample of unanticipated macroprudential policy events contains 8 macroprudential policy announcements, as summarised in Table 1 and Table 2:

[11] 19 January 2009 was previously known as Blue Monday. RBS shares fell over 67% in a single day. Shares in all other British banks suffered heavy losses.

[12] See Table A.1 for a detailed account of the excluded macroprudential policy events.

Table 1: CAARs under 4 different event windows

Date	Event	CAAR[-1,1]	CAAR[-1,0]	CAAR[0,1]	CAR[0,0]
16 Dec 2010	Basel III	-4.3326%***	-1.6927%	-2.6153%**	0.0247%
		(0.0020)	(0.1355)	(0.0215)	(0.9753)
04 Nov 2011	G-SII Buffers	-2.9975%**	-1.6390%	-1.8067%	-0.4482%
		(0.0391)	(0.1654)	(0.1263)	(0.5902)
27 Jun 2013	CRD IV	-2.7029%**	-2.3429%**	-2.8696%***	-2.5096%***
		(0.0319)	(0.0232)	(0.0052)	(0.0006)
27 Oct 2014	PRA PS + EBA Stress Test	-3.1828%***	-1.0871%	-3.9078%***	-1.8121%***
		(0.0003)	(0.1273)	(0.0000)	(0.0004)
31 Oct 2014	Leverage ratio	1.6806%*	2.0174%***	1.9809%***	2.3177%***
		(0.0609)	(0.0061)	(0.0069)	(0.0000)
19 Feb 2016	O-SII Methodology + SSM	-2.4653%**	-2.9856%***	-0.3349%	-0.8553%
		(0.0121)	(0.0002)	(0.6741)	(0.1286)
29 Mar 2016	CCyB	-2.3971%**	-2.3222%***	-1.1828%	-1.1079%*
		(0.0258)	(0.0082)	(0.1769)	(0.0728)
25 Sep 2017	PRA Buffer	-2.0571%**	-1.7545%**	-1.6967%**	-1.3940%**
		(0.0440)	(0.0353)	(0.0415)	(0.0178)

Notes: This table presents the cumulative average abnormal returns (CAAR) from a portfolio of the 6 largest LSE-listed banks, following a macroprudential policy announcement. The estimation window is chosen to be (-261, -2). p-values in parenthesis are obtained under the normality assumption. *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Table 1 shows the cumulative average abnormal returns (CAAR) for each of the macroprudential policy announcements that generated a significant market reaction.[13] For more information on the disaggregated CAARs on the announcement dates for each bank stock, see Appendix B.1. As a robustness check, we also include the event study results under three other event windows. Namely, an event window that concerns one day before the announcement and the day of the announcement (-1,0), an event window that concerns the day of the announcement and one day after (0,1) and an event window that only takes into account the day of the announcement (0,0). The results show that the macroprudential policy announcements listed in Table 1 did provide new information to the financial markets and had a significant impact on expected future bank earnings and profitability. Moreover, the sign of the CAARs is negative in all but one announcement, suggesting that macroprudential policy measures were in general 'tighter' than expected.

Table 2 shows the cumulative average abnormal changes in CDS spreads for each of the macroprudential policy announcements that generated a significant market reaction. The majority of the macroprudential policy events were met by a negative or an insignificant abnormal change in CDS spreads. This is consistent with the mechanisms described in Section 3.1. The joint effect of stock price changes (proxied by CAARs in Table 1) and the perceived probability of bank default changes (proxied by abnormal changes in CDS spreads in Table 2) places the majority of our announcements in Quadrant III of Figure 3 (i.e. pure tightening macroprudential policy surprises).

[13]We elaborate more on the nature of each surprise announcement in Section B.4.

Table 2: Cumulative abnormal changes in CDS spreads under 4 different event windows

Date	Event	CDS[-1,1]	CDS[-1,0]	CDS[0,1]	CDS[0,0]
04 Nov 2011	G-SII buffers	1.8670%	-0.6266%	3.4362%	0.9425%
		(0.6106)	(0.8294)	(0.2492)	(0.6406)
27 Jun 2013	CRD IV	-7.7589%***	-13.1495%***	1.4060%	-3.9845%***
		(0.0024)	(0.0000)	(0.4962)	(0.0066)
27 Oct 2014	PRA PS + EBA ST	-2.0662%	-4.9653%**	-0.9419%	-3.8411%***
		(0.3852)	(0.0109)	(0.6272)	(0.0053)
31 Oct 2014	Leverage ratio	0.9541%	1.8901%	-4.5427%**	-3.6067%***
		(0.6901)	(0.3326)	(0.0207)	(0.0092)
19 Feb 2016	O-SII Methodology + SSM	4.3065%	4.3722%**	4.8340%**	4.8998%***
		(0.1113)	(0.0476)	(0.0286)	(0.0018)
29 Mar 2016	CCyB	0.9544%	1.2960%	-1.0138%	-0.6722%
		(0.7324)	(0.5689)	(0.6559)	(0.6755)
25 Sep 2017	PRA Buffer	4.3234%**	3.8122%**	2.4711%	1.9600%*
		(0.0221)	(0.0133)	(0.1073)	(0.0705)

Notes: This table presents the cumulative average abnormal changes in CDS spreads from a portfolio of the 6 largest LSE-listed banks, following a macroprudential policy announcement. The estimation window is chosen to be (-261, -2). p-values in parenthesis are obtained under the normality assumption. *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

There are three notable exceptions. The first is the 31 October 2014 announcement in which the BoE increased the leverage ratio requirement, but markets did not consider the new requirement as binding. On this date CAAR increased by approximately 1.68% on a (-1,1) window.[14] Interestingly, CDS spreads decreased quite significantly on the day of the announcement. As explained in Section 3.1, this announcement belongs in Quadrant II of Figure 3. The other announcement that was met by a significant CDS spread response is that of 25 September 2017. On this date the BoE warned that banks had been 'too' lax in provisioning for potential losses in consumer credit and should increase their capital buffers to 'protect' themselves (Financial Times).[15] One could argue that the bank equity response on this date can in principle be the result of both a reduction in the expected future bank profitability and an increase in the probability of bank default. In other words, the announcement of 25 September 2017 also contains Central Bank information effects. Our simple asset pricing equation places this announcement in Quadrant IV of Figure 3. Similarly, we place the announcement of 19 February 2016 in Quadrant IV of Figure 3, because this event led to a significant reduction in equity prices, but was simultaneously accompanied by an increase in CDS spreads.

Robustness: We conduct a number of robustness checks to ensure that the shock series we identify are indeed true macroprudential surprises. Firstly, we check the robustness

[14]We think of this as a 'positive' macroprudential policy surprise. Financial news suggests that analysts regarded this policy measure as 'looser' than expected. "Credit Suisse estimates indicated that most UK banks were in a comfortable position to meet their requirements by the following year". (Article by Max Colchester and Jason Douglas, retrievable at Dow Jones Top News and Commentary, www.dowjones.com/professional/factiva)

[15]Article by Chris Giles (Financial Times), retrievable at www.ft.com/content/c0f1eb7c-a1d2-11e7-b797-b61809486fe2

of the simple market model by comparing it to a Fama-French (1993) three-factor model:

$$R_{i,t} = R_{f,t} + \beta_i(R_{m,t} - R_{f,t}) + s_i SMB_t + h_i HML_t + \epsilon_{i,t} \tag{9}$$

where $R_{f,t}$ is the risk-free rate of return and SMB_t and HML_t are, respectively, the size and value factors constructed by Gregory et al. (2013). The results from the three-factor specification are reported in Table B.10 and they are quantitatively and qualitatively very similar to the results reported in Table 1.
Secondly, to ensure that our $\hat{\alpha}$ and $\hat{\beta}$ estimates from the market model are consistent and the results are robust to different estimation windows, we consider two alternative estimation windows. Namely (-120, -30) in line with Linton (2019) and (-91, -11) in line with Harris et al. (2019). The results are very similar and are reported in Table B.11.
And lastly, we conduct the event studies under different test diagnostics. Campbell et al. (2010) argue that in multi-day windows nonparametric rank and generalized sign tests are more powerful than common parametric tests. Our results in Table B.12 are robust to both parametric (Patell 1976, Boehmer et al. 1991) and non-parametric (Wilcoxon 1945, Kolari & Pynnonen 2011) tests.

3.4 Macroprudential policy shocks series

We use the results in Table 1 to construct the macroprudential policy shock series. We elaborate more on the nature of each surprise in Section B.4. We next convert the identified surprises into a shock series. More specifically, for every tightening macroprudential policy announcement in Table 1 that generates a significant negative cumulative average abnormal return (CAAR), our ΔMaP_t^{shock} variable will take a value of 1. Analogously, for every tightening macroprudential policy announcement that generates a positive financial market reaction, our ΔMaP_t^{shock} variable will take a value of -1. And finally, for all macroprudential policy announcements that were met by an insignificant financial market response, our ΔMaP_t^{shock} variable will take a value of 0.

$$\Delta MaP_t^{shock} = \begin{cases} 1, & \text{if } C\hat{A}AR_t < 0 \text{ (significantly)} \\ -1, & \text{if } C\hat{A}AR_t > 0 \text{ (significantly)} \\ 0 & \text{otherwise.} \end{cases} \tag{10}$$

Borrowing from the monetary policy literature, an alternative way of constructing our macroprudential policy shock series would be to scale ΔMaP_t^{shock} according to the CAAR responses bracketing the macroprudential policy event windows. This ensures that we take into account not only the occurrence of a financial market surprise, but also the degree to which the markets were surprised. Hence macroprudential policy events that were met by a stronger financial market reaction are attributed a higher ΔMaP_t^{scaled}

index. Based on the results from Table 1, we proceed by constructing the following alternative macroprudential shock series:[16]

$$\Delta MaP_t^{scaled} = \begin{cases} 4.3326, & \text{if Date} = \text{16 Dec 2010} \\ 2.9975, & \text{if Date} = \text{04 Nov 2011} \\ 2.7029, & \text{if Date} = \text{27 Jun 2013} \\ 3.1828, & \text{if Date} = \text{27 Oct 2014} \\ -1.6806, & \text{if Date} = \text{31 Oct 2014} \\ 2.4653, & \text{if Date} = \text{19 Feb 2016} \\ 2.3971, & \text{if Date} = \text{29 Mar 2016} \\ 2.0571, & \text{if Date} = \text{25 Sep 2017} \\ 0 & \text{otherwise.} \end{cases}$$

In the scaled series, a one unit increase in ΔMaP_t^{scaled} reflects an unanticipated macroprudential policy measure that surprised the markets by 1pp. Similarly, a one unit decrease in ΔMaP_t^{scaled} reflects a looser-than-expected macroprudential policy announcement that 'positively' surprised financial markets by 1pp.

We argue that our macroprudential policy shocks are orthogonal to the state of the economy and unrelated to contemporaneous macro-financial conditions. This is because changes in expectations about future bank profitability using a tight window around a macroprudential policy announcement should predominantly be driven by information about macroprudential policy. On the assumption that the markets and the central bank have the same information about the determinants of macroprudential policy, any news that arrives in this short window about how policy is to be set must be about the actions of policy makers given the state of the economy, rather than the state of the economy itself (Cesa-Bianchi et al. 2020). Moreover, since we have made sure that no other news of economic or financial importance has occurred on the same day as the identified macroprudential policy surprises, these surprises are pure macroprudential policy surprises and not contaminated by any information effects.

To empirically verify that our series of macroprudential policy surprises is 'unpredictable' by current macrofinancial conditions, we regress the unanticipated changes in macroprudential policy on contemporaneous and lagged financial conditions over different time horizons. The explanatory variables considered include CISS as a measure of systemic stress, MES as a measure of systemic risk and VIX as a measure of market sentiment. Results in Table B.13 are nil, suggesting that financial conditions and/or market sentiment cannot forecast future unanticipated changes in macroprudential policy and

[16] These are based on the CAAR results from a portfolio of the 6 largest UK banks, bracketing a three-day event window (-1,1) around the macroprudential policy announcements.

that our identification assumption thus holds.

4 Empirical Analysis

4.1 Empirical Methodology

We estimate the impact of macroprudential policy shocks on systemic risk using daily data from 1 January 2009 to 31 December 2019. Since the effect of macroprudential policies on financial markets might take some time to be priced in, we estimate the dynamic effects using local projection methods in the spirit of Jordà (2005). The specification we use is as follows:

$$\Delta_h y_t = \alpha + \beta^h \Delta MaP_t^{shock} + \sum_{l=1}^{L} \delta_l^h y_{t-l} + \sum_{l=1}^{L} \beta_l^h \Delta MaP_{t-l}^{shock} + \sum_{k=1}^{K} \phi_k^h \Delta X_{t-k} + \epsilon_{t+h} \quad (11)$$

where $\Delta_h y_t = y_{t+h} - y_t$ denotes the response variable of interest (i.e. the change in systemic risk between announcement day t and day t+h over varying prediction horizons h = 1,2,..., 60). ΔMaP_t^{shock} is a dummy variable defined from the event study results in equation (4). X are a set of one-day lagged controls (K = 1) including daily changes in the UK 1 year gilt, 10 year gilt, euro/pound and pound/dollar exchange rate and an economic policy uncertainty index from Baker et al. (2016). We include lagged changes in the UK 1 year gilt and 10 year gilt to account for changes in conventional and unconventional monetary policy in the UK. The latter could affect systemic risk through the risk-taking channel, but also trigger a change in macroprudential policy depending on the economy's risk environment. We control for exchange rate fluctuations in our baseline specification because in a small open economy like the UK, movements in the exchange rate are important determinants of monetary policy transmission, which could have implications for both financial stability in the FOREX markets and the conduct of macroprudential policy. Moreover, since our sample period contains episodes of elevated financial risk such as Brexit, movements in the euro/pound and dollar/pound exchange rate are likely to control for such events. Lastly, we control for economic policy uncertainty, since the latter is associated with greater stock price volatility and reduced investment and employment.[17]

Equation (11) allows us to gauge the effect of an unanticipated change in macroprudential policy on systemic risk. The coefficient β^h represents the cumulative average impact of a macroprudential policy surprise on systemic risk h days after the shock hit.

[17] To the extent that our macroprudential policy shocks are orthogonoal to financial conditions, the inclusion of additional controls should not affect our results. We confirm empirically that this is indeed the case.

Since we are using daily data we set L = 30 days. Including lags of both the independent and dependent variable does not only correct for serial correlation in the error terms, but also allows us to account for historical factors that might have influenced the dependent and independent variable. If our macroprudential policy surprises are exogenous then the inclusion of the lags will not affect the probability limit of our estimator $\hat{\beta}^h$, but will affect its standard error and the value it takes in finite samples.[18]

4.2 Results

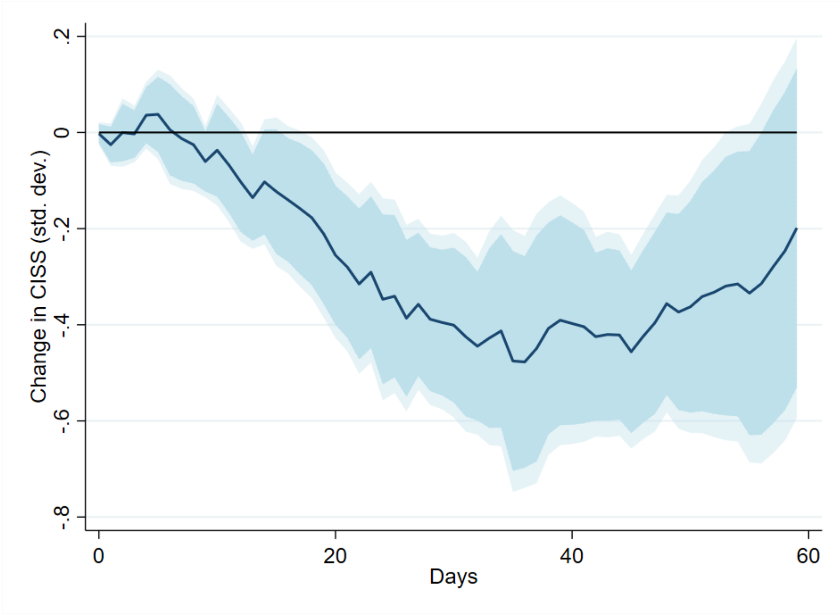
Figure 5 shows the dynamic effects of an unexpected macroprudential policy announcement on systemic risk, as defined in equation (10). The impulse response function indicates that in response to an unanticipated macroprudential policy tightening announcement, CISS in the UK falls by 0.48 standard deviations.[19] Our results indicate that macroprudential policies are not just a regulatory cost banks have to meet, but have a substantial role to play in reducing systemic risk. This is in line with the objective of macroprudential policy which is to pursue financial stability by ensuring banks are resilient enough to withstand financial shocks. It takes about 36 trading days for this effect to reach its peak, which is consistent with the idea that it takes time for banks to adjust their positions in the face of new regulatory requirements. This suggests that macroprudential policy announcements are indeed effective in reducing systemic risk in the short run with effects persisting for several months.

Additionally, we assess the systemic risk response to macroprudential policy shocks scaled by the degree to which the markets were surprised. The IRF in Figure 6 shows that in response to a tightening macroprudential policy announcement that negatively surprised the market by 1pp, the composite indicator of systemic stress in the UK falls by 0.152 standard deviations. Similarly to Figure 5, it takes about a month for this effect to reach its peak.

[18] Our results are robust to different lag-length specifications and are quantitatively and qualitatively very similar to setting L = 0 days.

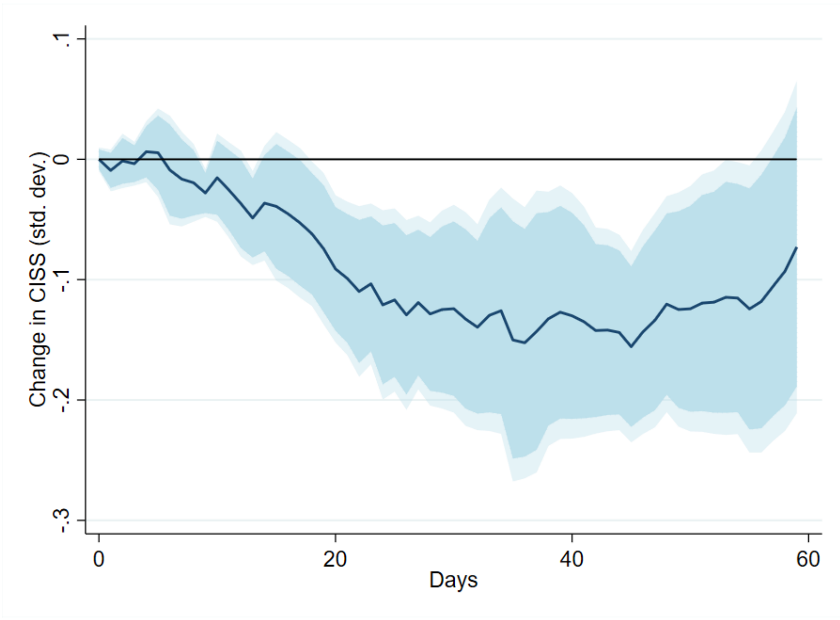
[19] As a point of reference, systemic risk in the UK as measured by CISS increased by around 4 standard deviations in the height of the Great Financial Crisis and by around 2 standard deviations on the week following the Brexit referendum.

Figure 5: The effect of macroprudential policies on systemic risk



Notes: In line with local projection methods, each horizon is estimated separately. The blue solid line represents the $\{\beta^h\}_{h=1}^{60}$ estimates in standard deviation units. The dependent variable is $\Delta_h CISS^{UK}$, over the horizons considered. The independent variable is $\Delta \text{MaP}^{shock}$. The light blue shaded areas denote the 95% and 90% confidence intervals around point estimates constructed with robust standard errors.

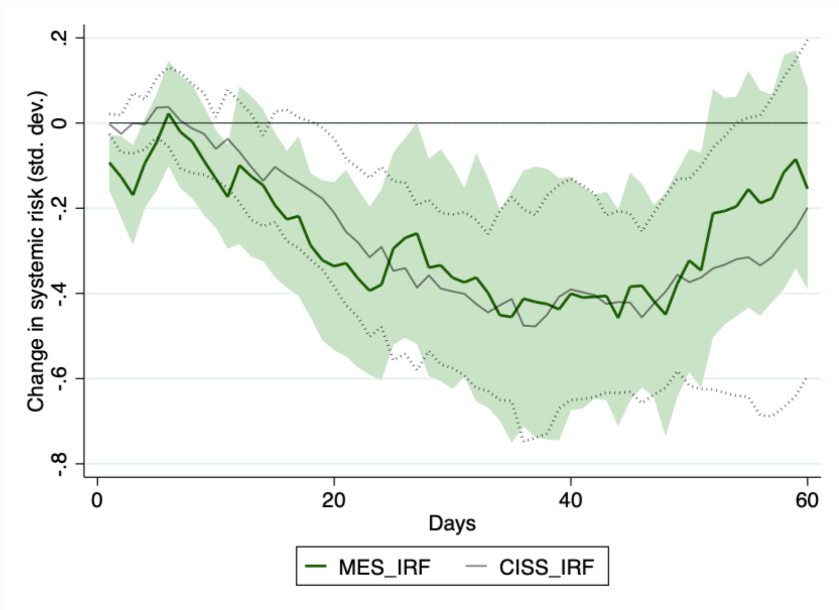
Figure 6: The effect of 'scaled' macroprudential policies on systemic risk



Notes: In line with local projection methods, each horizon is estimated separately. The blue solid line represents the $\{\beta^h\}_{h=1}^{60}$ estimates in standard deviation units. The dependent variable is $\Delta_h CISS^{UK}$, over the horizons considered. The independent variable, $\Delta \text{MaP}^{scaled}$ is scaled according to the CAAR responses bracketing the macroprudential policy event window, as defined in Section 3.4. The light blue shaded areas denote the 95% and 90% confidence intervals around point estimates constructed with robust standard errors.

Robustness to other measures of systemic risk Pertaining to the fact that the CISS is not the only indicator of systemic stress, as a robustness check we also use another measure of systemic risk, the Marginal Expected Shortfall (MES), in the local projection framework. As described in Section 2, MES can be thought of as the marginal contribution of an individual bank into the tail risk of the banking sector as a whole. Figure 7 reconfirms that the unanticipated macroprudential policy measures implemented in the post-GFC period led to a substantial reduction in systemic risk. The IRF in Figure 7 depicted by the green solid line is remarkably similar both in shape and magnitude to the IRF we obtained previously using CISS as an indicator of systemic risk. The results indicate that in the aftermath of a macroprudential policy shock, the average UK bank's contribution to overall downside risk in the financial markets falls down by approximately 0.5 standard deviations. This is again in line with the notion that tighter macroprudential policy is beneficial in reducing systemic risk and in particular risks emanating from the banking system, as banks become more resilient to external shocks. The result is also consistent with Meuleman & Vennet (2020) who showed that the introduction of tightening macroprudential policies have a downward effect on banks' MES within a one-month horizon.

Figure 7: The effect of macroprudential policies on systemic risk

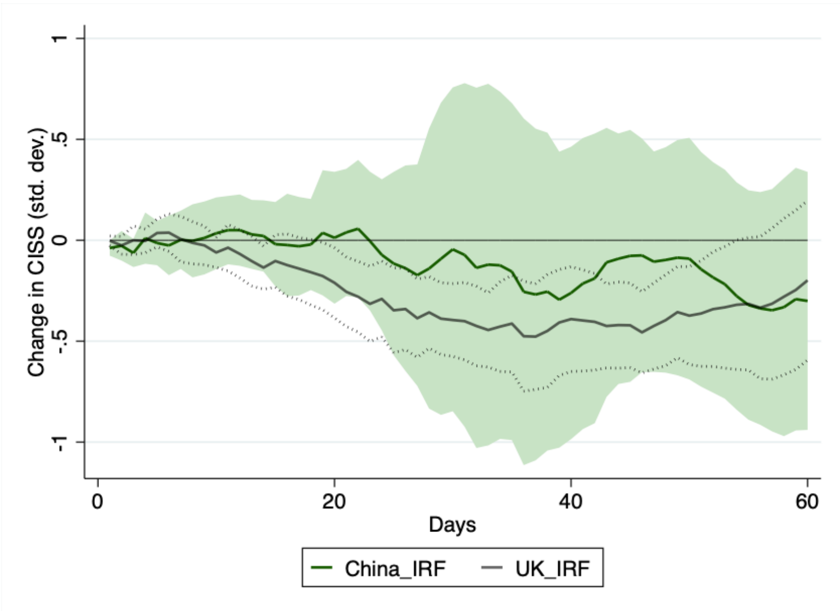


Notes: In line with local projection methods, each horizon is estimated separately. The green solid line represents the $\{\beta^h\}_{h=1}^{60}$ estimates in standard deviation units. The dependent variable is $\Delta_h MES^{Banks}$, over the horizons considered. The independent variable is $\Delta \text{MaP}^{shock}$. The light green shaded area denotes the 95% confidence intervals around point estimates constructed with robust standard errors. The gray solid line denotes the $\{\beta^h\}_{h=1}^{60}$ estimates with $\Delta_h CISS^{UK}$ as a dependent variable. Area bound by the gray dotted lines is the corresponding 95% confidence interval.

Additionally, we also conduct a robustness check against another well-known financial conditions indicator, namely the FTSE100 (30 day) Implied Volatility Index, VIX^{UK}. The results in Figure C.1 show that 30 days after an unanticipated macroprudential measure VIX reduces by approximately 0.7 standard deviations. This result lends support to the idea that by making the financial system safer, macroprudential policies may improve investors' sentiment and reduce market uncertainty.

We next want to ensure that the macroprudential shocks we identified are not just global shocks but specific to UK macroprudential policy. We construct a quasi-placebo test with our dependent variable being the h-horizon change of the composite indicator of systemic stress in China as opposed to the UK. The reason why we choose China as a counterfactual is twofold. First, UK and/or European specific macroprudential policy shocks (like the ones in our sample) are unlikely to affect systemic stress in Chinese financial markets. Second, in sharp contrast to some major jurisdictions, the Chinese Banking Regulatory Commission (CBRC) enthusiastically embraced the adoption of Basel III reforms. In fact, Knaack (2017) and Xi (2016) argue that China subjected itself to tougher regulatory standards compared to Basel III and aimed to implement them ahead of the international schedule. One could argue that since the Chinese banks were subject to stricter domestic regulatory requirements, the two Basel announcements that are part of our macroprudential policy shock series are unlikely to be binding. For these reasons we do not expect unanticipated UK macroprudential policy shocks to affect systemic risk in China. The insignificant impulse response function indicated by the green solid line in Figure 8 confirms our hypothesis.

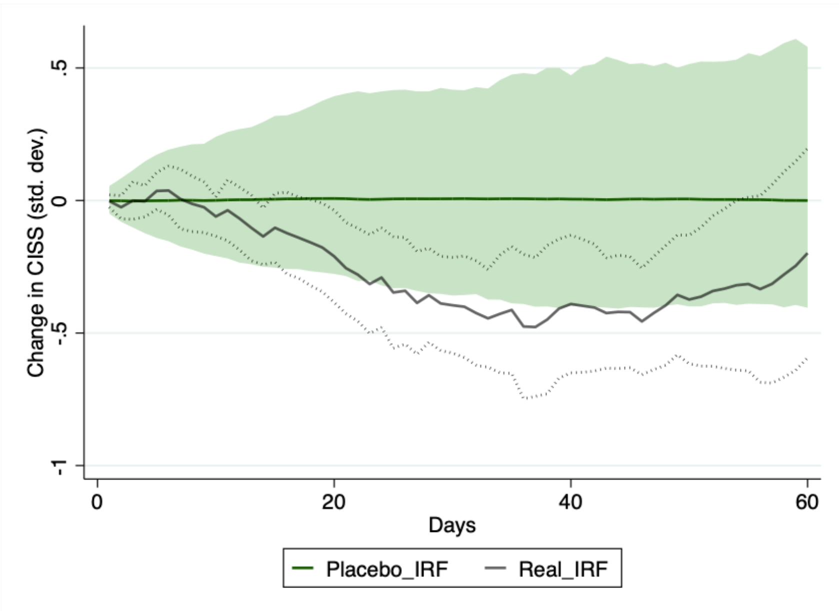
Figure 8: The effect of UK macroprudential policies on systemic risk in China



Notes: In line with the local projection methods, each horizon is estimated separately. The green solid line represents the $\{\beta^h\}_{h=1}^{60}$ estimates in standard deviation units. The dependent variable is $\Delta_h CISS^{China}$, over the horizons considered. The independent variable is $\Delta \text{MaP}^{shock}$. The light green shaded area denotes the 95% confidence interval around point estimates constructed with robust standard errors. The gray solid line denotes the $\{\beta^h\}_{h=1}^{60}$ estimates with $\Delta_h CISS^{UK}$ as a dependent variable. Area bound by the gray dotted lines is the corresponding 95% confidence interval.

Our next robustness step concerns a placebo test, where we simulate at random 8 macroprudential policy shocks days and investigate the effect of these placebo dates on systemic risk.[20] We do this to ensure that the shock series truly holds informational content rather than just being noise. We repeat this exercise 1000 times and we expect the 'placebo treatment' to not have an effect on systemic risk in the UK. Finding an effect would indicate an important flaw in our study. Figure 9 verifies that the placebo treatment does not have any effect on systemic risk. The IRF obtained from the placebo test (in solid green) oscillates around zero, with quite wide confidence bounds around the mean effect. The 'true' IRF on the other hand reports tight bands around a mean effect that is statistically different from zero. This result gives us confidence that the reductions in systemic risk in response to unanticipated macroprudential policy announcements (indicated in solid gray) are not pure coincidences and that our sample does not yield similar results for randomly selected shock dates.

Figure 9: The effect of a placebo treatment on systemic risk



Notes: In line with the local projection methods, each horizon is estimated separately. The green solid line represents the $\{\beta^h\}_{h=1}^{60}$ estimates in standard deviation units. The dependent variable is $\Delta_h CISS^{UK}$, over the horizons considered. The independent variable is $\Delta \text{MaP}^{Placebo}$. The light green shaded area denotes the 95% confidence intervals around point estimates. The gray solid line denotes the $\{\beta^h\}_{h=1}^{60}$ estimates with $\Delta \text{MaP}^{shock}$ as an independent variable. Area bound by the gray dotted lines is the corresponding 95% confidence interval.

Finally, we test for existence of 'outlier' macroprudential policy shocks dates i.e. the possibility that one of our macroprudential announcements is driving the majority of the results. Results of Figure 5 are robust to dropping one macroprudential policy surprise

[20] In essence we randomly generate seven dates (without replacement) for which our placebo macroprudential policy shock variable will take a value of 1 and one day for which our macroprudential policy shock variable will take a value of -1.

at a time, thus indicating that the effect of macroprudential policy shocks on systemic risk is not driven by an outlier macroprudential policy event (see Table C.2 for details).

4.3 Disaggregated results

Our next question is on which dimension of systemic risk do macroprudential polices have the strongest effect. In other words is the reduction in systemic risk coming from the money markets, bond markets, equity markets or foreign exchange markets? To address this question we make use of the daily decomposed CISS subindices for the UK and estimate Equation (11) with the dependent variable being one of the systemic stress subindences (see Chavleishvili & Kremer (2021) for more information on the statistical framework used for constructing the daily CISS.)

Money markets: We find that the effect is not coming from the money markets. This is not surprising given that stress in the interbank markets, which usually displays symptoms like flight-to-quality, flight-to-liquidity or emergency lending from the central bank has very much dissipated in the aftermath of the Great Financial Crisis (GFC).[21] Moreover, to the extent that macroprudential policies aim to reduce the build-up of financial system vulnerabilities over time, as opposed to restoring market functioning when a financial crisis occurs, it is unlikely that they have an impact on money market stress.[22] Of course the only exception here are the countercyclical buffers, which can be released in times of distress. However, given that our macroprudential policy shock series only consists of tightening measures (i.e. CCyB cuts were not identified as 'surprises' in Section 3), we cannot capture how a reduction in these buffers (which would be a loosing measure) can alleviate money market stress.

Bond markets: Figure 10 shows that a considerable reduction in overall systemic risk is attributed to a significant reduction in bond market stress or instability. A reduction in bond market stress is usually associated with containment of credit default and liquidity risk. There are three main reasons why macroprudential policies may have contributed to a reduction in bond market stress. First, the supervised banks issue large amounts of debt themselves. A tightening of capital/leverage requirements reduces the riskiness of these banks and leads to a redistribution of value from shareholders to creditors. This would be reflected in a reduction in the yield spreads between A-rated financial and non-financial corporations, which is one of the determinants of the bond market CISS subindex. Secondly, to the extent that macroprudential policies dampen down investor uncertainty and risk aversion, as reflected in our results in Figure C.1, it is perhaps not

[21]Money market stress contributed almost 15% to the aggregate CISS in the height of the GFC. It represented only 4% of the aggregate stress in December 2019. See Figure 1 for a detailed time evolution of the decomposed CISS series.

[22]Other central bank interventions such as emergency lending facilities, special liquidity operations and US dollar funding facilities could potentially be more effective at reducing risk in the money markets.

surprising that this reduces bond market stress. And thirdly, by limiting the banks' ability to lend to risky borrowers (in an effort to improve credit quality), macroprudential polices may reduce the pool of risky borrowers in the economy, which would also be reflected in a reduction in counterparty credit risk.

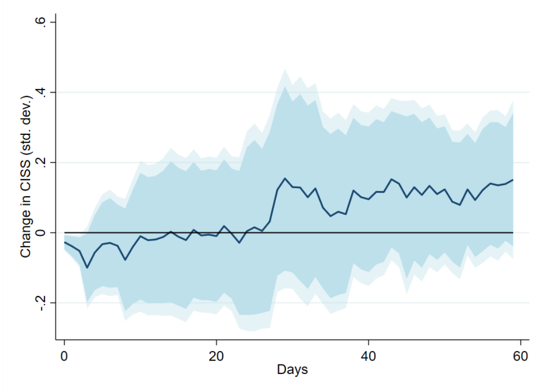
Equity (non-financials) markets: Additionally, our findings show that macroprudential policies may have also contributed to a reduction in systemic risk for non-financial corporations, potentially pointing to spillover effects from the financial sector to the non-financial sector. This effect is however statistically significant only for a few estimation horizons.

Equity (financials) markets: As expected, a significant reduction in systemic risk occurs in the equity markets and more particularly in the financials group. This result is consistent with our previous findings, which demonstrated that in the aftermath of a surprise macroprudential policy announcement, an individual bank's contribution to system-wide risk fell down by 0.48 standard deviations. In other words, we showed that macroprudential policy shocks reduce the likelihood of large bank equity losses. Additionally, our result in Figure C.1 indicated that unanticipated macroprudential policy shocks led to an improvement in investor sentiment and a reduction in risk aversion, as embedded in the VIX^{UK} response. These two effects combined are indicative of macroprudential polices contributing to an improvement in financial sector stability as is shown in Figure 10.

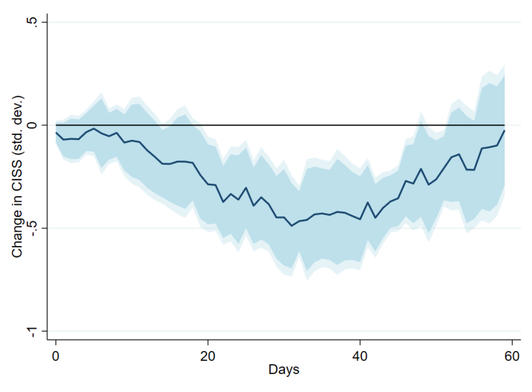
FOREX markets: We find no evidence of unanticipated macroprudential policy announcements affecting risk in the foreign exchange markets. Our measure of risk in the FOREX markets is exclusively represented by the volatility of three bilateral exchange rates. Namely, GBP/USD, GBP/EUR and GBP/JPY. To the extent that FOREX-based macroprudential policies might limit banks' risk-taking incentives and reduce cross-border bank capital flows, the latter could have a stabilization effect on exchange rate volatility.[23] The macroprudential policy surprises in our sample are not necessarily of a FOREX nature. Hence it is not surprising that we find no FOREX risk effect in the aftermath of a surprise macroprudential policy measure.

[23]See Adrian et al. (2010) for empirical and theoretical evidence on how exchange rate volatility is linked to time-variation in systematic risk premia.

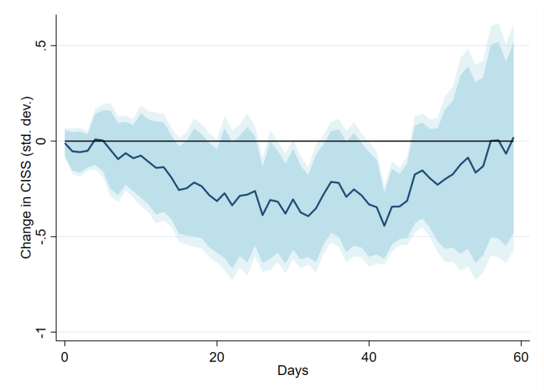
Figure 10: Disaggregated Impulse Response Functions



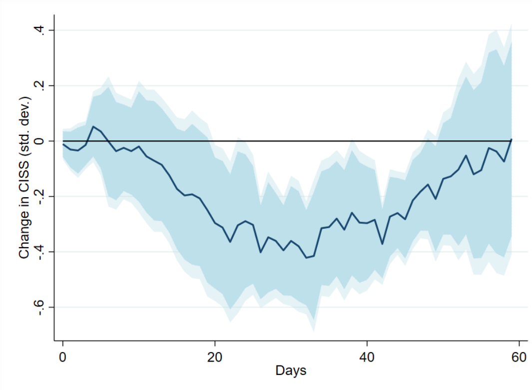
(a) Money Markets



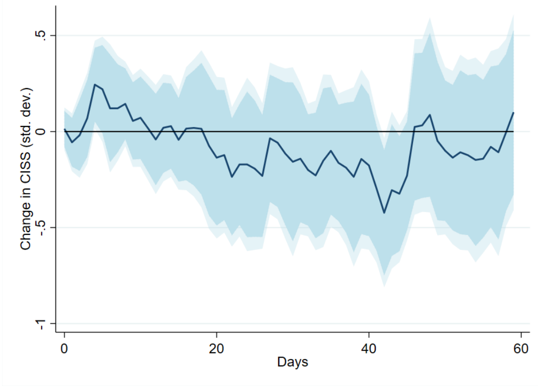
(b) Bond Markets



(c) Equity (non-financials)



(d) Equity (financials)



(e) FOREX

Notes: In line with local projection methods, each horizon is estimated separately. The blue solid lines represent the $\{\beta^h\}_{h=1}^{60}$ estimates in standard deviation units. The dependent variable in panels (a), (b), (c), (d) and (e) is the change in the CISS subindex in the money markets, bond markets, equity (non-financials), equity (financials) and foreign exchange markets respectively, over the horizons considered. The independent variable across all panels is ΔMaP^{shock}. The light blue shaded areas denote the 95% and 90% confidence intervals around point estimates constructed with robust standard errors.

5 Conclusion

We have shown that macroprudential policy announcements can reduce systemic risk, specifically in the (financial) equity and bond market. In order to conduct this analysis, we have developed a database of daily macroprudential policy announcements encompassing a wide range of UK and international macroprudential authorities. Using high frequency techniques to ensure we identify true macroprudential 'surprises', we were able to test the impact of these shocks on systemic risk. Throughout all the rigorous robustness checks, our main result still holds: macroprudential tightening can reduce systemic risk. Our main explanation for this results stems from the fact that macroprudential tightening is often associated with an increase in the resilience of banks to withstand shocks in the future i.e. by having higher capital ratios, more liquidity, less risky portfolios.

Our results could be extended along several dimensions. Firstly, while the 8 UK surprise dates gave us sufficient information to identify macroprudential shocks, the vast majority of UK announcements were well anticipated and potentially priced in by the markets in advance. Therefore, in order to extend our information set, cross-country information would add another richer dimension on which to judge the impact of macroprudential policy.

Secondly, it would be interesting to investigate the real economy impact of macroprudential policy and the effect on lending decisions. As macroprudential policy can involve a trade-off between ensuring financial stability in the longer-term versus higher credit growth in the near-term, an analysis incorporating this would be very insightful, e.g. by using GDP-at-risk vs GDP growth as a way of measuring the trade-off.

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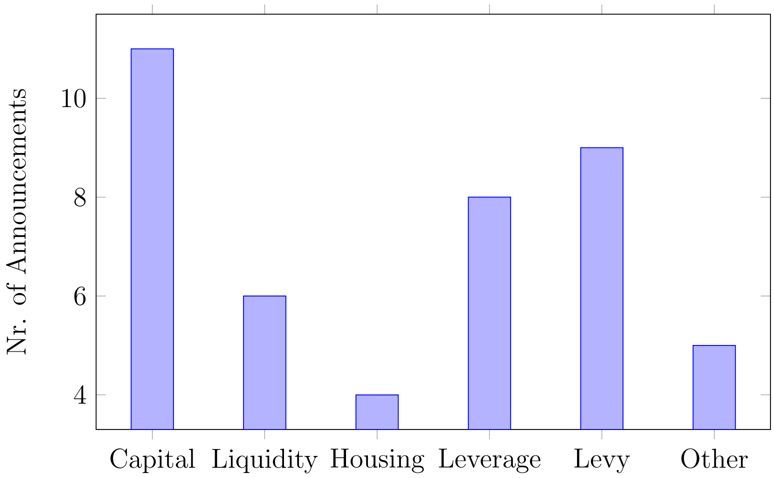
Appendices

A Data

A.1 Macroprudential policy dataset

Figure A.1: Nr. of macroprudential policy announcements by instrument type



Notes: This bar chart categorises the macroprudential policy announcements in our dataset into instrument types. Capital-based macroprudential policy announcements concern instruments such as capital requirements, capital conservation buffers and countercyclical capital buffers. Liquidity-based macroprudential policy announcements concern measures such as LCR and NSFR. Housing tools cover macroprudential policy announcements related to LTI, LTV, DTI and mortgage affordability rates. Leverage instruments pertain to minimum leverage ratio requirements and countercyclical and G-SII leverage ratio buffers. Bank levy announcements refer to changes in tax rates on short-term and long-term chargeable bank equity and liabilities, which aim to encourage banks to reduce the use of wholesale finance. Other instruments contain announcements on ring-fencing, risk weights, limits on large exposures and concentration, adoption of IFRS9 standards and measures which aim to reduce financial risks from climate change.

A.2 List of macroprudential policy announcements

Table A.1: Macroprudential policy announcements

Date	Macroprudential policy announcement
17 Dec 2009	Basel II: Raising the quality, consistency and transparency of the capital base.
19 Jan 2009	FSA stated that it expected the banks participating in the recapitalisation scheme maintain core Tier 1 capital of at least 4% after applying stress tests.
05 Oct 2009	Under the FSA Policy Statement (09/16) on 'Strengthening Liquidity Standards', a subset of banks are required to hold a sufficient stock of HQLA.
22 Jun 2010	Bank levy: The rate for 2011 will be 0.05 per cent for ST liabilities and 0.025 per cent for LT liabilities.
16 Dec 2010	Publication of Basel III package.
23 Mar 2011	An increase in the bank levy to 0.078% rate for short-term liabilites.
04 Nov 2011	Basel III: Assessment methodology and the additional loss absorbency requirement for G-SIIs.
29 Nov 2011	Bank levy is being raised from 0.078% to 0.088% from 1 January 2012.
01 Dec 2011	A recommendation by the FPC that major UK firms disclose their leverage ratios in accordance with Basel III.
21 Mar 2012	Short-term liabilities rate and long-term liabilities rate increase to 0.105 and 0.0525%, respectively.
05 Dec 2012	Bank Levy will increase to 0.130 per cent from 1 January 2013.
07 Jan 2013	Basel III: LCR will be introduced as planned in 2015, but the minimum requirement will be set at 60% and rise in equal annual steps to reach 100% in 2019.
20 Mar 2013	Bank levy Short-term liabilities rate and long-term liabilities rate increase to 0.142 and 0.071, respectively.
27 Mar 2013	FPC: PRA should take steps to ensure that, by the end of 2013, major UK banks and building societies hold capital resources equivalent to at least 7% of their RWA, have credible plans to meet the significantly higher targets for capital and leverage ratio that will come into effect in 2019 and the trading book review and surcharge for G-SIIs.
26 Jun 2013	FPC: PRA should provide an assessment to the FPC of the vulnerability of borrowers and financial institutions to sharp upward movements in long-term interest rates and credit spreads in the current low interest rate environment.
27 Jun 2013	CRD IV was published in the official journal of the European Union on 27 June 2013. CRD IV consists of a directly applicable EU Regulation, and an EU Directive which must be reflected in national law.
29 Nov 2013	PRA issued SS3/13 on capital and leverage ratios for major UK banks and building societies (SS3/13). The PRA set a 3% leverage ratio expectation for 8 major UK firms.
05 Dec 2013	Under Finance Act 2014, the bank levy rate had been increased to 0.156% for short term liabilities (and 0.078% for long terms equity and liabilities) from 2014.
14 Jan 2014	Basel III: Market risk minor revisions to (i) boundary between banking and trading book, (ii) internal models approach, (iii) standardised approach.
26 Jun 2014	FPC: FCA should ensure that mortgage lenders do not extend more than 15% of new residential mortgages at LTI ratios at or greater than 4.5. CCyB set at 0%. When assessing affordability, mortgage lenders should apply an interest rate stress test that assesses whether borrowers could still afford their mortgages if, at any point over the first five years of the loan, the Bank Rate were to be 3 pp higher than the rate at origination.
02 Oct 2014	FPC recommends that HM Treasury to exercise its statutory power to enable the FPC to direct the PRA and FCA to require regulated lenders to place limits on residential mortgage lending.
27 Oct 2014	EBA Stress Test results and PRA (PS10/14) on 'CRD IV: updates for credit risk mitigation, credit risk, governance and market risk'.
31 Oct 2014	FPC published its final review setting out proposals for the design of the leverage ratio framework, including its views on the calibration of the framework.
18 Mar 2015	Bank levy: Further increases the rate of the bank levy to 0.21% for short term liabilities from 1 April 2015 (and 0.105% for long term liabilities).
26 Apr 2015	The recast Banking Consolidation Directive (recast BCD) includes a revised framework for the risk weighting of credit risk in the banking book, including the standardised approach. Exposures secured by mortgages on residential property are to be weighted by 35% risk weight.

Date	Macroprudential policy announcement
27 May 2015	PRA PS on (i) legal structure arrangements of banking groups subject to ring-fencing, (ii) governance arrangements of ring-fenced bodies and (iii) arrangements to ensure continuity of services and facilities to ring-fenced bodies.
01 Jul 2015	The FPC directs the PRA to require major banks to (i) satisfy a minimum leverage ratio of 3%, (ii) countercyclical leverage buffer rate of 35% of its institution-specific CCyB and (iii) G-SII additional leverage ratio buffer of 35% of its G-SII buffer rate.
08 Jul 2015	Bank levy: the short and long term rates were reduced to 0.18 and 0.09 % respectively, effective from January 2016. Alongside these cuts, the Government introduced an 8% corporation tax surcharge for banks.
15 Dec 2015	PRA disclosed the 2015 list of UK headquartered GSIIs and their respective sub-categories. Applicable buffers are: HSBC Holdings Plc 2.5%, Barclays Plc 2%, RBS 1%, Standard Chartered Plc 1%.
19 Feb 2016	PRA set out the criteria and scoring methodology it proposed to use to identify O-SIIs. The Single Supervisory Mechanism ordered the biggest Eurozone banks to boost their capital levels by 0.5pp
24 Mar 2016	From 21 March 2016 second and subsequent charge mortgage contracts fell under the definition of a regulated mortgage contract. PRA PS(11/16) rules that LTI flow limits automatically apply to second and subsequent charge mortgage contracts.
29 Mar 2016	FPC: Consistent with the Committee's assessment of the current risk environment, and its intention to move gradually, the Committee has decided to increase the UK countercyclical capital buffer rate from 0% to 0.5% of RWA.
05 Jul 2016	In light of the Brexit referendum results, the FPC reduced the UK countercyclical capital buffer rate from 0.5% to 0% of banks' UK exposures with immediate effect.
04 Aug 2016	The FPC recommends to the PRA that, when applying its rules on the leverage ratio, it considers allowing firms to exclude from the calculation of the total exposure measure those assets constituting claims on central banks where they are matched by deposits accepted by the firm that are denominated in the same currency and of identical or longer maturity.
27 Feb 2017	PRA PS: Amendments to the loan to income (LTI) ratios in mortgage lending. PRA sets out the final rules for the LTI flow limit to operate on a four-quarter rolling basis.
27 Jun 2017	FPC increased the CCyB rate to 0.5%, from 0%. When assessing affordability, mortgage lenders should apply an interest rate stress test that assesses whether borrowers could still afford their mortgages if, at any point over the first 5 years of the loan, their mortgage rate were to be 3 pp higher than the 'reversion' rate.
06 Jul 2017	PRA PS sets out final rules intended to update regulatory reporting requirements, and expectations, in light of the introduction of International Financial Reporting Standard 9 (IFRS 9) from 1 January 2018.
25 Sep 2017	FPC set out its view on the appropriate loss rate on consumer credit in the Bank's 2017 annual stress test of major UK banks. It judged that, in the first three years of the severe stress test scenario, the UK banking system would, in aggregate, incur consumer credit losses of around £30 billion, representing 150 bps of the aggregate common equity Tier 1 capital ratio of the UK banking system.
28 Nov 2017	The FPC is raising the UK countercyclical capital buffer rate from 0.5% to 1%, with binding effect from 28 November 2018.
07 Dec 2017	Basel III : Revisions to help restore credibility in the calculation of RWA by: (i) enhancing the robustness and risk sensitivity of the standardised approaches for credit risk and operational risk, (ii) constraining the use of internally modelled approaches, (iii) complementing the risk-weighted capital ratio with a finalised leverage ratio, a leverage ratio buffer for G-SIIs and a revised and robust capital floor.
16 Mar 2018	FPC agreed to the hurdle rates for the 2018 stress test evolving from those used in earlier years. The Bank would hold G-SIIs to higher standards each participating bank would now be assessed against single risk-weighted capital and leverage hurdle rates, which would now include for the first time, capital buffers for domestic, as well as global, systemic importance.
15 Apr 2019	PRA PS(11/19) on "Enhancing banks' and insurers' approaches to managing the financial risks from climate change".
11 Jul 2019	The 2019 biennial exploratory scenario will examine the implications of a severe and broad-based liquidity stress affecting major UK banks simultaneously. This exercise will explore how the reactions of banks and authorities to the stress would shape its impact on the broader financial system and the UK economy.
16 Dec 2019	The FPC judges a 2% UK CCyB rate to be appropriate for the current standard risk environment. It is therefore raising the CCyB rate from 1% to 2%. This will take effect in one year.

Notes: This table presents the 44 macroprudential policy announcements in our dataset. The announcements in dark green are days that generated a significant market response at the 1%, 5% or 10% significance level, around an event window of (-1, 1) days before and after the announcement. However, news coverage revealed that the dates in dark green were 'contaminated' by other macro-financial news and/or bank specific announcements that were not of a macroprudential nature. The announcements in bright blue depict our macroprudential policy 'surprises'. In other words, they are the days when financial markets were significantly surprised in the aftermath of a macroprudential policy announcement and were not affected by any other news.

A.3 Marginal Expected Shortfall

A commonly used approach to modelling systemic risk in the banking sector is the Marginal Expected Shortfall (MES) by Acharya et al. (2010). MES measures an individual bank's marginal contribution to the overall tail risk in the banking system. Formally, the MES of a financial institution represents the expected equity loss of a bank's stock price conditional on a large shock to the financial system (what is known as a tail event). First, following Brownlees and Engle (2010) the bivariate process of bank and market returns is represented by:

$$r_{i,t} = \sigma_{i,t}\rho_{i,t}\epsilon_{m,t} + \sigma_{i,t}\sqrt{1-\rho_{i,t}^2}\varepsilon_{i,t} \tag{12}$$

$$r_{m,t} = \sigma_{m,t}\epsilon_{m,t} \tag{13}$$

where $r_{i,t}$ and $r_{m,t}$ are the individual bank and market return, respectively.[24] $\sigma_{m,t}$ and $\sigma_{i,t}$ are volatilities of the market and the bank i at time t, respectively. $\rho_{i,t}$ is the correlation between $r_{i,t}$ and $r_{m,t}$ at time t. The disturbances $(\epsilon_{m,t}, \varepsilon_{i,t})$ are assumed to be iid with mean zero and unit variance. The MES can be written more explicitly as a function of correlation, volatility and the tail expectations of the standardised innovations distributions:

$$MES_{i,t} = E_{t-1}(r_{i,t}|r_{m,t} < C) \tag{14}$$

$$MES_{i,t} = \sigma_{i,t}\rho_{i,t}\mathop{\mathbb{E}}_{t-1}\left(\varepsilon_{m,t}|\varepsilon_{m,t} < \frac{C}{\sigma_m, t}\right) + \sigma_{i,t}\sqrt{1-\rho_{i,t}^2}E_{t-1}\left(\epsilon_{i,t}|\varepsilon_{m,t} < \frac{C}{\sigma_{m,t}}\right) \tag{15}$$

In line with Acharya et al. (2010), we set the threshold C that defines a crisis such that $Pr(r_{m,t} < C_{0.05}) = 0.05$. In other words, C represents the **most** the market as a whole stands to lose with confidence 95%. If we assume $\epsilon_{i,t}$ and $\varepsilon_{i,t}$ are iid at time t, MES becomes equivalent to:

$$MES_{i,t} = \frac{\sigma_{i,t}}{\sigma_{m,t}}\rho_{i,t}E_{t-1}(r_{m,t}|r_{m,t} < C) \tag{16}$$

$$MES_{i,t} = \frac{\sigma_{i,t}}{\sigma_{m,t}}\rho_{i,t}ES_{m,t} \tag{17}$$

where $E_{m,t}$ denotes the Expected Shortfall of the market and reflects the expected loss of the market when the market experiences a shock greater than the threshold C.

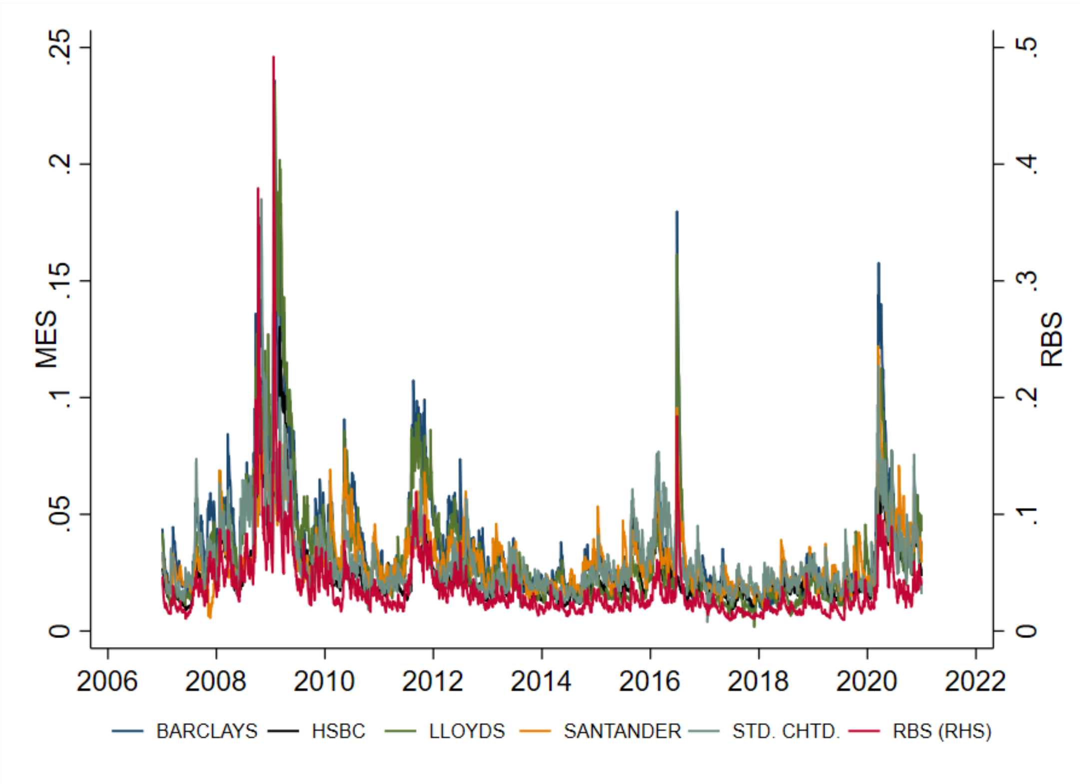
[24] In line with Gregory et al. (2013) we use the daily returns on FTSE All Share to approximate the market returns in the UK.

We can see that the MES is proportional to the tail $\beta_{i,t}$:

$$MES_{i,t} = \beta_{i,t} ES_{m,t} \tag{18}$$

where $\beta_{i,t} = \frac{Cov(r_{i,t})}{Var(r_{m,t}} = \rho_{i,t}\frac{\sigma_{i,t}}{\sigma_{m,t}}$ denotes the time-varying conditional beta for bank i at time t and ES_t is the expected shortfall of the market. The expected shortfall of the return on the financial system is invariant across banks i which implies that the dispersion in MES can be only attributed to cross-sectional differences in $\beta_{i,t}$. We proceed by computing the MES measure for each of the 6 individual banks in our analysis.[25] Figure A.2. plots the MES for six UK-listed banks in our analysis. MES spikes in times of well-known financial stress periods such as the Great Financial Crisis, the European Sovereign Debt crisis, Brexit and more recently the Covid-19 crisis.

Figure A.2: Marginal Expected Shortfall by Bank



[25]To construct the series of the time-varying conditional betas, the expected shortfall of the market and the marginal expected shortfall for each of the banks in our analysis, we make use of the systemic risk toolbox by Tomasso Belluzo (2022). See www.mathworks.com/matlabcentral/fileexchange/62482-systemic-risk for more detail.

B Event Study Results

B.1 Individual event studies

Table B.1: Event Study Results - 16 December 2010

Security	CAR[-1,1]	CAR[-1,2]	CAR[0,1]
Lloyds	-4.4146%	-4.3472%	-3.1364%
	(0.2621)	(0.3396)	(0.3281)
Standard Chartered	-1.1480%	-0.4564%	-0.6385%
	(0.6729)	(0.8846)	(0.7732)
HSBC	-2.3707%	-2.3660%	-0.8214%
	(0.2199)	(0.2898)	(0.6015)
Santander UK	-4.8010%	-4.3792%	-2.8996%
	(0.1779)	(0.2878)	(0.3176)
Barclays	-4.4500%	-4.3907%	-0.8228%
	(0.2033)	(0.2777)	(0.7725)
RBS	-8.9539%**	-7.7217%	-7.4882%**
Portfolio (6 securities)	-4.3326%***	-3.9189%**	-2.6153%**
	(0.0020)	(0.0153)	(0.0215)

Notes: This table presents the cumulative abnormal returns of each individual bank stock following a macroprudential policy announcement, as well as the CAAR of an equally-weighted portfolio that contains these 6 securities. The estimation window is chosen to be (-261, -2). p-values in parenthesis are obtained under the normality assumption. *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Table B.2: Event Study Results - 4 November 2011

Security	CAR[-1,1]	CAR[-1,2]	CAR[0,1]
Lloyds	-5.5840%	-2.6251%	-2.7748%
	(0.1940)	(0.5974)	(0.4279)
Standard Chartered	-2.5286%	-2.3183%	-1.7139%
	(0.2848)	(0.3968)	(0.3735)
HSBC	-1.6553%	-2.2120%	-0.4458%
	(0.3549)	(0.2858)	(0.7596)
Santander UK	-2.1256%	-2.7551%	-3.4023%
	(0.5630)	(0.5174)	(0.2564)
Barclays	-1.9393%	-2.3055%	-1.5970%
	(0.6405)	(0.6316)	(0.6370)
RBS	-4.3484%	-5.5550%	-1.0321%
	(0.2979)	(0.2508)	(0.7615)
Portfolio (6 securities)	-2.9975%**	-2.9198%*	-1.8067%
	(0.0391)	(0.0822)	(0.1263)

Notes: This table presents the cumulative abnormal returns of each individual bank stock following a macroprudential policy announcement, as well as the CAAR of an equally-weighted portfolio that contains these 6 securities. The estimation window is chosen to be (-261, -2). p-values in parenthesis are obtained under the normality assumption. *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Table B.3: Event Study Results - 27 June 2013

Security	CAR[-1,1]	CAR[-1,2]	CAR[0,1]
Lloyds	-0.4983%	-1.3640%	-0.8829%
	(0.8633)	(0.6853)	(0.7076)
Standard Chartered	-1.2204%	-0.0404%	-1.4935%
	(0.6883)	(0.9909)	(0.5460)
HSBC	-1.0241%	-0.9897%	-0.8047%
	(0.4610)	(0.5399)	(0.4760)
Santander UK	-1.4238%	-2.3575%	-3.9955%
	(0.6716)	(0.5461)	(0.1441)
Barclays	-5.8077%*	-6.4403%*	-5.8458%**
	(0.0837)	(0.0989)	(0.0325)
RBS	-6.3663%*	-5.6763%	-4.2630%
	(0.0961)	(0.2013)	(0.1701)
Portfolio (6 securities)	-2.7029%**	-2.7876%*	-2.8696%***
	(0.0319)	(0.0567)	(0.0052)

Notes: This table presents the cumulative abnormal returns of each individual bank stock following a macroprudential policy announcement, as well as the CAAR of an equally-weighted portfolio that contains these 6 securities. The estimation window is chosen to be (-261, -2). p-values in parenthesis are obtained under the normality assumption. *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Table B.4: Event Study Results - 27 October 2014

Security	CAR[-1,1]	CAR[-1,2]	CAR[0,1]
Lloyds	-3.8273%*	-3.3952%	-4.8262%***
	(0.0632)	(0.1541)	(0.0042)
Standard Chartered	-8.9431%***	-10.2325%***	-10.9098%***
	(0.0000)	(0.0000)	(0.0000)
HSBC	-1.0472%	-1.3537%	-1.0850%
	(0.4148)	(0.3628)	(0.3004)
Santander UK	-2.1158%	-4.5996%**	-3.0144%*
	(0.2903)	(0.0477)	(0.0653)
Barclays	-1.1674%	-3.2165%	-1.9790%
	(0.6179)	(0.2359)	(0.3002)
RBS	-2.3998%	-3.1571%	-2.0195%
	(0.4207)	(0.3604)	(0.4060)
Portfolio (6 securities)	-3.1828%***	-4.2535%***	-3.9078%***
	(0.0003)	(0.0000)	(0.0000)

Notes: This table presents the cumulative abnormal returns of each individual bank stock following a macroprudential policy announcement, as well as the CAAR of an equally-weighted portfolio that contains these 6 securities. The estimation window is chosen to be (-261, -2). p-values in parenthesis are obtained under the normality assumption. *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Table B.5: Event Study Results - 31 October 2014

Security	CAR[-1,1]	CAR[-1,2]	CAR[0,1]
Lloyds	2.5166%	2.3852%	1.7984%
	(0.2289)	(0.3238)	(0.2912)
Standard Chartered	-5.1792%**	-4.2146%*	-0.2617%
	(0.0123)	(0.0771)	(0.8758)
HSBC	-0.4550%	-0.6021%	-0.4644%
	(0.7213)	(0.6831)	(0.6550)
Santander UK	0.6352%	-2.1356%	0.4405%
	(0.7563)	(0.3672)	(0.7917)
Barclays	7.0928%***	7.6122%***	6.3291%***
	(0.0027)	(0.0053)	(0.0010)
RBS	5.0819%*	5.4551%	3.7824%
	(0.0885)	(0.1136)	(0.1195)
Portfolio (6 securities)	1.6806%*	1.4892%	1.9809%***
	(0.0609)	(0.1503)	(0.0069)

Notes: This table presents the cumulative abnormal returns of each individual bank stock following a macroprudential policy announcement, as well as the CAAR of an equally-weighted portfolio that contains these 6 securities. The estimation window is chosen to be (-261, -2). p-values in parenthesis are obtained under the normality assumption. *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Table B.6: Event Study Results - 19 February 2016

Security	CAR[-1,1]	CAR[-1,2]	CAR[0,1]
Lloyds	0.1415%	0.8495%	0.0982%
	(0.9420)	(0.7056)	(0.9506)
Standard Chartered	-2.2242%	-7.1998%*	2.1601%
	(0.5043)	(0.0624)	(0.4266)
HSBC	-2.8832%*	-2.6542%	-1.8672%
	(0.0771)	(0.1591)	(0.1601)
Santander UK	-2.9159%	-1.6329%	0.3813%
	(0.2823)	(0.6024)	(0.8630)
Barclays	-2.1193%	-2.8069%	0.7762%
	(0.3144)	(0.2495)	(0.6512)
RBS	-5.0440%**	-7.5043%***	-3.7433%**
	(0.0255)	(0.0042)	(0.0420)
Portfolio (6 securities)	-2.4653%**	-3.4263%***	-0.3349%
	(0.0121)	(0.0026)	(0.6741)

Notes: This table presents the cumulative abnormal returns of each individual bank stock following a macroprudential policy announcement, as well as the CAAR of an equally-weighted portfolio that contains these 6 securities. The estimation window is chosen to be (-261, -2). p-values in parenthesis are obtained under the normality assumption. *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Table B.7: Event Study Results - 29 March 2016

Security	CAR[-1,1]	CAR[-1,2]	CAR[0,1]
Lloyds	-1.9733%	-1.2210%	-2.1243%
	(0.3960)	(0.6496)	(0.2635)
Standard Chartered	-0.6917%	0.2425%	4.7129%
	(0.8459)	(0.9530)	(0.1057)
HSBC	-2.8469%*	-3.0614%	-2.2676%*
	(0.0786)	(0.1019)	(0.0862)
Santander UK	-3.9000%	-5.3653%	-3.2233%
	(0.1867)	(0.1166)	(0.1815)
Barclays	-3.2559%	-3.6692%	-2.7411%
	(0.1859)	(0.1975)	(0.1728)
RBS	-2.0036%	-1.8579%	-1.6367%
	(0.4081)	(0.5072)	(0.4081)
Portfolio (6 securities)	-2.3971%**	-2.4375%**	-1.1828%
	(0.0258)	(0.0499)	(0.1769)

Notes: This table presents the cumulative abnormal returns of each individual bank stock following a macroprudential policy announcement, as well as the CAAR of an equally-weighted portfolio that contains these 6 securities. The estimation window is chosen to be (-261, -2). p-values in parenthesis are obtained under the normality assumption. *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Table B.8: Event Study Results - 25 September 2017

Security	CAR[-1,1]	CAR[-1,2]	CAR[0,1]
Lloyds	-4.1747%**	-0.9535%	-2.9770%*
	(0.0453)	(0.6916)	(0.0794)
Standard Chartered	-3.1059%	-1.6199%	-1.5090%
	(0.2195)	(0.5795)	(0.4636)
HSBC	-1.0758%	0.1250%	-1.1431%
	(0.5529)	(0.9525)	(0.4391)
Santander UK	-2.2195%	1.2510%	-2.6206%
	(0.4030)	(0.6836)	(0.2259)
Barclays	-1.6789%	-0.8688%	-1.6448%
	(0.5118)	(0.7692)	(0.4303)
RBS	-0.1251%	3.0821%	-0.3058%
	(0.9680)	(0.3929)	(0.9041)
Portfolio (6 securities)	-2.0571%**	0.1814%	-1.6967%**
	(0.0440)	(0.8775)	(0.0415)

Notes: This table presents the cumulative abnormal returns of each individual bank stock following a macroprudential policy announcement, as well as the CAAR of an equally-weighted portfolio that contains these 6 securities. The estimation window is chosen to be (-261, -2). p-values in parenthesis are obtained under the normality assumption. *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

B.2 Additional event study results

We extend our event studies in 2 dimensions. First, we assess whether in addition to the abnormal equity returns our macroprudential policy events also generated an abnormal trading volume response. We do this because existing literature concludes that trading volumes spike up if new disclosure of information affects investors' prior beliefs. Second, as a robustness check to ensure that the abnormal equity returns we obtained in Table 1 only apply to banks and no other company that is not PRA-regulated, we compute abnormal stock returns for 6 LSE-listed pharmaceutical companies. This exercise could be thought of as a counterfactual experiment.

Abnormal Trading Volumes: Analogously to abnormal stock returns, we measure abnormal volumes as deviations of trading volumes in the event window compared to 'normal times':

$$AV_{i,t} = Volume_{i,t} - \overline{Volume_{i,t}} \tag{19}$$

where $Volume_{i,t}$ is the number of shares of bank i traded on day t divided by the number of outstanding free-floating shares and $\overline{Volume_{i,t}}$ is the average of Volume for firm i over the estimation window (-261, -2) associated with each macroprudential policy announcement. We proceed by calculating abnormal volumes over the event window in a similar fashion to equations (2) and (3) and test their significance under the normality assumption.

Abnormal equity returns for pharmaceutical companies: As a counterpart to our bank

CAAR, we assess whether a non-PRA regulated group of LSE-listed companies is similarly affected by the macroprudential policy announcements that we study. The companies that we select for this counterfactual exercise are the top 6 pharmaceutical companies in the UK by market capitalization.[26] Since they are not subject to micro-and-macroprudential regulatory requirements, these companies should not react similarly to banking shares on the day of the macroprudential policy announcements.

Table B.9 shows that the majority of the macroprudential policy events were met by an increase in trading activity. However these results are statistically significant for only two of our macroprudential policy event dates.[27] In line with our conjecture, the last column of Table B.9 shows that pharmaceutical companies did not react in a similar fashion to Banks following macroprudential policy announcements.[28]

Table B.9: Cumulative average abnormal values for different macroprudential policy events

Date	Event	Bank returns [-1,1]	Volumes [-1,1]	CDS spreads [-1,1]	Pharma returns [-1,1]
16 Dec 2010	Basel III	-4.3326%***	-0.0287%		-0.8756%
		(0.0020)	(0.7420)		(0.4565)
04 Nov 2011	G-SII Buffers	-2.9975%**	0.0392%	1.8670%	1.2458%
		(0.0391)	(0.4923)	(0.6106)	(0.2426)
27 Jun 2013	CRD IV	-2.7029%**	0.0460%	-7.7589%***	0.9539%
		(0.0319)	(0.5597)	(0.0024)	(0.2856)
27 Oct 2014	EBA Stress Testing	-3.1828%***	0.1861%***	-2.0662%	0.6863%
		(0.0003)	(0.0010)	(0.3852)	(0.5065)
31 Oct 2014	Leverage ratio	1.6806%*	0.4790%***	0.9541%	-0.5058%
		(0.0609)	(0.0000)	(0.6901)	(0.6272)
19 Feb 2016	O-SII Methodology	-2.4653%**	0.0266%	4.3065%	1.9874%**
		(0.0121)	(0.8105)	(0.1113)	(0.0447)
29 Mar 2016	CCyB	-2.3971%**	0.0431%	0.9544%	1.4996%
		(0.0258)	(0.6987)	(0.7324)	(0.1373)
25 Sep 2017	PRA Buffer	-2.0571%**	-0.1874%**	4.3234%**	2.0776%**
		(0.0440)	(0.0308)	(0.0221)	(0.0381)

Notes: This table presents the cumulative average abnormal values from a portfolio of the 6 largest LSE-listed banks, following a macroprudential policy announcement. The estimation window is chosen to be (-261, -2). p-values in parenthesis are obtained under the normality assumption. *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

[26] These companies include GlaxoSmithKline, Astrazeneca, Sinclair Pharma, Hikma Pharmaceuticals, Dechra Pharmaceuticals PLC and Vectura Group PLC.

[27] We think that the lack of statistical significance for other events could be an outcome of the specification chosen in equation (7). We are working on a different market model specification.

[28] The two significant Pharmaceuticals CAARs were the result of idiosyncratic pharmaceutical events.

B.3 Event study robustness

Table B.10: Event studies under Fama-French 3 Factor Model

Date	Event	CAAR[-1,1]	CAAR[-1,2]	CAAR[0,1]	CAAR[0,0]
16 Dec 2010	Basel III	-3.9001%***	-3.2482%**	-2.7253%***	-0.0953%
		(0.0020)	(0.0251)	(0.0080)	(0.8949)
04 Nov 2011	G-SII Buffers	-1.8824%	-2.1116%	-1.1039%	-0.0899%
		(0.1489)	(0.1608)	(0.2994)	(0.9048)
27 Jun 2013	CRD IV	-2.4214%**	-2.2286%*	-2.6157%***	-2.0120%***
		(0.0326)	(0.0881)	(0.0048)	(0.0022)
27 Oct 2014	PRA PS + EBA Stress Test	-2.8295%***	-3.8655%***	-3.4751%***	-1.5401%***
		(0.0007)	(0.0001)	(0.0000)	(0.0014)
31 Oct 2014	Leverage ratio	1.4602%*	1.3539%	1.7403%**	1.9692%***
		(0.0852)	(0.1665)	(0.0123)	(0.0001)
19 Feb 2016	O-SII Methodology	-2.2850%**	-2.9803%***	0.1574%	-0.8606%
		(0.0129)	(0.0051)	(0.8330)	(0.1038)
29 Mar 2016	CCyB	-2.1497%**	-2.3391%**	-0.9899%	-0.8848%
		(0.0333)	(0.0447)	(0.2285)	(0.1283)
25 Sep 2017	PRA Buffer	-1.6744%*	0.1786%	-1.4225%*	-1.2662%**
		(0.0676)	(0.8654)	(0.0572)	(0.0169)

Notes: This table presents the cumulative average abnormal returns (CAAR) from a portfolio of the 6 largest LSE-listed banks, following a macroprudential policy announcement.The estimation window is chosen to be (-261, -2). p-values in parenthesis are obtained under the normality assumption. *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively. The event study results for 04 Nov 2011 are statistically significant at the 1% significance level under a Wilcoxon test (1954) test (not shown here).

Table B.11: Event studies with different estimation windows

Date	Event	(1)	(2)	(3)
16 Dec 2010	Basel III	-4.3326%***	-4.1918%***	-3.6734%***
		(0.0020)	(0.0009)	(0.0014)
04 Nov 2011	G-SII Buffers	-2.9975%**	-2.9128%*	-3.0544%*
		(0.0391)	(0.0721)	(0.0829)
27 Jun 2013	CRD IV	-2.7029%**	-1.9763%*	-1.8976%
		(0.0319)	(0.0865)	(0.1016)
27 Oct 2014	PRA PS + EBA Stress Test	-3.1828%***	-3.3330%***	-3.3623%***
		(0.0003)	(0.0002)	(0.0002)
31 Oct 2014	Leverage ratio	1.6806%*	1.5363%*	1.4556%
		(0.0609)	(0.0683)	(0.1033)
19 Feb 2016	O-SII Methodology	-2.4653%**	-2.2122%**	-1.8855%*
		(0.0121)	(0.0203)	(0.0785)
29 Mar 2016	CCyB	-2.3971%**	-2.0829%*	-2.1717%
		(0.0258)	(0.0683)	(0.1085)
25 Sep 2017	PRA Buffer	-2.0571%**	-1.8545%*	-1.6151%*
		(0.0440)	(0.0519)	(0.0569)

Notes: This table presents the cumulative average abnormal returns (CAAR) from a portfolio of the 6 largest LSE-listed banks, following a macroprudential policy announcement, with an event window (-1,1). The estimation windows are (-261, -2), (-120, -30), (-90, -30) in columns (1), (2) and (3) respectively. p-values in parenthesis are obtained under the normality assumption. *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively. The results in column (3) become statistically significant when changing the event window to (0,1) for the announcements of 27 Jun 2013 and 31 Oct 2014 and (-1,0) for the CCyB announcement of 29 Mar 2016 (not shown here).

Table B.12: Event studies with different test diagnostics

Date	Event	(1)	(2)	(3)	(4)	(5)
16 Dec 2010	Basel III	-4.3326%***	-4.3326%***	-4.3326%***	-4.3326%**	-4.3326%**
		(0.0020)	(0.0022)	(0.0000)	(0.0277)	(0.0170)
04 Nov 2011	G-SII Buffers	-2.9975%**	-2.9975%**	-2.9975%***	-2.9975%**	-2.9975%**
		(0.0391)	(0.0284)	(0.0000)	(0.0277)	(0.0214)
27 Jun 2013	CRD IV	-2.7029%**	-2.7029%**	-2.7029%***	-2.7029%**	-2.7029%*
		(0.0319)	(0.0365)	(0.0020)	(0.0277)	(0.0906)
27 Oct 2014	PRA PS + EBA Stress Test	-3.1828%***	-3.1828%***	-3.1828%**	-3.1828%**	-3.1828%
		(0.0003)	(0.0000)	(0.0159)	(0.0277)	(0.1080)
31 Oct 2014	Leverage ratio	1.6806%*	1.6806%	1.6806%	1.6806%***	1.6806%
		(0.0609)	(0.1697)	(0.4704)	(0.0000)	(0.5295)
19 Feb 2016	O-SII Methodology	-2.4653%**	-2.4653%***	-2.4653%***	-2.4653%***	-2.4653%*
		(0.0121)	(0.0064)	(0.0008)	(0.0000)	(0.0613)
29 Mar 2016	CCyB	-2.3971%**	-2.3971%**	-2.3971%***	-2.3971%**	-2.3971%**
		(0.0258)	(0.0105)	(0.0000)	(0.0277)	(0.0230)
25 Sep 2017	PRA Buffer	-2.0571%**	-2.0571%**	-2.0571%***	-2.0571%**	-2.0571%*
		(0.0440)	(0.0289)	(0.0011)	(0.0277)	(0.0917)

Notes: This table presents the cumulative average abnormal returns (CAAR) from a portfolio of the 6 largest LSE-listed banks, following a macroprudential policy announcement. The estimation window is chosen to be (-261, -2). p-values in parenthesis are obtained under the normality assumption in column (1). p values in Columns (2), (3), (4) and (5) are obtained under a Patell (1976), Boehmer, Musumeci and Poulsen (1991), Wilcoxon (1945) and a GRANK test diagnostic, respectively. *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

B.4 Institutional Background to the Macroprudential Policy Events

16 December 2010: Publication of Basel III
This document represents the initial phase of the Basel III reforms, which focused on strengthening the existing regulatory framework. The new rules proposed higher levels of capital requirements and enhanced risk capture by revising risk-weights to accurately reflect market risk, credit risk and securitisation. Additionally, new macroprudential instruments such as the countercyclical capital buffer and leverage ratio were added.

4 November 2011: G-SII assessment and additional loss absorbency requirement
At the Cannes Summit, the G20 Leaders endorsed the implementation of an integrated set of policy measures to address the risks to the global financial system from systemically important financial institutions (SIFIs), and the timeline for implementation of these measures.

27 June 2013: CRD IV was published in the official journal of the European Union.
On this day, the Capital Requirements Directive IV, which covers prudential rules for banks, building societies and investment firms was published in the official journal of the European Union. Additionally, on the same day a final agreement on bail-in rules were agreed by EU finance ministers. The new rules were designed to force shareholders, bondholders and some depositors to contribute to the costs of bank failure. Insured deposits under €100,000 were exempt and uninsured deposits of individuals and small companies were given preferential status in the bail-in pecking order.

27 October 2014: PRA- Updates for credit risk mitigation. EBA Stress Test Results.
On this day, 24 out of 123 financial institutions subjected to stress tests failed to meet the threshold for a 5.5% capital buffer under an exercise by the European Banking Authority on how they would cope in the event of a crisis. Shares in Lloyds, Royal Bank of Scotland, Barclays and HSBC were all lower on fears that a further examination by the Bank of England could prove more stringent and force them to build-up additional buffers.

31 October 2014: Bank of England : Increase in leverage ratio requirement.
On this day the Bank of England proposed a smaller-than-expected increase in UK bank capital requirements. The Bank of England proposed the big British banks be required to boost their leverage ratios to 4.05% by 2019. Analysts doubted the new rules would have a significant impact on banks' operations or the supply of loans to the UK economy as most banks' leverage ratios would meet their new requirement by the following year, according to estimates from Credit Suisse.

19 February 2016 PRA: O-SII Buffers. Europe's banks ordered to boost capital
The Single Supervisory Mechanism ordered the biggest eurozone banks to boost their capital levels by 0.5 percentage points on average after a yearlong assessment of their risks. Additionally, the PRA published a policy statement which detailed the approach to identifying and designating as O-SIIs those firms whose distress or failure would have a systemic impact on the UK or the EU economy or financial system due to size, importance (including substitutability or financial system infrastructure), complexity, cross-border activity, and interconnectedness.

29 March 2016: Bank of England : CCyB increases from 0% to 0.5%.
The Financial Policy Committee of the Bank of England judged that the outlook for financial stability in the United Kingdom had deteriorated since it last met in November 2015. Consistent with the Committee's assessment of the risk environment at the time, and its intention to move gradually, the Committee decided to increase the UK countercyclical capital buffer rate from 0% to 0.5% of risk-weighted assets and raise the bar for banks to pass its annual stress test.

25 September 2017: Bank of England: Increase in PRA Buffers
The Bank of England warned banks on Monday that they had been too lax in provisioning for potential losses on consumer credit and should increase their capital buffers by £10bn to protect themselves. Because the level of consumer debt and its riskiness varies across UK lenders, the BoE did not increase aggregate capital buffers but said it would raise the level of capital individual banks need in November when it publishes its annual stress tests.

B.5 Can macro-financial conditions forecast macroprudential policy shocks?

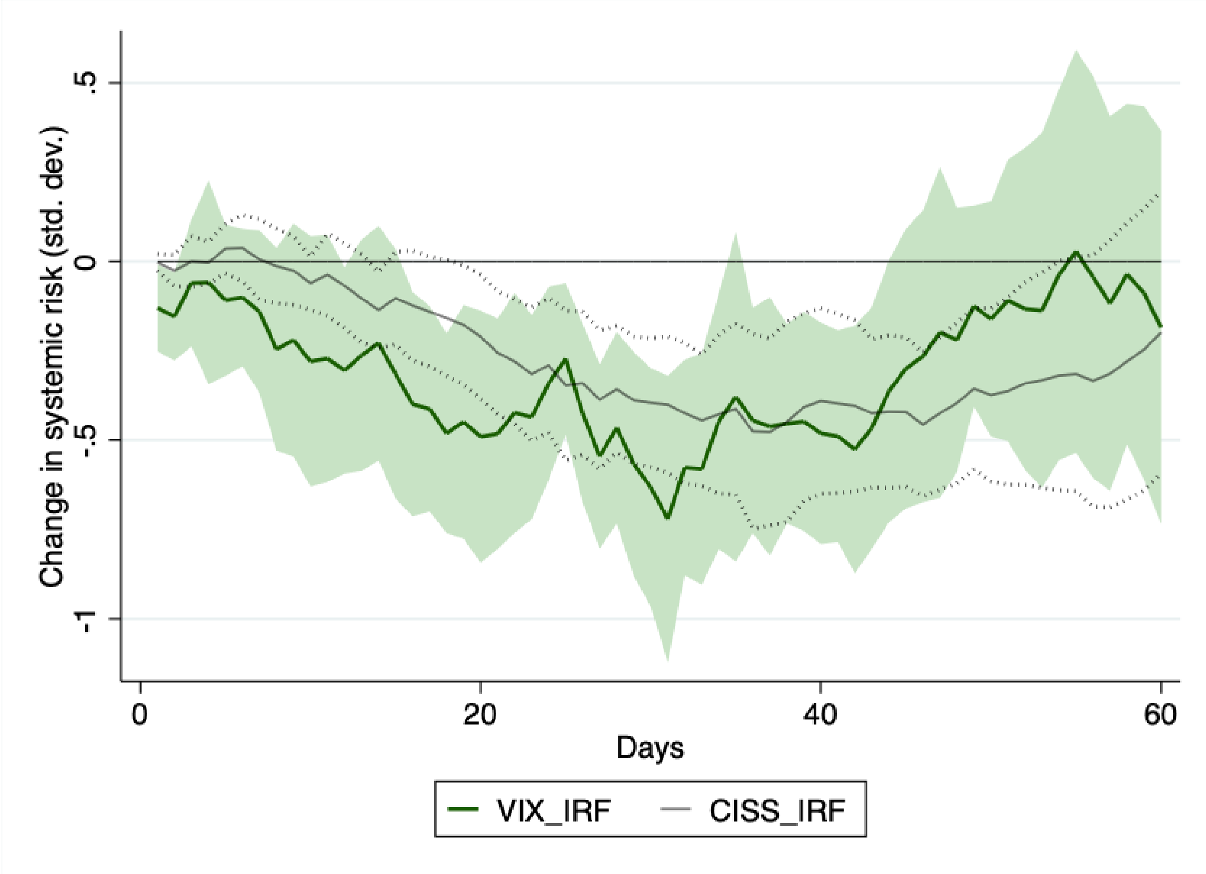
Table B.13: Unpredictability of the macroprudential policy shock series

	(1) MaP shock	(2) MaP shock	(3) MaP shock
Lagged changes in financial conditions			
Contemporaneous effect	0.0099	0.0863	0.0001
	(0.1870)	(0.2392)	(0.348)
One-day effect	-0.2084	-0.1392	0.0007
	(0.1731)	(0.6859)	(0.2965)
Five-day effect	-0.0267	-0.0168	0.0003
	(0.5498)	(0.9039)	(0.6137)
Ten-day effect	0.0137	0.0930	0.0000
	(0.5764)	(0.3932)	(0.9765)
Twenty-day effect	0.0055	-0.0348	0.0000
	(0.7503)	(0.7659)	(0.9914)
Thirty-day effect	0.0116	0.0366	-0.0004
	(0.4486)	(0.7962)	(0.1637)
Forty-day effect	0.0186	0.1092	0.0001
	(0.1262)	(0.2290)	(0.7431)
Fifty-day effect	0.0193	0.1349	-0.0000
	(0.1826)	(0.1364)	(0.8344)
Sixty-day effect	0.0189	0.1251	0.0000
	(0.1104)	(0.1218)	(0.8250)
Controls	Yes	Yes	Yes

Notes: In line with the local projection methods, each horizon is estimated separately, the outcome of which is presented in a separate row. The dependent variable in all 3 columns is the macroprudential policy shock. The independent variables in columns (1), (2) and (3) the differences in CISS, MES and VIX respectively, over the horizons considered. Controls include one-day lags of the daily differences in the 1 year and 10 year gilts, euro/pound and dollar/pound exchange rate and the economic policy index by Baker et al. (2016). p-values in parentheses were obtained using robust standard errors. *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

C The effect of macroprudential policy shocks on systemic risk

Figure C.1: The effect of macroprudential policies on VIX



Notes: In line with local projection methods, each horizon is estimated separately. The green solid line represents the $\{\beta^h\}_{h=1}^{60}$ estimates in standard deviation units. The dependent variable is $\Delta_h VIX^{UK}$, over the horizons considered. The independent variable is ΔMaP^{shock}. The light green shaded area denotes the 95% confidence intervals around point estimates constructed with robust standard errors. The gray solid line denotes the $\{\beta^h\}_{h=1}^{60}$ estimates with $\Delta_h CISS^{UK}$ as a dependent variable. Area bound by the gray dotted lines is the corresponding 95% confidence interval.

Table C.1: Robustness with respect to other financial instability indicators

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	h = 1	h = 5	h = 10	h = 15	h = 20	h = 25	h =30	h = 35	h = 40	h = 45	h =50	h = 55	h = 60
Dependent variable: $\Delta_h CISS^{UK}$	-0.0023	0.0360	-0.0605	-0.1028	-0.2106**	-0.3470***	-0.3952***	-0.4129***	-0.3905***	-0.4213***	-0.3735***	-0.3151*	-0.1985
	(0.8460)	(0.3091)	(0.1104)	(0.1210)	(0.0177)	(0.0012)	(0.0000)	(0.0007)	(0.0032)	(0.0001)	(0.0026)	(0.0596)	(0.3246)
Dependent variable: $\Delta_h MES^{Banks}$	-0.0927***	-0.0450	-0.1306**	-0.1931**	-0.3362***	-0.2946**	-0.3630***	-0.4552***	-0.4004***	-0.3840***	-0.3225**	-0.1553	-0.1543
	(0.0050)	(0.4362)	(0.0254)	(0.0255)	(0.0009)	(0.0106)	(0.0066)	(0.0025)	(0.0042)	(0.0050)	(0.0158)	(0.2740)	(0.2009)
Dependent variable: $\Delta_h VIX^{UK}$	-0.1295**	-0.1086	-0.2796	-0.3149*	-0.4905***	-0.2719**	-0.6320***	-0.3791	-0.4809***	-0.3000	-0.1608	0.0282	-0.1846
	(0.0375)	(0.3152)	(0.1180)	(0.0771)	(0.0065)	(0.0120)	(0.0002)	(0.1068)	(0.0024)	(0.1331)	(0.3379)	(0.9219)	(0.5113)
Observations	2748	2744	2739	2734	2729	2724	2719	2714	2709	2704	2699	2694	2689

p-values in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes:In line with local projection methods, each horizon is estimated separately, the outcome of which is presented in a separate column. The dependent variable is $\Delta_h CISS^{UK}$, $\Delta_h MES^{UK}$ and $\Delta_h VIX^{UK}$ in the top, middle and bottom row, respectively. The independent variable is ΔMaP^{shock} across all estimations. p values in parentheses were obtained with robust standard errors.

Table C.2: Robustness with respect to macroprudential policy shock outliers

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	h = 1	h = 5	h = 10	h = 15	h = 20	h = 25	h =30	h = 35	h = 40	h = 45	h =50	h = 55	h = 60
Full sample	-0.0023	0.0360	-0.0605	-0.1028	-0.2106**	-0.3470***	-0.3952***	-0.4129***	-0.3905***	-0.4213***	-0.3735***	-0.3151*	-0.1985
	(0.8460)	(0.3091)	(0.1104)	(0.1210)	(0.0177)	(0.0012)	(0.0000)	(0.0007)	(0.0032)	(0.0001)	(0.0026)	(0.0596)	(0.3246)
Excl. 16 Dec 2010	-0.0078	0.0639*	-0.0472	-0.1211*	-0.2362**	-0.3813***	-0.4539***	-0.4614***	-0.4131***	-0.4323***	-0.4016***	-0.3263*	-0.2590
	(0.4740)	(0.0744)	(0.2522)	(0.0947)	(0.0147)	(0.0011)	(0.0000)	(0.0006)	(0.0067)	(0.0005)	(0.0047)	(0.0882)	(0.2395)
Excl. 04 Nov 2011	0.0052	0.0318	-0.0672*	-0.1464**	-0.2083**	-0.3194***	-0.4002***	-0.3690***	-0.3145***	-0.3468***	-0.2663***	-0.1771	-0.0372
	(0.6497)	(0.4447)	(0.0818)	(0.0177)	(0.0337)	(0.0033)	(0.0001)	(0.0031)	(0.0086)	(0.0000)	(0.0018)	(0.1731)	(0.8330)
Excl. 27 Jun 2013	-0.0032	0.0297	-0.0399	-0.0385	-0.1140*	-0.2711**	-0.3227***	-0.3524***	-0.3369**	-0.3852***	-0.3412**	-0.2730	-0.1342
	(0.8155)	(0.4647)	(0.3716)	(0.5197)	(0.0660)	(0.0117)	(0.0001)	(0.0056)	(0.0168)	(0.0008)	(0.0141)	(0.1388)	(0.5437)
Excl. 27 Oct 2014	-0.0064	0.0503	-0.0202	-0.0404	-0.1478	-0.2828*	-0.3305***	-0.4209***	-0.4043***	-0.3993***	-0.3820***	-0.3161*	-0.1966
	(0.6315)	(0.1648)	(0.7053)	(0.6110)	(0.1963)	(0.0563)	(0.0024)	(0.0001)	(0.0045)	(0.0017)	(0.0036)	(0.0909)	(0.3803)
Excl. 31 Oct 2014	-0.0039	0.0342	-0.0874***	-0.1266*	-0.2303**	-0.3813***	-0.3723***	-0.3656***	-0.3883***	-0.4177***	-0.3602***	-0.3327*	-0.2528
	(0.7591)	(0.3368)	(0.0093)	(0.0787)	(0.0168)	(0.0007)	(0.0002)	(0.0051)	(0.0096)	(0.0006)	(0.0096)	(0.0755)	(0.2476)
Excl. 19 Feb 2016	-0.0036	0.0168	-0.0685**	-0.1108	-0.2381***	-0.3073***	-0.3789***	-0.3726***	-0.3275**	-0.4035***	-0.3728***	-0.2736	-0.1438
	(0.7800)	(0.5878)	(0.0407)	(0.1204)	(0.0084)	(0.0017)	(0.0000)	(0.0030)	(0.0230)	(0.0006)	(0.0048)	(0.1380)	(0.5291)
Excl. 29 Mar 2016	-0.0045	0.0093	-0.0898***	-0.1302*	-0.2720***	-0.4271***	-0.4286***	-0.4453***	-0.4485***	-0.4951***	-0.4336***	-0.4881***	-0.4070***
	(0.7351)	(0.7731)	(0.0040)	(0.0636)	(0.0013)	(0.0000)	(0.0000)	(0.0009)	(0.0014)	(0.0000)	(0.0014)	(0.0004)	(0.0095)
Excl. 25 Sep 2017	0.0001	0.0482	-0.0573	-0.1032	-0.2215**	-0.3772***	-0.4418***	-0.4572***	-0.4278***	-0.4593***	-0.4192***	-0.3361*	-0.1912
	(0.9967)	(0.2392)	(0.1839)	(0.1690)	(0.0277)	(0.0016)	(0.0000)	(0.0012)	(0.0047)	(0.0001)	(0.0025)	(0.0737)	(0.4032)
Observations	2748	2744	2739	2734	2729	2724	2719	2714	2709	2704	2699	2694	2689

p-values in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: In line with local projection methods, each horizon is estimated separately, the outcome of which is presented in a separate column. The dependent variable is $\Delta_h CISS^{UK}$ over the horizons considered. The independent variable is $\Delta \text{MaP}^{shock}$. p values in parentheses were obtained with robust standard errors.