MARKET RESPONSE TO POLICY INITIATIVES DURING THE GLOBAL FINANCIAL CRISIS

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ABSTRACT

This paper examines the impact of macroeconomic and financial sector policy announcements in the United States, the United Kingdom, the euro area, and Japan during the recent crisis on interbank credit and liquidity risk premia. Announcements of interest rate cuts, liquidity support, liability guarantees, and recapitalization were associated with a reduction of interbank risk premia, albeit to a different degree during the subprime and global phases of the crisis. Decisions not to reduce interest rates and bail out individual banks in an ad hoc manner had adverse repercussions, both domestically and abroad. The results are robust to controlling for the surprise content of announcements and using alternative measures of financial distress.

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1. Introduction

When the subprime crisis struck in the United States and especially when it spread to other advanced economies and pushed the global economy into recession, designing an effective policy response to the crisis became the number one priority for policymakers around the globe. The ultimate goal of wide-ranging central bank and government interventions was to address the fragility of banking systems and restore confidence in the financial markets. Achieving these goals required a delicate consideration of the sources of stress and the availability of suitable remedies—all against heightened uncertainty about financial and macroeconomic prospects. Reaching consensus on how quick and aggressive policy actions should be, how much weight should be put on macroeconomic and financial sector policies, and what specific form they should take, particularly given various legal, political and other constraints, has been a challenge both at the national and global levels (Swagel (2009)).

The debate on what policy response would be most effective unfolded in real time, and first econometric analyses also appeared. They largely focused on the effectiveness of the Federal Reserve's Term Auction Facility (TAF), with conflicting results (contrast, for example, Taylor and Williams (2009) and McAndrews, Sarkar and Wang (2008)). Some studies underscored the importance of the U.S. Federal Reserve's commitment to provide unlimited U.S. dollar swap lines to other central banks in alleviating dislocations in the dollar swap markets (Baba and Packer (2009) and McAndrews (2009)). Announcements of financial restructuring measures were found to have reduced bank credit default swap (CDS) spreads, including for foreign banks, with the magnitude of the impact correlated with the magnitude of resources pledged (Panetta et al. (2009)).[1] The literature on the effectiveness of crisis policy response has been growing rapidly, with most analyses focusing on individual countries or specific policy measures.

The contribution of this paper is twofold. First, we construct a detailed database of macroeconomic and financial sector policy initiatives announced during the crisis by four systemically important advanced economies—the United States, the United Kingdom, the euro area, and Japan—between June 1, 2007 and March 31, 2009. The database covers announcements in the area of fiscal policy, monetary policy (interest rate decisions, and quantitative and credit easing), liquidity support (in domestic and foreign currency), as well as financial sector policy (recapitalization, asset purchases, liability guarantees, and deposit insurance). It also contains information about decisions not to act (for example, to leave interest rates unchanged or allow banks to fail) and ad hoc bailouts of individual banks.

Second, using a methodology common in the finance literature—the event study—we assess how successful macroeconomic and financial sector policy initiatives (as well as policy inaction)

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[1] Other studies assessing the impact of policy interventions during the current crisis include Artuç and Demiralp (forthcoming), Meier (2009), Frank and Hesse (forthcoming), and International Monetary Fund (IMF; 2009a and b).

were in addressing the financial sector distress. Our main indicator of financial distress is a widely monitored measure of credit and liquidity risk premia in the global interbank markets—the change in the spread between London Inter-Bank Offered Rates (Libor) and Overnight Index Swaps (OIS) for the U.S. dollar, and we also examine the robustness of results to an array of alternative measures. We employ parametric and nonparametric means tests to evaluate whether policy announcements had an economically and statistically significant impact on interbank risk premia.

The event study methodology has a number of advantages. The most important are its simplicity, parsimony and focus on the immediate market response to a policy announcement. Compared to alternative methodologies (for example, the regression analysis used, among others, by Taylor and Williams (2009) and Baba and Packer (2009)), event studies are designed to work with limited sample sizes. Although the basis of policy evaluation is narrow in an event study, it may be suggestive of policies' long-term effectiveness as a positive immediate market reaction may be self-fulfilling, laying ground for a sustained policy success.

Nonetheless, an event study has limitations. It does not lend itself to the analysis of causality. It also cannot provide a comprehensive evaluation of policy effectiveness. Such an assessment requires correlating measures of policy intensity and objectives over the entire policy horizon, while controlling for the effects of other policies and changes in market conditions. A comprehensive assessment of policies may reach different conclusions from an event study. For example, some policies which markets initially receive negatively (such as bank failures) may ultimately be welfare-enhancing (for example, by avoiding moral hazard) (Klingebiel et al. (2001)). A comprehensive assessment of crisis policies appears too early to be conducted at this time.

The event study needs to be designed carefully to address several issues. The first challenge is to create multiple draws of announcements, which we achieve by classifying announcements by type and pooling them across countries. To ensure that the event window for an announcement is not contaminated by the effects of other announcements, we apply a number of filtering criteria when classifying announcements, exclude overlapping announcements and use a narrow five-day event window. We also explore the robustness of results to using a three-day window. We also examine robustness to controlling for expectations about the Libor-OIS spread and content of monetary and fiscal policy announcements (expectations data for other types of policies were not easily available).

Although an event study cannot fully control for the multitude of macroeconomic and structural factors that may affect market response to news, we attempt to address this issue by splitting the sample period into two—the subprime crisis, prior to the collapse of Lehman Brothers, and the global crisis, after the collapse. We also undertake country-specific analyses to gauge the importance of differences in country conditions and characteristics of announcements. To ensure that we are not using a biased measure of financial distress, we test robustness to alternative system-wide measures of interbank risk premia, such as the recently introduced transaction-based New York Funding rate (NYFR)-OIS spread, the spread between the Libor rate and the risk-free rate (the TED spread), the expected Libor-OIS spread, and the spread of repo transactions to the risk-free rate. We also consider a composite measure of bank-specific default

risk (credit default swap (CDS) spread), and measures of market perceptions of macroeconomic prospects and financial market volatility (equity price and volatility indices (VIX), respectively).

Based on the literature on past crises, both macroeconomic and financial sector policy announcements are expected to have a significant calming impact on interbank credit and liquidity risk premia (see Reinhart and Rogoff (2008); Calomiris, Klingebiel and Laeven (2005); Claessens, Klingebiel, and Laeven (2005); and Furfine (2002)). Financial sector policies aim to restore financial stability, while macroeconomic policies help to avoid the vicious feedback between the financial sector and the broader economy. Consistent with McQueen and Roley (1993), we expect market response to announcements to be state-contingent, i.e., depend not only on the surprise content of announcements but also on the state of the economy and financial markets in which investors interpret them. Owing to a high degree of integration of the global financial system, we would also expect to find evidence of international spillovers from policy announcements by systemically important countries.

The announcement effects are likely to vary across types of policies. For example, although both monetary and fiscal easing aim to support activity, the impact of monetary easing on credit and liquidity risk premia is likely to be stronger as it directly relieves funding pressures and reduces counterparty risk. Unconventional policies are likely to show little impact on the spreads themselves, as their system-wide impact is more difficult to assess, although some institutions are likely to benefit significantly. Announcements of liquidity support, even if reducing funding pressures, may have an ambiguous impact if markets are uncertain whether the liquidity provision could mask underlying solvency problems.

The introduction of government guarantees may have a larger immediate effect on interbank risk premia than asset purchases, because guarantees instantaneously transfer risks from banks' balance sheets to the sovereign. Principles-based bank recapitalization programs are likely to be welcomed by markets, while decisions to bailout financial institutions in an ad hoc manner may have ambiguous effects. Although intended to allay markets' fears about the stability of individual institutions, they may increase their concerns about the soundness of the overall financial system, as markets may consider that announcements about ad hoc bank bailouts reveal bad news that financial institutions are in trouble and country authorities are privy. Such announcements may raise uncertainty and information asymmetry about counterparty risk, which have been the main cause behind stress in interbank markets (Heider, Hoerova and Holthausen (2009)).

The findings of this paper underscore that there was no silver bullet for containing the crisis. Both macroeconomic and financial sector policy announcements were associated with reductions in the Libor-OIS spreads, with market responses to announcements depending on the broader context in which market participants were interpreting the news. Three specific results emerge, which are robust to the changes in specification discussed above:

1. Decisions to keep interest rates stable or raise them had adverse implications during the subprime crisis, while announcements of interest rate cuts contributed positively during the global phase of the crisis. Announcements of domestic and foreign currency liquidity support

were mostly associated with reductions in interbank risk premia throughout the crisis, while fiscal policy announcements consistently had negligible effects.

2. In the financial sector area, announcements of ad hoc bank bailouts had by far the largest impact, aggravating distress in interbank markets during the global phase of the crisis. This impact was not limited to domestic markets but spread throughout the global financial system. By contrast, systematic financial restructuring measures were more likely to be associated with a reduction in interbank risk premia.

3. In particular, recapitalization announcements had a favorable effect on interbank risk premia during the global crisis, suggesting that markets saw merit in these measures. Liability guarantee announcements had mixed effects: reducing interbank risk premia during the subprime crisis (when they largely reflected the U.K. government's measures in response to the Northern Rock case) and widening interbank risk premia after the crisis deepened (possibly because most announcements at that time were in response to the Irish move to offer blanket guarantees on all deposits and were associated with concerns about possible regulatory arbitrage and disruptive cross-border flows). Announcements of asset purchases were ineffective throughout the crisis, as markets may have anticipated problems in implementing these measures.

The rest of the paper is organized as follows. Section 2 discusses the Libor-OIS spread as a measure of credit and liquidity risks premia in interbank markets and describes the specially created database on policy announcements. Section 3 provides a brief overview of the event study methodology and describes how the event study was designed. Section 4 discusses graphical evidence and statistical tests of policy announcement effects for the pooled and country-specific samples as well as confirms the robustness of results to alternative specifications. Section 5 concludes.

2. Measuring Financial Sector Distress and Policy Initiatives

The analysis of interbank market responses to policy announcements requires daily data on a measure of financial distress in interbank markets and on policy announcements. Such measures are discussed below. The section also describes how the time period is split to control for differences in macroeconomic and financial conditions before and after the collapse of Lehman Brothers.

2.1. The Libor-OIS Spread

We measure the effect of policy announcements on the day-to-day changes in the 3-month U.S. dollar Libor-OIS spread—a proxy for the liquidity and counterparty risk premia in the global interbank markets. The Libor rate comprises the expected risk-free interest rate over a specific term, the term premium, the credit risk premium of unsecured trading with another bank, and the liquidity risk premium of term in lieu of overnight (McAndrews, Sarkar and Wang (2008)). The OIS rate is a measure of the expected risk-free interest rate over a specific term of secured transactions. Thus, the spread between the Libor and OIS rates over the same term quantifies the

premium that banks pay when borrowing funds for a pre-determined period relative to the expected interest cost from repeatedly rolling over funding in the overnight market.

In times of sufficient liquidity and in the absence of market dislocations, the Libor-OIS spread is close to zero. However, when markets are under stress, uncertainty about credit and liquidity risk creates an opportunity cost of term funding, resulting in a positive spread between the Libor and OIS rates. With credit and liquidity risks becoming the major drivers of the increase in the interbank interest rates since the summer of 2007 (Michaud and Upper (2008)), the Libor-OIS spreads turned into a widely monitored indicator of financial distress (Taylor (2009)) and a useful measure of the effectiveness of policy interventions (McCormick (2007)).

When undertaking country-specific analyses, we use the Libor-OIS spreads for the U.S. dollar, pound, euro and yen. Although the Libor-OIS spreads for all major currencies moved closely together during the crisis, they are likely to be reflective of credit and liquidity conditions in interbank markets of the respective countries. Figure 1 plots the daily observations of the levels of and changes in the Libor-OIS spreads from January 1, 2007 to March 31, 2009. Spreads increased sharply in August 2007 (the "black swan" event of Taylor, 2009), remained persistently high through the rest of 2007 and the first half of 2008, and then shot up further in September 2008 after Lehman Brothers' collapse. The collapse of this systemic institution aggravated distrust in wholesale funding markets, and banks became increasingly reluctant to lend to each other over longer terms. The above periods were associated with the largest day-to-day changes in the spreads.

[Figure 1 about here]

Although the Libor-OIS spread was widely used as a key indicator of financial distress, its reliability can be contested, for example, owing to major dislocations in money markets during the crisis and the role of central banks in displacing financial intermediation in wholesale term markets (Mollenkamp (2008)). Another concern is that the Libor rate tends to be calculated based on banks' quotes rather than rates used in actual lending transactions.

To confirm that using the Libor rates does not bias the results, we examine robustness to using alternative measures of financial distress (Section IV.B). Instead of the U.S. dollar Libor rate, we consider the recently introduced three-month NYFR, an interdealer-based analog to the London fixing of the unsecured money market in U.S. dollars, which reflects the actual funding cost of banks. [2] (Similar data were not easily available for other countries in the sample.) We also consider several alternative system-wide measures of credit and liquidity risks— the spread between the Libor rate and the risk-free rate (the TED spread), the forward-looking Libor-OIS spread, and the repo risk-free spread —as well as bank-specific measures of default risks

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[2] In contrast to Libor, which represents a quote of the benchmark rate of interest at which banks can expect to lend funds to each other in the London interbank market, the NYFR is the representative transaction rate at which an institution would be likely to obtain funding in the market. The NYFR was launched on June 11, 2008 by the inter-dealer brokerage ICAP in response to market concerns about the accuracy of the LIBOR fixing and the panel composition of contributing banks.

(composite bank CDS spreads) and measures of market expectations of macroeconomic prospects and financial stability, such as equity price and volatility indices (VIX).

2.2. Crisis Timeline

To account for differences in the macroeconomic and financial environment before and after the collapse of Lehman Brothers, we split the crisis period into two subperiods: (i) the *subprime crisis* from June 1, 2007 to September 14, 2008, which was characterized by a series of predominantly central bank policy measures with a relatively narrow focus on arresting the downward spiral of counterparty confidence; and (ii) the *global crisis* from September 15, 2008 to March 31, 2009, which witnessed frequent and diverse policy interventions motivated by a sense of heightened urgency about the need to restore financial stability and avoid a global economic depression.

The onset of the crisis is identified as June 1, 2007 based on a Markov-switching vector autoregression of bond market data (see Nowak et al. (2009)). The end of the period coincides with the G20 Leaders' Summit on Financial Markets and the World Economy, held in London on April 2, 2009, when the leaders pledged more than 1 trillion dollars to tackle the global financial crisis by improving international finance and trade, and fostering an economic recovery. The collapse of Lehman Brothers on September 14, 2008 marks the end of the subprime phase and the beginning of the global phase of the crisis.

Differences in the level of the Libor-OIS spread during the precrisis period (January 1 to May 31, 2007) and the two crisis subperiods are apparent from Figure 1. Market responses to policy announcements are likely to have differed during the two subperiods owing to differences in market perceptions of the underlying problems, the nature of the policy effort required to address them, and the policy room country authorities had at their disposal. During the subprime phase, country authorities and markets perceived the crisis as largely limited to the fallout from the collapse of the U.S. subprime mortgage market and its implications for mortgage-backed securities' markets. Policy priorities largely focused on the unfreezing of credit markets and dealing with weak financial institutions. Interest rate cuts and aggressive provision of liquidity support were seen as ways to address these policy objectives.

The collapse of Lehman Brothers demonstrated the systemic nature of the crisis, at the same time as a sharp deterioration of incoming macroeconomic data pointed to global recession. Aggressive use of monetary and fiscal easing, while appropriate, gradually eroded policy room available to country authorities. Policy priorities during the global phase of the crisis increasingly shifted to restoring market confidence, preventing further systemic bank collapses, and stimulating domestic demand. During that phase of the crisis, interest rates declined sharply, and many central banks shifted to using unconventional monetary policy measures.

2.3. Policy Announcements

We compile data on major policy initiatives announced by country authorities in the United States, the United Kingdom, the euro area, and Japan in response to the financial crisis. Data for

the euro area include policy announcements by the European Central Bank (ECB) and national authorities from Austria, Belgium, France, Germany, Ireland, Italy, the Netherlands, and Spain. Dates of policy announcements are identified based on official press releases, major newspapers and news search engines, and are double-checked against similar compilations of crisis events by central banks, investment banks, international organizations and individual researchers (for example, Federal Reserve Bank of St. Louis (2009); Furceri and Mourougane (2009); Global Financial Association (2009); Guillén (2009); and IMF (2009a and b)).

To minimize noise and the number of overlapping events (which may bias statistical tests), we focus on watershed policy events. Such events are distinguished by the prominence of their media coverage. For the United States and the United Kingdom, we identify major policy events by their appearance as front-page news in the *Financial Times* and/or the *Wall Street Journal* within the symmetric four-day window around the official announcement. Given a greater diversity of the economic and financial press in the euro area and Japan, for these economies, we identify watershed events using additional news sources, such as Bloomberg and Associated Press, and the coverage in Federal Reserve Bank of New York (2009).

Policy initiatives are dated as of their official announcement. For a few measures that involved a multi-stage decision-making process (for example, the adoption of a fiscal stimulus package), the consecutive stages of the process are recorded to the degree the authorities made public announcements at each stage.

We distinguish ten categories of announcements in four policy areas: (i) fiscal measures; (ii) monetary policy; (iii) liquidity support; (iv) financial sector measures; and (v) policy inaction and ad hoc bank bailouts (Table 1):

[Table 1 about here]

Fiscal measures include all policy actions that aim at stimulating domestic demand, through increases in expenditures or reductions in taxes, unless classified in other categories. Since fiscal measures typically require legislative approval, the political decision process is usually protracted with a series of announcements making headlines.

Monetary policy measures include interest rate decisions and quantitative and credit easing, aimed at easing monetary conditions. *Quantitative easing* involves the central bank's purchasing government securities, while *credit easing* consists of purchases of private sector debt in primary or secondary markets, including mortgage-backed securities.

Liquidity support is the provision of domestic currency liquidity through broadened access to central bank refinancing, extended collateral framework, more frequent auctions, or longer maturities, as well as the provision of foreign currency liquidity through swap agreements between central banks and central bank funding facilities for foreign currency liquidity.

Financial sector policies include the tools commonly utilized to resolve systemic banking crises, and are further broken down according to their implications for bank balance sheets:

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- *Asset purchase* programs use public funds to buy risky assets from banks to shield them from losses. Banks profit from asset purchase programs to the extent that credit risk is removed from their balance sheets, and also because the purchases may put a floor on market prices in banks' trading books. The category also includes ring-fencing of bad assets, which may be conducted either off-balance sheet through a special purpose vehicle absorbing assets, or on the balance sheet through asset guarantees. Asset purchases usually involve signing a loss-sharing agreement between a public institution providing funds and the bank receiving them. The measure can either be adopted for a single institution or as a system-wide facility for a given asset class.

- *Liability guarantees* are system-wide guarantees for newly issued or existing wholesale financing, and the enhancement of deposit protection schemes. It also embraces the lender-of-last resort funding to individual banks and other ways to grant financial institutions access to alternative funding sources, such as the chartering of U.S. investment banks as bank holding companies to allow them to tap retail funds.

- Finally, *recapitalization* includes the direct injection of capital partially or fully originating from public funds, including the announcement of system-wide recapitalization programs, like the U.K. Bank Recapitalization Fund, and nationalization, which includes the assumption of a controlling stake in a bank.

A special category—*policy inaction and ad hoc bailouts*—comprises decisions not to enact comprehensive measures to contain the financial crisis. The most prevalent policy announcement in this category is decisions to maintain interest rates unchanged. Interest rate increases, which were rare, are also included. The category also covers decisions to allow banks to fail—Lehman Brothers, IndyMac, and NetBank—and decisions to bail out individual troubled institutions. In contrast to the financial sector measures discussed above, a bank bailout is an ad hoc, unsystematic rescue package or nationalization plan aimed to prevent the failure of an individual financial institution. We use the adoption of a comprehensive recapitalization program or system-wide principles for bank rescues as the criterion for distinguishing between ad hoc bailouts and systematic restructuring measures.

For announcements consisting of several measures, we identify the main measure based on the degree of prominence of front-page coverage for the measures included in the package, which also helps to reduce the number of overlapping announcements. For example, the FOMC's vote to maintain the interest rate corridor on March 18, 2009, is considered less significant than the same day's release that the Fed would purchase agency debt and treasury securities for more than one trillion U.S. dollars. In a few cases where several equally important policy initiatives were announced on the same day, they are included as separate entries in the database.

All in all, the database includes 196 front-page announcements (Table 2). Financial sector initiatives accounted for the largest share of front-page announcements (38 percent), followed by policy inaction and ad hoc bank bailouts (23 percent), liquidity support (19 percent), and monetary policy announcements (15 percent). Fiscal policy announcements were just 5 percent of the total. The largest number of front-page announcements covered the policy measures undertaken by the United States (43 percent) and the ECB and the euro area governments (37

percent). The U.K. front-page announcements accounted for 16 percent of the total number of front-page announcements, and Japanese, for only 4 percent, possibly reflecting a smaller direct impact of the crisis on this country with correspondingly fewer crisis-response measures taken.

[Table 2 about here]

Although countries' approaches to stabilize the financial sector and support domestic growth were broadly similar, the exact timing and characteristics of measures varied depending on authorities' perceptions of the extent and timing of crisis impact as well as local institutional, structural and political factors. Figure 2 shows the evolution of the front-page policy announcements over time, pointing to a considerable variation in countries' policy responses to the crisis. With the onset of the subprime crisis, most countries stepped up the provision of liquidity support to financial institutions, but only the United States (and to a lesser degree the United Kingdom) aggressively cut interest rates during that period. The United States also initiated the first fiscal stimulus early on, in January 2008, long before the crisis took on its global dimension, while other countries announced fiscal stimulus packages much later, in the last quarter of 2008.

[Figure 2 about here]

Several countries resorted to ad hoc interventions to bail out troubled financial institutions during the subprime crisis, such as the bailout of Bear Stearns in the United States, guarantees to Northern Rock in the United Kingdom, and the rescue of IKB and two Landesbanken in Germany. The United States was the only country that employed a diverse set of financial sector measures early on, ranging from asset purchases to liability guarantees and recapitalization. The U.K. early response to the crisis concentrated on the provision of liability guarantees and changes in deposit insurance schemes, motivated by the need to address shortcomings in the latter. The euro area responded with a large number of recapitalization and liability guarantee measures only after the collapse of Lehman Brothers. In Japan, major financial sector policy announcements focused on recapitalizations.

In addition to dates and types of policy announcements, we record information about the expected and officially announced intensity of some announcements. Data on officially announced intensity are available for fiscal, monetary, and financial sector interventions in the United States and the United Kingdom. For fiscal stimulus packages or asset purchases that imply (quasi-) fiscal outlays, we record the officially announced size of the package or special-purpose budget allocation. Expectations data are available only for fiscal and monetary interventions in these two countries. For fiscal stimuli, market expectations of the magnitude of intervention are determined using news searches in the *Financial Times* and the *Wall Street Journal* within one week prior to the official release, and checked against the IMF's internal data. For policy rate decisions, we use median expectations from *Bloomberg*'s surveys of market analysts.

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3. Event Study Methodology

We evaluate the real-time impact of policy announcements on interbank credit and liquidity risk premia using the event study methodology. The methodology is well established, especially in the finance literature (see, e.g., Campbell, Lo, and McKinlay (1997); and Kothari and Warner (2007)). The event study methodology is generally well suited to assessing the short-run effects of policy and other announcements. Its main strengths are simplicity and parsimony. Compared to regression-based analyses, event studies are less affected by the problems associated with joint hypothesis testing—the difficulty of distinguishing whether insignificant test results are due to a failure of the efficient market hypothesis or a genuinely insignificant impact of announcements (see Jensen (1978) and Fama (1991) for a discussion). The event study methodology is also designed to work with the limited samples of announcements we have.

An event study needs to be designed carefully to address several issues. To create multiple draws of similar events, we classify announcements into several types (as discussed above) and pool them across countries. We examine consistency of country-specific analyses with those based on the pooled sample. It is also important to ensure that the results for a given type of policy announcement are not driven by other events. Applying the front-page and main-event criteria for classifying announcements as described above helps to reduce the number of overlapping events. Furthermore, when undertaking the analysis on the pooled sample, we exclude domestic and foreign announcements of the same type which fall within five days from each other, with an exception of announcements of support packages where identifying the main event was difficult.[3] Country-specific event studies exclude overlapping domestic announcements and tests of bilateral and total spillovers exclude overlapping announcements for the foreign country in question or all foreign countries, respectively.

Limiting the size of the event window helps to avoid contaminating the analysis of given announcement effects with those of preceding and subsequent announcements in an environment where such announcements were made in relatively short succession. We use a narrow event window—one day before and three days after an announcement—while examining the robustness of results to using a symmetric one-day window. A longer post-announcement window allows for a more protracted-than-usual absorption of news, which appears appropriate as many crisis policy initiatives were unprecedented and/or complex, without any apparent benchmarks for evaluating their effects. This interpretation is supported by the graphical analysis (Figure 3), which shows a pronounced accumulation of announcement effects. Besides reducing the contamination of the event window with the effects of other events, limiting the event window also helps to reduce potential endogeneity between policy announcements and market responses.

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[3] They include 12 events in the United States (on 12/19/2007, 7/13/2008, 9/15–17/2008, 10/03/2008, 10/14/2008, 11/10/2008, 11/25/2008, 1/16/2009, and 1/28/2009), 6 events in the United Kingdom (on 7/05/2007, 10/4/2007, 11/08/2007, 10/03/2008, 01/19/2009, and 02/26/2009), 7 events in the euro area (on 2/13/2008, 9/29/2008, 10/07/2008, 10/12–15/2008, and 10/20/2008), and 2 events in Japan (on 7/15/2008 and 10/31/2008).

[Figure 3 about here]

Another aspect of the identification problem is that policy announcements may affect markets before the event window because they were anticipated. In this case, the policy measures would be priced out before the announcement, rendering insignificant estimates of the announcement effects. To account for such a possibility, we collect measures of the surprise component of interest rate cuts and fiscal stimulus packages in the United States and the United Kingdom (see Section 2.3 for details) and examine the robustness of results to using only the surprise content of announcements. Expectations data for other countries or types of announcements were not easily available.

The last challenge, which event studies cannot address directly (by design), is controlling for the multitude of factors that may have bearing on market response to announcements. The event study focuses on the credibility of these announcements as well as market participants' beliefs about their appropriateness, timeliness, feasibility and ultimate implementation. Market perceptions of policy announcements are likely to be state-contingent, depending on how markets perceive the underlying problem that needs to be addressed through policy measures and whether the announced policy measure is timely, appropriate, sufficient, and credible to address this problem. These considerations are likely to have differed considerably before and after the collapse of Lehman Brothers, and the splitting of the crisis period into the two subperiods (see Section II.B for details) helps to control for differences in the macroeconomic and financial conditions to some extent.

Tests of the robustness of results to using alternative measures of financial distress also help to confirm that the main results are not biased. We consider alternative system-wide measures of interbank risk premia such as the recently introduced transaction-based NYFR-OIS rate, expectations about the Libor-OIS spread, the spread of repo transactions to the risk-free rate, and the TED spread. We also consider composite measures of bank-specific default risk (credit default swap spreads), and measures of market perceptions of macroeconomic prospects and financial market volatility, such as equity price and volatility indices (VIX), respectively.

We analyze the impact of policy announcements on changes in the Libor-OIS spread, and capture the cumulative impact of policy announcements over a few days. The event study methodology requires aggregating the abnormal differences in the market indicator of interest within each event window to construct cumulative abnormal differences, under an assumption that no other factors moved the stress indicators during the event window. These differences are then averaged across types of policy to calculate average cumulative abnormal differences (ACAD). Focusing the analysis on short-term changes in the Libor-OIS spread avoids the need to model the time-varying properties of its level, including trends, structural breaks, nonlinearities and nonstationarity.

We define abnormal differences as actual daily changes in the Libor-OIS spread. During both phases of the crises, day-to-day changes of the Libor-OIS spread were not statistically different from zero. Statistical tests based on an alternative definition of abnormal differences—the difference between the actual daily change on each day of the event window and the expected daily change measured as the average daily change over the previous 20 working days—point to

the same conclusions as the baseline results. This is not surprising as the two measures of abnormal differences are highly correlated with each other.

For other financial market indicators, which we consider as part of robustness analysis, the assumption of zero mean reversion is not valid. Abnormal differences are computed as a difference between the expected daily change of the market indicator and its actual daily change. The expected daily change of the market indicator, is estimated as the average daily change over the previous 20 working days, and is subtracted from the actual daily change on each day of the event window to obtain abnormal differences.

We apply parametric and nonparametric tests of means before and after announcements to abnormal differences to ascertain whether the announcement induces a statistically significant effect on interbank risk premia. Parametric tests attribute an equal chance to both positive and negative deviations from expectations (in addition to allowing for asymmetric tail behavior of abnormal changes) while nonparametric tests do so without distributional assumptions. A small number of observations weakens the power of statistical tests, pointing to the need to consider both the economic and statistical significance of results. Statistical tests are specified in line with the literature, see for example, Patell (1976); Brown and Warner (1985); Boehmer, Masumeci and Poulsen (1991); Campbell, Lo, and McKinlay (1997); and McKinlay (1997). For a detailed description of test statistics, see Appendix I.

4. The Results: Impact of Policy Announcements on Interbank Credit and Liquidity Risk

To gauge the response of the Libor-OIS spreads to announcements of policy interventions, we first plot changes in the Libor-OIS spreads during the event window and then test the statistical significance of differences in the behavior of the Libor-OIS spreads prior to and after announcements. We start with the graphical analysis and statistical tests on a pooled sample of announcements and the dollar Libor-OIS spread and then proceed to the robustness analysis and country-specific analyses on the Libor-OIS spreads for all major currencies.

4.1. Analysis on a Pooled Sample

4.1.1. Graphical Analysis

Announcements of policy initiatives had a small calming effect on the distressed financial markets, with the Libor-OIS spread falling by about 3 basis points on average during both crisis periods (Figure 3, top panels). In contrast, policy inaction (defined here as decisions to raise policy interest rates or keep them stable) and announcements about ad hoc bank bailouts and failures) were associated with a dramatic increase of the financial market stress during the global phase, yielding an increase of 46 basis points on average over the event window.

This finding carries through to monetary and financial sector policy measures. The middle panels of Figure 3 underscore the adverse effects of maintaining or increasing policy rates, especially during the global phase. The Libor-OIS spreads widened by about 25 basis points on average over the event window in response to announcements of maintaining or increasing policy rates during the global phase. Announcements of interest rate cuts are found to be associated with a

decline of the Libor-OIS spread. Such announcements were more effective in calming financial markets than announcements about liquidity support, especially when the crisis worsened.

Among the measures targeted directly at banks, announcements concerning recapitalization were associated with the largest reductions in the Libor-OIS spread during the global phase (by about 20 basis points on average over the event window). On the opposite, liability guarantee announcements were even followed by wider spreads during the global phase, as were asset purchases. Ad hoc bank bailouts and bank failures yielded a much worse response than any other policy initiative, with the Libor-OIS spread widening by almost 50 basis points on average over the event window.

Policy actions led to a reduction of the Libor-OIS spread more often on average than policy inaction and ad hoc bank bailouts (Figure 4). Although the frequency plots for both policy actions and policy inaction and ad hoc bank bailouts are centered at zero (i.e., announcements had on average a negligible impact on the Libor-OIS spreads), the frequency distribution of policy actions is wider and more skewed to the left. This implies that announcements of policy actions led to a decline of the Libor-OIS spreads more often on average than policy inaction and ad hoc bank bailouts did (the respective probabilities are 58 percent and 32 percent, for the total sample period). The differences were particularly pronounced during the global phase of the crisis, as the probability declined to 3 percent for policy inaction and ad hoc bank bailouts.

[Figure 4 about here]

Announcements of both macroeconomic and financial sector policy initiatives were associated on average with reductions in interbank risk premia (Figure 4). The frequency plots for all categories of policy—monetary policy and liquidity support, financial sector policy, and fiscal policy—have long left-hand-side tails, containing a larger mass of observations than the right-hand-side tails. This suggests that announcements in these policy categories tended to decrease spreads more frequently than increasing them. The average probabilities were around 60 percent for all categories of policies. Surprises in monetary and fiscal policy announcements were associated with declines in spreads more often (with about 77 percent on average over the entire sample period and 82 percent during the global phase).

The effect of policy announcements on the Libor-OIS spread varied over the event window during different phases of the crisis (Figure 5). Although some fiscal and financial sector policy announcements were followed by lower Libor-OIS spreads during the subprime crisis, after the collapse of Lehman all types of policy announcements were accompanied by wider Libor-OIS spreads. The adverse impact of policy announcements on the Libor-OIS spreads during that period was rising over the event window, suggesting that markets were not just concerned about the ability of the announced policies to contain the crisis but that these concerns were worsening in the days immediately following policy announcements. However, throughout the crisis, surprises in monetary and fiscal policy announcements were associated with declines in interbank risk premia over the event window.

[Figure 5 about here]

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4.1.2. Statistical Analysis

Statistical tests confirm that while both macroeconomic and financial sector announcements were associated with a significant favorable impact on interbank credit and liquidity risk premia, the effects of announcements varied considerably across different types of policies and phases of the crisis. In contrast to announcements of policy initiatives, policy inaction and ad hoc bailouts had an adverse impact on financial stress in interbank markets.

Monetary Policy. Interest rate cuts led to significant declines in the Libor-OIS spreads (by about 11 basis points, see Column 5 in Table 3) during the global phase of the crisis. This was by far the largest impact among all types of monetary policy and liquidity support measures (Figure 6). More countries implemented interest rate cuts during the global phase of the crisis than during the early stage, the magnitude of the cuts was larger, and on one occasion interest rate cuts were coordinated by major central banks. The decline in the Libor-OIS spreads following interest rate cuts may have reflected markets' expectation that lower interest rates would increase liquidity in the financial system, thereby reducing liquidity risk in interbank markets.

[Table 3 about here]

We do not find evidence that announcements about unconventional monetary policy helped reduce interbank credit and liquidity risk premia, possibly because the likely effects of these policies were more difficult to discern than those of interest rate decisions. Although some institutions may have been expected to benefit significantly from unconventional policies, the system-wide impact of these measures was uncertain and difficult to assess.

Liquidity Support. Announcements of liquidity support were associated with reductions in interbank risk premia during both phases of the crisis. During the early stage of the crisis, announcements about the provision of U.S. dollar liquidity through swap agreements between the Federal Reserve and other major central banks (which often coincided with announcements about the provision of domestic currency liquidity support) were accompanied by statistically significant but small reductions in the Libor-OIS spreads (Table 3). Although the finding of strong announcement effects for forex swaps is consistent with other studies (for example, Baba and Packer (2009); and McAndrews (2009)), it is possible that the results partly reflect the effects of domestic currency liquidity support, as the respective announcements often took place together (for example, the Federal Reserve's announcements on December 12, 2007).

[Figure 6 about here]

During the global crisis, the Libor-OIS spread declined by about 6½ basis point on average following announcements of domestic currency liquidity support, and this effect was statistically significant (Column 5 in Table 3). The provision of liquidity support seems to have helped reduce funding pressures for those institutions that had access to liquidity facilities, contributing to lower liquidity risk premia in the interbank markets (consistent with the findings in Artuç and Demiralp, forthcoming; McAndrews, Sarkar, and Wang (2008); Deutsche Bank (2009); and Christensen (2009)).

Fiscal Easing. Announcements concerning fiscal stimulus packages were not associated with significant reductions in interbank credit and liquidity risk premia, possibly because fiscal policy measures were seen as mainly targeting other objectives, for example, increasing domestic demand, and as likely to have uncertain and delayed effects on interbank risks.

Financial Restructuring. During the subprime phase of the crisis, announcements of liability guarantees were accompanied by large and statistically significant reductions in interbank credit and liquidity risk premia (by about 11 basis points on average, see Table 3). This effect is likely to reflect the large guarantees extended by the U.K. government to depositors of a mortgage lender Northern Rock. The authorities provided stronger support for depositors than the latter anticipated (as manifested by the run on the bank) and also guaranteed wholesale creditors. The support of Northern Rock may have been viewed as crucial for reducing risk premia in global interbank markets, given the role of the United Kingdom as a major money center. Other countries used few liability guarantee measures during the subprime period and these measures were smaller in magnitude (Table 4).

[Table 4 about here]

In contrast, during the global phase, announcements about liability guarantees were not successful in lowering liquidity and credit risk premia in interbank markets. Spreads widened in response to such announcements, possibly owing to the fact that many announcements were implemented in response to the Irish government's decision to introduce blanket guarantees on assets and were accompanied by concerns that such decisions would result in regulatory arbitrage and outflows of deposits to countries with more generous guarantees and deposit protection. In addition, unlike in the subprime phase, guarantees on impaired assets may have no longer been able to allay markets' heightened concerns about the underlying soundness of financial institutions.

Announcements concerning recapitalization are associated with a favorable effect on the Libor-OIS spread during the global phase of the crisis (with the spread declining by about 3¾ basis points on average, see Column 5 in Table 3), even though this effect was statistically insignificant. This result supports the argument of Eichengreen and Baldwin (2008), made in early October 2008, that an urgently implemented, globally coordinated recapitalization was the key policy action needed to stabilize the banking system at that time.

News about asset purchase programs were followed by an increase in credit and liquidity risk premia throughout the crisis, although these effects were statistically insignificant (Table 3). One possible reason for the more negative impact of announcements about asset purchases than those about liability guarantees and recapitalization is markets' concern about the potential ineffectiveness of asset purchases—owing to banks' unwillingness to realize implicit losses out of fear that participation in asset purchase programs would be interpreted as a negative signal about their soundness. Hoshi and Kashyap (2008) point to banks' stigma derived from participating in the asset purchase program and their reluctance to sell the distressed assets at current market prices (below their fundamental value).

Policy Inaction and Ad Hoc Bank Bailouts. The impact of ad hoc bank bailouts of individual institutions by far outweighed the impact of policy actions during the global phase. Bailouts were accompanied by a 28¾ basis point increase in the Libor-OIS spread on average in that period (Column 5 in Table 3). The impact was also much larger than that of decisions to raise interest rates or keep them stable and decisions to let banks fail (Figure 6).

Announcements of bailouts tended to send shockwaves through markets as they suggested the possibility of failure of a systemic institution (see, for example, Hoshi and Kashyap (2008)). In most cases, bailouts were carried out with constructive ambiguity about the government's willingness to provide further support to banks—an intentional difference compared to system-wide recapitalization and liability guarantee programs. Banks may have interpreted bailout announcements as evidence of forthcoming bad news about the soundness of other financial institutions amid increased uncertainty about the government's intentions of supporting them. As a result, bailouts may have not been able to mitigate asymmetric information and uncertainty about counterparty risk—the main causes of stress in interbank markets (Heider, Hoerova, and Holthausen (2009)).

During the subprime phase of the crisis, the effects of ad hoc bank bailouts were smaller and statistically insignificant (Table 3), possibly because concerns about counterparty risk were less acute and related more to idiosyncratic reasons such as weak bank management than the overall strength of bank balance sheets. However, decisions not to change interest rates or raise them resulted in a small but statistically significant widening of the Libor-OIS spread (by about 1¾ basis points, see Column 1 in Table 3) during the subprime crisis.

4.2. Robustness Checks

Event Window. To evaluate the robustness of results, we first consider a narrower event window (three days instead of five). This is a less conservative benchmark for assessing the announcement effects as it gives a higher weight to transitory effects. The narrowing of the event window does not affect the main conclusions, with the results showing a variation typical of event studies (Table 3). As before, interest rate reductions are found to have been associated with reductions in interbank risk premia during the global phase of the crisis. The findings concerning announcements of liquidity support are also confirmed. Announcements of liquidity guarantees are found to have reduced the Libor-OIS spreads during the subprime phase but not during the global phase. Announcements about policy inaction and ad hoc bank bailouts had large and statistically significant adverse effects on spreads during both phases the crisis, reflecting decisions to maintain stable rates or raise them during the subprime crisis and ad hoc bank bailouts during the global phase.

Policy Expectations. The results are also robust to controlling for the surprise content of announcements. Consistent with the earlier findings, surprises in interest rate cuts had large effects on interbank risk premia during both phases of the crisis (Table 3). In the global phase of the crisis, the effect was statistically significant and by far outweighed the effect of monetary policy surprises during the subprime phase as well as the insignificant effects of fiscal policy announcements during both phases (Figure 6).

Although constraints on the availability and quality of expectations data prevent us from extending the analysis of surprises to other types of announcements, the above analysis provides some comfort that using dummy variables does not severely bias the results. Using dummy variables also seems to be appropriate as during a crisis both the expected and unexpected components of policy announcements are likely to have material effects owing to high uncertainty surrounding expectations and rapidly changing policy environment. As McQueen and Roley (1993) show, the effect of macroeconomic releases depends not only on their new informational content but also the state of the economy and financial markets in which investors interpret them. In normal times, policy announcements, for example, interest rate decisions, may be better anticipated (Bernanke and Kuttner (2005)).

Alternative Measures of Financial Distress. Lastly, we confirm that the main results hold across alternative measures of financial distress. During the global phase of the crisis, all system-wide measures of interbank risk premia—the NYFR-OIS rate, the TED spread, the expected Libor-OIS spread, and the spread of repo transactions to the risk-free rate —registered an improvement after announcements of liquidity support, recapitalization programs and interest rate cuts (whether measured as dummy variables or surprises, with the exception of the repo-risk free spread) (Figures 7–9, Table 5). The mixed results for liability guarantees during the subprime and global phases are also confirmed across most system-wide measures of interbank risk premia. These measures also deteriorated following announcements of ad hoc bailouts and decisions to keep interest rates stable during both phases of the crisis. The effects of policy announcements on the measures of macroeconomic prospects and financial volatility (the equity price index and VIX) and bank-specific default risks (CDS spreads) were more mixed, reflecting differences in the nature of these measures compared to measures of the system-wide interbank risks. The latter findings are consistent with those by Baba and Packer (2009).

[Figures 7-9 and Table 5 about here]

4.3. Country-Specific Results

Country-specific analyses shed light on the drivers of the pooled results. In this section, we discuss the results of the graphical and statistical analyses on the Libor-OIS spreads for individual currencies and the respective domestic policy announcements. We also examine bilateral and total spillovers from foreign policy announcements.

4.3.1. Graphical Analysis

Plotting responses of the Libor-OIS spread to policy announcements shows a diversity of market responses to crisis-related policy initiatives across countries. However, policy inaction and ad hoc bank bailouts had a much worse impact on the Libor-OIS spread (the left panels of Figure 10). This effect was particularly pronounced during the global stage of the crisis and most significant for the United States.

[Figure 10 about here]

Given the global nature of the crisis and close integration of financial markets, crisis policy initiatives taken by systemically important countries are likely to have bearing on market conditions in other countries. Similarly, policy inaction and ad hoc bank bailouts can affect financial risks in other countries. The graphical analysis of spillover effects on the other countries supports this hypothesis (the right panels of Figure 10). The spillover effect was less prevalent during the subprime stage of the crisis, given the small impact of foreign policy initiatives on the U.S. and U.K. Libor-OIS spreads. However, during the global stage of the crisis, international policy spillovers intensified. While foreign policy initiatives generally had few effects beyond the national borders, foreign policy inaction and ad hoc bank bailouts sent shock waves around the globe. The result underscores the strong policy interdependence between major systemic economies particular with regard to monetary inaction and ad hoc or unsystematic rescue packages aimed at single individual financial institutions which might have systemic relevance beyond national borders.

4.3.2. Statistical Analysis

Figures 11–12 and Table 6 report the main findings of statistical tests of domestic and foreign policy announcements on the Libor-OIS spreads for the respective currencies.

[Figures 11–12 and Table 6 about here]

Monetary Policy. Aggressive interest rate cuts by the United States during the subprime crisis and by the United Kingdom during the global phase of the crisis were associated with significant declines in the respective Libor-OIS spreads (see Figure 11). Other countries either did not cut interest rates (the euro area and Japan during the subprime crisis) or did so much more gradually, possibly owing to concerns about reaching the zero-interest-rate floor (for example, the United States and Japan during the global crisis) and concerns about price stability and the functioning of the money market (for example, the ECB during the global phase). International spillovers from interest rate cuts were significant during the global phase, with all countries benefiting from the interest rate reductions undertaken by their peers (Figure 11 and Table 6). The Libor-OIS spreads declined most significantly in the United Kingdom in response to foreign interest rate cuts during the global crisis.

Only the U.K. announcements about the use of unconventional monetary policy were associated with reductions in interbank credit and liquidity risk premia domestically and had some small (albeit statistically significant) spillovers to Japan and the euro area (Figure 11 and Table 6). These results may reflect the large scale of unconventional monetary operations pursued by the Bank of England and their narrow focus on purchases of government paper. The Federal Reserve's unconventional monetary operations, while also sizeable, covered a broad range of instruments, aiming in part to support asset prices, particularly those of mortgage-backed securities. (The Bank of Japan announced limited purchases of equities from banks, while the ECB set up a small program to buy covered bonds.) A broad focus may have made it more difficult for markets to discern the effects of the Federal Reserve's unconventional policies on interbank liquidity and counterparty risk premia.

Liquidity Support. Announcements of domestic currency liquidity support in the United Kingdom during the subprime crisis and the euro area during the global crisis were associated

with significant reductions in interbank credit and liquidity risk (Figure 11). The provision of liquidity support may have helped to reduce funding pressures for those institutions that had access to liquidity facilities, and it may have lowered the liquidity risk premia in the interbank markets. In other countries, however, at the time of announcement, liquidity support measures did not translate into significantly lower Libor-OIS spreads for the financial system, possibly because markets expected that benefiting institutions would hoard cash or did not consider liquidity problems to be the main reason for bank distress. Further, central bank borrowing carries a stigma that significantly influences banks' decision to use the liquidity support (see Furfine (2003)).

During the subprime crisis, announcements about the provision of U.S. dollar liquidity through swap agreements between the Federal Reserve and other major central banks in response to global U.S. dollar shortages are found to have been associated with a significant reduction in the Libor-OIS spreads for the United States and the United Kingdom. The U.S. dollar Libor-OIS spread also benefited from spillovers from the euro area's announcements about forex swaps. The results may partly reflect the effects of domestic currency liquidity support, as the respective announcements often took place together.

Fiscal Easing. Although fiscal policy measures were not targeting reductions in interbank spreads, they may have affected them to the extent that they were interpreted as evidence of political will to support ailing financial institutions. Statistical tests suggest that U.S. announcements of fiscal stimulus during the subprime crisis were not associated with significantly lower Libor-OIS spreads for the U.S. dollar, but had beneficial spillovers to the United Kingdom and the euro area (Table 6).

During the global phase, announcements of fiscal stimulus packages by the euro area helped reduce the Libor-OIS spreads. (The euro area governments announced fiscal stimulus measures later than their peers as they expected automatic stabilizers to play a more significant role during the crisis. Coordination difficulties and the constraints imposed by the European Union's Stability and Growth Pact also contributed.)

Countries had mutually beneficial spillovers from foreign fiscal policy announcements. Stronger effects of foreign fiscal policy announcements compared to domestic announcements may reflect asymmetric information about the content and effects of domestic and foreign stimulus packages and more optimistic expectations about the success of foreign packages.

Financial Restructuring. Approaches to financial restructuring varied considerably among the four economies in question, reflecting differing perceptions of the degree of bank undercapitalization, potential spillovers from other countries and feasibility and effectiveness of policies in the local institutional and political environment. During the subprime phase, liability guarantees introduced by the United Kingdom helped to reduce credit and liquidity risk premia in that country (a large effect both in absolute terms and in comparison to other policy measures, see Figure 11). As pointed out earlier, this effect can be traced to the case of Northern Rock, in which the authorities showed a strong commitment towards depositors. The United States and, to a lesser extent, the euro area benefited from this stance (Figure 11 and Table 6). In contrast,

during the global phase, announcements about liability guarantees and deposit insurance were not successful in lowering liquidity and credit risk premia in interbank markets (Figure 11).

Announcements concerning recapitalization were not successful in reducing the Libor-OIS spreads during the subprime crisis, possibly because they mostly addressed shortfalls at individual institutions. During the global phase, however, such announcements were associated with reductions in the Libor-OIS spreads in the United States and Japan. This finding underscores the high confidence-building effect of the recapitalization measures undertaken by the United States and Japan, especially considering their relatively small scale (Table 4). This effect may owe to the targeted nature of the recapitalization programs. For example, nationalization of the U.S. quasi-public housing government-sponsored enterprises, which were believed to be at the core of crisis risks, and the focus on banks' equity holdings in Japan, where banks' exposure to toxic assets was negligible and the main impact on their balance sheets stemmed from the declining values of equity holdings. The insignificant impact of recapitalization measures in the United Kingdom and the euro area may have reflected greater concerns about the rigor of stress tests used to determine banks' capital needs in these economies. The euro area, Japan, and the United Kingdom benefited from U.S. announcements of recapitalizations (Table 6). Announcements of asset purchase programs failed to lower credit and liquidity risk premia, both domestically and overseas.

Policy Inaction and Ad Hoc Bank Bailouts. Although policy initiatives had a mixed impact on the Libor-OIS spreads, the announcements of policy inaction and ad hoc bank bailouts were triggering wider spreads, particularly during the global phase of the crisis (Figure 12). Announcements of ad hoc bank bailouts led to the largest widening of the Libor-OIS spreads during the global phase of the crisis, both in domestic markets and overseas. In particular, U.S. announcements of ad hoc bank bailouts led to significant adverse spillovers into the U.K. and euro area banking systems.

During the global phase of the crisis, international spillovers from announcements of policy inaction and ad hoc bailouts were often occurring in both directions. For example, such announcements by the United States led to a significant widening of the pound and yen Libor-OIS spreads (Table 6). Likewise, announcements of policy inaction and ad hoc bank bailouts by the euro area resulted in statistically significant adverse spillovers on the Libor-OIS spreads for the U.S. dollar.

During the subprime phase of the crisis, the effects of policy inaction and ad hoc bank bailouts stemmed from decisions not to reduce interest rates. These effects were small and caused few spillovers, possibly because concerns about the counterparty risk were less acute during the initial stage of the crisis.

Having reviewed the effects of announcements by policy category, we now summarize them by country, again drawing on Figures 8–9 and Table 6.

United States. Being the country where the crisis originated, the United States front-loaded its policy response to the crisis. It also employed a variety of policy tools early on, announcing policy measures in most categories during the subprime crisis, before it became apparent that

U.S. housing problems would significantly affect the financial sectors of other advanced economies. However, with the exception of interest rate cuts and forex swaps, these measures were unsuccessful in reducing credit and liquidity risk premia in the financial system over the short run. The U.S. dollar Libor-OIS spreads narrowed upon U.K. announcements of liability guarantee measures and euro area announcements of forex swaps.

During the global phase, the United States continued to announce major policy initiatives in nearly all macroeconomic and financial sector areas. However, only announcements of recapitalization measures were associated with reductions in the U.S. dollar Libor-OIS spread. The U.S. dollar Libor-OIS spread also benefited from foreign announcements of recapitalization, particularly in the euro area. The effect of domestic and foreign ad hoc bank bailouts (the latter largely stemming from developments in the euro area) was significant.

United Kingdom. Like the United States, the United Kingdom introduced a broad range of policy initiatives early on. Announcements of liquidity support, forex swaps and liquidity guarantees were associated with a narrowing of the Libor-OIS spread for the pound. The impact of liability guarantees was particularly large compared to that of other measures, owing to their large scale (Table 4). Markets may have favored the use of liability guarantees because, given the large size of the financial sector relative to the economy, recapitalization on a comparable scale would have had a direct impact on the U.K. fiscal position, while liability guarantees represented a contingent public liability. The only beneficial spillover from foreign policy announcements for the United Kingdom was from announcements of fiscal easing and liability guarantees in the United States.

During the global phase the U. K. authorities announced additional major initiatives in fiscal policy, conventional and unconventional monetary policy, liquidity support, and financial restructuring measures (recapitalization, asset purchases, and liability guarantees). Statistical tests suggest that of these, only interest rate cuts were associated with a significant reduction of interbank credit and liquidity risk premia. Announcements about quantitative easing and asset purchases also had favorable effects. The United Kingdom benefited from interest rate cuts by the euro area and Japan and, like before, announcements of liability guarantees by the United States.

Euro area. Policy response by the euro area was largely back-loaded to the global phase of the crisis. During the subprime phase policy announcements did not result in significant reductions in the Libor-OIS spreads for the euro. The euro area benefited, however, from the U.S. announcements of fiscal stimulus and the U.K. announcements of liability guarantees and recapitalization (Table 6). During the global phase, domestic announcements of fiscal easing were associated with reductions in interbank credit and liquidity risk premia.

While foreign bank bailouts had some uneven and, in comparison to other countries, smaller effects, bank bailouts within the euro area were associated with higher spreads, albeit to a lesser extent than similar events in the United States. Announcements of other financial sector measures, particularly recapitalization programs and liability guarantees, were followed by wider spreads, although this result is not statistically significant. Although such a response was found for the United Kingdom too, for the euro area it may have reflected a limited integration of the

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crisis response, with most recapitalization and liability guarantee measures targeted at selected national banks. Insufficient coordination may explain the detrimental effect of the respective announcements on the Libor-OIS spread, triggering a response that is qualitatively similar (albeit smaller) than that of ad hoc bank bailouts.

Japan. None of the policy measures used by Japan during the subprime crisis were front-page events, and foreign announcements of policy initiatives did not have a material impact on the yen Libor-OIS spread during that period. During the global phase of the crisis, announcements of fiscal easing and recapitalization helped reduce credit and liquidity risk premia in the financial system. Japan benefited from foreign policy initiatives in several areas, for example, interest rate cuts and quantitative easing by the United Kingdom, as well as U.S. fiscal easing and recapitalization.

5. Conclusions

An immediate positive market response to announcements of policy initiatives during a financial crisis may be self-fulfilling and indicative of whether these initiatives would help to restore confidence. This paper examined the global crisis through the lens of interbank markets' immediate response to announcements of macroeconomic and financial sector policy initiatives in systemically important advanced economies. The analysis drew on a unique database of policy announcements and a standard event study methodology, with the findings supported through the gamut of robustness checks. The following broad policy implications emerge from the study:

(a) *A systemic financial crisis requires an integrated macro-financial policy response*. The paper does not find strong evidence that either macroeconomic or financial policies had an advantage in calming interbank markets. The study does not point to a policy silver bullet that could have been expected to contain the crisis.

(b) A *coordinated policy response is required to restore market confidence during a global crisis*. The paper finds that foreign policy initiatives had significant bearing on credit and liquidity risk premia in domestic interbank markets. International spillovers of policy announcements intensified as the crisis deepened.

(c) *Some policy decisions, for example, decisions not to reduce interest rate, to allow banks to fail, or ad hoc bank bailouts tend to increase credit and liquidity risk premia*. This is one of the strongest and most consistent results in the paper. This is one of the strongest and most consistent results in the paper, which underscores the importance of a comprehensive approach to financial crisis resolution. Policy actions that are perceived as ad hoc or targeted at individual systemic institutions tend to exacerbate market fears, even if they are well intentioned from the long-run perspective, for example, aim to prevent moral hazard.

Results need to be taken with caution as they do not provide a comprehensive assessment of policy effectiveness. The study focuses on an immediate market response to policy announcements, which tends to have bearing on but may not be always indicative of the long-term effectiveness of policies. It emphasizes the effectiveness of policy announcements in

breaking adverse trends in global interbank markets during the financial crisis, which was without doubt one of the most important goals of crisis containment.

Table 1. Classification of Policy Measures

Type	Measures	Examples
Fiscal policy	Fiscal stimulus packages	German Pact for Employment and Stability (1/14/09), Stimulus plan announced by President Sarkozy (12/4/08), U.K. stimulus package (11/24/08), U.S. Economic Stimulus Act (1/18/08, 1/24/08, 1/29/08)
Monetary policy		
Interest rate cuts		Coordinated rate cut by six central banks (10/8/2008)
Quantitative and credit easing		Gilt purchases (3/5/09), BoJ outright JGB purchases (1/22/09, 3/19/09), Federal Reserve buys long-term Treasuries (3/18/09)
		BoE asset purchase facility (1/19/09), U.K. Corporate Bond Secondary Market Purchase Scheme and CP Facility (3/5/09), BoJ purchase of corporate financing instruments (1/22/09, 2/19/09), Fed purchases agency debt and MBS (3/18/09), ECB purchase of covered bonds (5/7/09)
Liquidity support		
Domestic currency liquidity support	Relaxation of collateral framework; change in funding terms or auction schedule	U.S. Term Auction Facility (12/12/07, 12/21/07), launch of the Term Asset-Backed Securities Loan Facility (TALF, 3/3/09), ECB's expansion of the collateral framework (10/15/08), lengthening of the terms (8/22/07) and introduction of additional auctions (12/17/07), U.K. Special Liquidity Scheme (4/21/2008, extended 9/17/2008), U.K. long-term repo with expanded collateral (10/3/08)
	Support of money markets	Asset-Backed Commercial Paper (ABCP) Money Market Fund Liquidity Facility (9/19/08)
Foreign currency swaps	FX swaps and FX funding	ECB offers dollar funding (12/12/07)
Financial sector policies		
Asset purchases	Asset purchases	Troubled Assets Relief Program (10/3/08), Spain's fund to buy impaired assets (10/7/08)
	Ring-fencing of bad assets and asset guarantees	Maiden Lane SPVs for buying impaired assets (Bear Stearns, 3/14/08; AIG, 11/10/08), SPV WestLB (2/6/08), French loan guarantees (10/13/08), asset guarantees to Citi (11/23/08) and BofA (1/16/09), UK Asset Protection Scheme (1/19/09)
Liability guarantees	Guarantees for old or new liabilities	Irish Government Guarantee Scheme (9/30/08), U.K. Credit Guarantee Scheme (10/8/08), U.S. Temporary Liquidity Guarantee Program (10/14/08)
	Enhancement of depositor protection	Ireland (9/20/2008), U.K. (10/3/08), Germany (10/5/08), U.S. extension to credit unions (1/28/09)
	Provision of lender of last resort facilities to individual banks	Northern Rock liquidity support facility (9/14/07), Hypo Real Estate rescue (9/29/08), Federal Reserve Board's acceptance of applications to be chartered as bank holding companies (e.g., Goldman Sachs and Morgan Stanley, 9/21/08)
Recapitalization	Capital injection and nationalization	TARP capitalization of nine U.S. banks (10/28/08), subordinated debt for six French banks (10/20/08), U.K. Bank Recapitalization Fund (10/8/08 and subsequent capital injections in October 2008 and February/March 2009)
Policy inaction and ad hoc bank bailouts		
Interest rate increases and decisions to maintain interest rates unchanged		Policy rates maintained (e.g., ECB 10/2/2008, BoE 11/8/2007, FOMC 9/16/2008) or increased (e.g., ECB 7/3/2008)
Ad hoc bank bailouts		IKB (8/2/07, 2/13/08), SachsenLB (8/26/07), Northern Rock (11/19/07, 2/17/08), Bear Stearns (3/14/08), Fannie Mae and Fredie Mac (9/7/08), Merrill Lynch (9/15/08, 11/26/08), WaMu (9/25/08), Bradford and Bingley (9/29/08), Fortis (9/29/08), Dexia (9/30/08), Wachovia (10/12/08)
Bank failures		NetBank (9/30/07), IndyMac (7/11/08), Lehman Brothers (9/15/08)

Source: Authors.

Table 2. Number of Front-Page Policy Announcements, June 1, 2007–March 31, 2009

	United States	United Kingdom	Euro Area	Japan	Total	As a Percentage of All Front-Page Announcements
Fiscal Policy	6	1	2	1	10	5
Monetary Policy	12	9	5	3	29	15
Interest rate cuts	10	7	5	1	23	12
Quantitative and credit easing	2	2	0	2	6	3
Liquidity Support	19	3	14	1	37	19
Domestic currency liquidity support	16	2	9	1	28	14
Foreign currency swaps	3	1	5	0	9	5
Financial Sector Policies	29	12	32	1	74	38
Asset Purchases	9	3	1	0	13	7
Liability Guarantees	8	4	17	0	29	15
Recapitalization	12	5	14	1	32	16
Policy Inaction and Ad Hoc Bank Bailouts	18	6	20	2	46	23
Interest rate decisions	5	3	13	2	23	12
Bank Bailouts and Assisted Mergers	8	3	7	0	18	9
Bank Failures	3	0	0	0	3	2
Other	2	0	0	0	2	1
Total number of front-page events	84	31	73	8	196	100
As a percentage of total number of front-page announcements	43	16	37	4	100	

Source: Authors.

Table 3. Statistical Tests for Alternative Event Windows and Measures of Surprise

	Parametric Test	Non-parametric Test	Stat. Sign.	Obs.	Parametric Test	Non-parametric Test	Stat. Sign.	Obs.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				Event Window of 1 Day Before and 3 Days After Announcement				
		Subprime Phase				Global Phase		
Fiscal policy	0.70	-0.50	—	1	-0.68	0.27	—	7
Monetary policy								
Interest rate cuts	-1.30	0.34	—	9	-11.16	2.77	***	7
Quantitative and credit easing	—	—	—	0	1.50	-0.71	—	2
Liquidity support								
Domestic currency	2.71	-0.42	—	11	-6.40	1.32	*	3
Forex swaps	-4.14	1.03	*	4	39.64	-0.50	—	1
Financial Sector Policy								
Recapitalization	—	—	—	0	-3.71	0.76	—	20
Asset purchases	9.82	-0.50	—	1	3.31	-0.50	—	4
Liability guarantees	-10.90	2.60	***	3	9.88	-1.14	—	16
Policy inaction and ad hoc bank bailouts	1.43	-1.41	***	23	25.50	-1.50	***	9
Higher/stable interest rates	1.79	-1.16	**	15	1.44	-0.50	—	1
Ad hoc bank bailouts	0.62	-0.59	—	6	28.65	-1.32	***	7
Bank failures	1.15	-0.59	—	2	27.54	-0.50	—	1
Surprises								
Fiscal policy	—	—	—	0	0.39	-0.16	—	3
Monetary policy	-4.45	0.19	—	3	-13.18	3.34	***	5
				Event Window of 1 Day Before and After Announcement				
		Subprime Phase				Global Phase		
Fiscal policy	-2.01	1.50	*	1	-0.76	0.29	—	7
Monetary policy								
Interest rate cuts	-0.42	0.13	—	9	-6.30	2.46	***	7
Quantitative and credit easing	—	—	—	0	0.80	-0.27	—	2
Liquidity support								
Domestic currency	3.27	-0.74	—	11	-8.64	1.43	*	3
Forex swaps	-3.59	3.00	*	4	26.03	-0.50	—	1
Financial Sector Policy								
Recapitalization	—	—	—	0	-0.81	0.13	—	20
Asset purchases	7.21	-0.50	—	1	-1.04	-0.13	—	4
Liability guarantees	-6.91	2.60	***	3	5.32	-0.96	—	16
Policy inaction and ad hoc bank bailouts	0.53	-0.79	*	23	19.14	-1.50	***	9
Higher/stable interest rates	0.82	-1.02	*	15	1.50	-0.50	—	1
Ad hoc bank bailouts	-0.39	0.31	—	6	22.48	-1.32	***	7
Bank failures	1.12	-0.39	—	2	13.33	-0.50	—	1
Surprises								
Fiscal policy	—	—	—	0	0.39	-0.16	—	3
Monetary policy	-4.45	0.19	—	3	-13.18	3.35	***	5

Source: Authors' estimates.

Note: The table reports test statistics for the parametric test based on the Average Cumulative Abnormal Differences (ACAD) and the sign-size nonparametric test, respectively (for more details on the test statistics, see Appendix I). The results of the parametric tests using the Average Abnormal Differences (AAD) and the Average Standardized Interval Prediction Errors (ASIPE) as well as the sign nonparametric test are available upon request. All tests are performed on a pooled sample of policy announcements and the U.S. dollar 3-month Libor-OIS spread. Asterisks ***,**,* indicate statistical significance (two-tailed, standard normal distribution) at the 1, 5 and 10 percent level, respectively. Statistical significance is assigned if all parametric and non-parametric tests are consonant with each other at the significance level of at least 10 percent; the lowest value of the test statistics is used. The peak-to-trough change in the Libor-OIS spread was 79.17 basis points during the subprime phase (with a daily average change of 0.18 basis points and a standard deviation of 1.02 basis points) and 141.19 basis points during the global phase of the financial crisis (with daily average change of 0.15 basis points and a standard deviation of 2.80 basis points) .

Table 4. Characteristics and Impact of Financial Sector Policy Measures

	United States	United Kingdom 1/	Euro area 2/	Japan
Scale of Intervention	(In percent of GDP)			
Liability guarantees 3/	10.9	21.7	15.8	—
Recapitalization 4/	4.6	3.5	2.4	0.0
Asset purchases 5/	13.4	26.9	1.1	—
Total	28.9	52.1	19.3	0.0
Impact	(In percent of periodic amplitude of LIBOR-OIS spread 6/)			
Liability guarantees	Subprime/Global	Subprime/Global	Global	—
	2.4/9.1	-27.6/15.4	8.8	—
Recapitalizations	Global	Global	Global	Global
	-1.6	5.5	2.0	-3.0
Asset purchases	Subprime/Global	Global	—	—
	4.2/4.9	-1.1	-7.3	—
Structural Factors	(In percent of GDP, unless otherwise indicated)			
Banking sector assets	111.0	456.0	302.7	161.8
Capital market size	347.4	276.1	365.2	495.7
Financial sector concentration. (HHI 7/)	859.6	1453.8	2894.9	717.6
Fiscal Position				
Central govt. net borrowing (in percent of debt 8/)	24.5	26.3	9.0	n.a.
Sovereign CDS spread change (in percent)	28.0	87.6	49.9	42.9

Source: Authors' estimates.

Note: Percentage of GDP calculated using WEO projections of GDP in 2008 in US dollars. "—" indicates that the measure was not used. "n.a." indicates that data is not available.

1/ These numbers were obtained from the Bank of England (2009).

2/ GDP-weighted composite of Austria, France, Germany, Greece, Ireland, Italy, Netherlands, and Spain.

3/ Includes guarantees on bond issuance, interbank lending, and other wholesale liabilities (In USD billions) according to the announced package unless specified otherwise. Guarantees on assets of financial institutions are excluded (such as in the case of Japan). For the United States, included are bank guarantees under the FDIC Temporary Liquidity Guarantee Program (TLGP) for new bank debt and certain checking and other non-interest bearing accounts (up to US$1.45 trillion), the FDIC guarantee to Citigroup (US$10 billion), as well as other guarantees to non-banks and non-financial institutions. However, the Hope for Homeowners Program (up to US$1 billion) and the Temporary Guarantee for Money Market Funds (up to US$3 trillion) are not considered.

4/ Refers to the actual capital committed under announced packages (In USD billions). The estimates for the United States do not include the total cost of support measures outside the Troubled Asset Relief Program (TARP) unless specified. So far, US$127 billion of TARP funds (US$700 billion) have been allocated for capital injections. Other capital injections considered include the Capital Purchase Program (up to US$218 billion), the Systemically Significant Failing Institutions Program (US$70 billion), the Targeted Investment Program (US$40 billion) and the conservatorship of Fannie Mae and Freddie Mac (up to US$200 billion). However, all crisis liquidity facilities and direct lending are excluded: TSLF (up to US$200 bilion), AMLF (US$23.6 billion), TAF (up to US$600 billion), TALF (up to US$1 trillion), CPFF (up to US$1.8 trillion), MMIFF (up to US$540 billion), loan commitments under the Home Affordable Modification Program (US$50 billion), Unlocking SBA Lending Markets (US$15 billion), Automotive Industry Financing Program (US$30 billion), programs of the National Credit Union Administration (up to US$41 billion), as well as loans of up to US$60 billion to AIG, US$234 billion to Citigroup, and US$87

5/ This excludes general asset purchases in capital markets, such as the purchase of bank stocks (Japan). For the United States, US$100 billion of TARP funds have been allocated for asset protection under the Private-Public Investment Program (PPIP). In addition, the following measures are included: GSE MBS and debt purchases (up to US$1.45 trillion), AIG assets (up to US$53 billion), Bear Stearns' assets (US$29 billion), as well as US$314 billion under the GSE MBS Purchase Program.

6/ "Subprime" (06/01/07-09/13/08), "Global" (09/14/08-3/31/09). The number below the crisis sub-period label show the ratio between the cumul. average abnormal change of the respective type of financial sector policy and the amplitude of the LIBOR-OIS spread over the subperiod. A bolded number indicates statistical significance (parametric and non-parametric) of at least 10 percent during the respective period.

7/ Herfindahl-Hirschman Index (HHI): S(market share of firmi)^2 based on the market capitalization of all financial sector firms in each country as of June 7, 2009.

8/ Fitch Ratings (2009) and Moody's (2009a and 2009b).

Table 5. Statistical Tests for Alternative Measures of Financial Risk

		3-month LIBOR-OIS Spread (Spot)	3-month NYFR-OIS Spread (Spot)[1]	3-month LIBOR-OIS Spread (Spot-Future)[2]	Repo-Risk free Spread[3,4]	TED Spread[3,5]	VIX[3,6]	CDS Composite Index[3,7]	Equity Composite Index[3,7]
				Subprime Phase					
Fiscal policy		↑	—	—	↑	↑	↑	↑	↓*
Monetary policy	Interest rate cuts	↓	—	↓	↑	↓	↑	↓	↓
	Quantitative and credit easing	—	—	—	—	—	—	—	—
Liquidity support	Domestic currency support	↑	↑	—	↓*	↓	↓	↑	↑
	Forex swaps	↓*	—	—	↑	↓*	↑	↑*	↓***
Financial sector policy	Recapitalization	—	—	—	—	—	—	—	—
	Asset purchases	↑	—	—	↑	↑	↑	↓*	↓*
	Liability guarantees	↓***	—	—	↓***	↓***	↓***	↑	↑
Policy inaction and ad hoc bank bailouts	Increase of interest rates	↑	—	—	↑	↓	↓	↓	↑
	Stable interest rates	↑**	↑**	↑*	↑*	↑**	↑*	↑**	↓
	Ad hoc bank bailouts	↑	↑	↑	↑	↑	↑*	↑*	↑
Surprises[6]	Fiscal policy surprises	—	—	—	—	—	—	—	—
	Monetary policy surprises	↓	—	—	↓	↓***	↓*	↓***	↑*
				Global Phase					
Fiscal policy		↓	↓	↓**	↓**	↑*	↓	↓	↓
Monetary policy	Interest rate cuts	↓***	↓**	↓**	↑**	↓***	↑	↑	↑
	Quantitative and credit easing	↑	↑	↓	↓	↑	↓***	↓	↑
Liquidity support	Domestic currency support	↓*	↓	↓	↓	↓	↓	↓	↑
	Forex swaps	↑	↑	↓*	↓*	↑	↑	↑	↑
Financial sector policy	Recapitalization	↓	↓*	↓**	↓	↓*	↓	↓	↓
	Asset purchases	↑	↑	↑	↓	↑	↑*	↓	↓
	Liability guarantees	↑*	↑	↑***	↓*	↓	↑	↓	↓
Policy inaction and ad hoc bank bailouts	Increase of interest rates	—	—	—	—	—	—	—	—
	Stable interest rates	↑	↑*	↑*	↑	↑	↓*	↓*	↑
	Ad hoc bank bailouts	↑***	↑*	↑***	↑	↑**	↑	↓	↓
Surprises[7]	Fiscal policy surprises	↑	↓	↑***	↓	↑*	↓	↓	↑
	Monetary policy surprises	↓***	↓*	↓	↑	↓*	↑	↓*	↓*

Note: An arrow "↑" ("↓") indicates an increase (decrease) of the corresponding market indicator. "—" denotes that no observations were available due to the absence of such policy measure or the late sample starting date (for example, for the New York Funding Rate and the Libor-OIS futures rates). Asterisks ***,**,* indicate statistical significance (two-tailed, standard normal distribution) at the 1, 5 and 10 percent level based on the parametric and nonparametric tests. Statistical significance is assigned if all parametric and non-parametric tests are consonant with each other at the significance level of at least 10 percent; the lowest value of the test statistics is used.

1/ In contrast to LIBOR, which represents a quote of the benchmark rate of interest at which banks can expect to lend funds to each other in the London interbank market, the New York Funding Rate (NYFR) is the representative transaction rate at which an institution would be likely to obtain funding in the market. The NYFR was launched on June 11, 2008 by the inter-dealer brokerage ICAP in response to market concerns about the accuracy of the LIBOR fixing and the panel composition of contributing banks.

2/ The difference between the current Libor-OIS spread and the forward contract on the Libor-OIS spread, 3-month contract. A positive difference between the two indicates elevated liquidity and credit risks in the future compared to the present.

3/ Controlling for expectations over the 20 day pre-event window.

4/ Based on the 3-month government bond yield.

5/ The TED spread is defined as the difference between the LIBOR rate and the risk free rate at a maturity term of 3 months.

6/ VIX is a Volatility Index, created by the Chicago Board Options Exchange as a measure of equity market volatility. The computation of VIX is based on the implied volatility of eight option series on the S&P 100 index, or OEX. VIX is quoted in percent per annum.

7/ See IMF (2009b) for the further details on the CDS and equity composites.

8/ Data on market expectations regarding financial sector policies were insufficient for comparable analysis.

Table 6. Statistical Significance of Foreign Policy Announcements on the Libor-OIS Spreads

		Subprime Phase				Global Phase			
		United States	United Kingdom	Euro Area	Japan	United States	United Kingdom	Euro Area	Japan
Fiscal policy		—	US	US,UK	US	JP	EU	JP	US
Monetary policy	Interest rate cuts	o	o	o	o	UK,JP	EU,JP	JP	EU,UK
	Quant./credit easing	o	—	o	o	o	o	UK,JP	UK
Liquidity support	Domestic currency	o	o	o	o	o	o	o	o
	Forex swap lines	EU	o	o	o	—	—	—	—
Financial sector policy	Recapitalization	o	o	UK	o	EU	US, JP	US,UK	US
	Asset purchases	—	o	o	o	o	EU	o	EU
	Liability guarantees	UK	US	UK	US	o	US	US	o
Policy inaction and ad hoc bank bailouts		o	JP	US,UK	US	EU	US	UK	US

Source: Authors' estimates.

Note: Abbreviated country names ("US" for the United States, "UK" for the United Kingdom, "EU" for the euro area, and "JP" for Japan) indicate statistically significant spillover effects of domestic policies on the corresponding country, based on bilateral country analyses. The column headers are the countries which received spillovers. The country abbreviations in cells indicate the countries where spillovers originated. Italics indicate an increase in the Libor-OIS spreads due to bilateral spillovers, and the regular font means a decrease. Borders show statistically significant spillovers from all foreign announcements. The solid-line borders indicate a reduction of the Libor-OIS spreads, while the dashed-line borders mean an increase. "o" indicates that spillovers were statistically insignificant. "—" means that spillovers were not feasible, i.e., foreign announcements in the respective policy category did not occur or did not qualify as a front-page event.

Figure 1. The 3-month Libor-OIS Spreads, in Levels and First Differences, in the United States, United Kingdom, Euro Area, and Japan, January 1, 2007–March 31, 2009
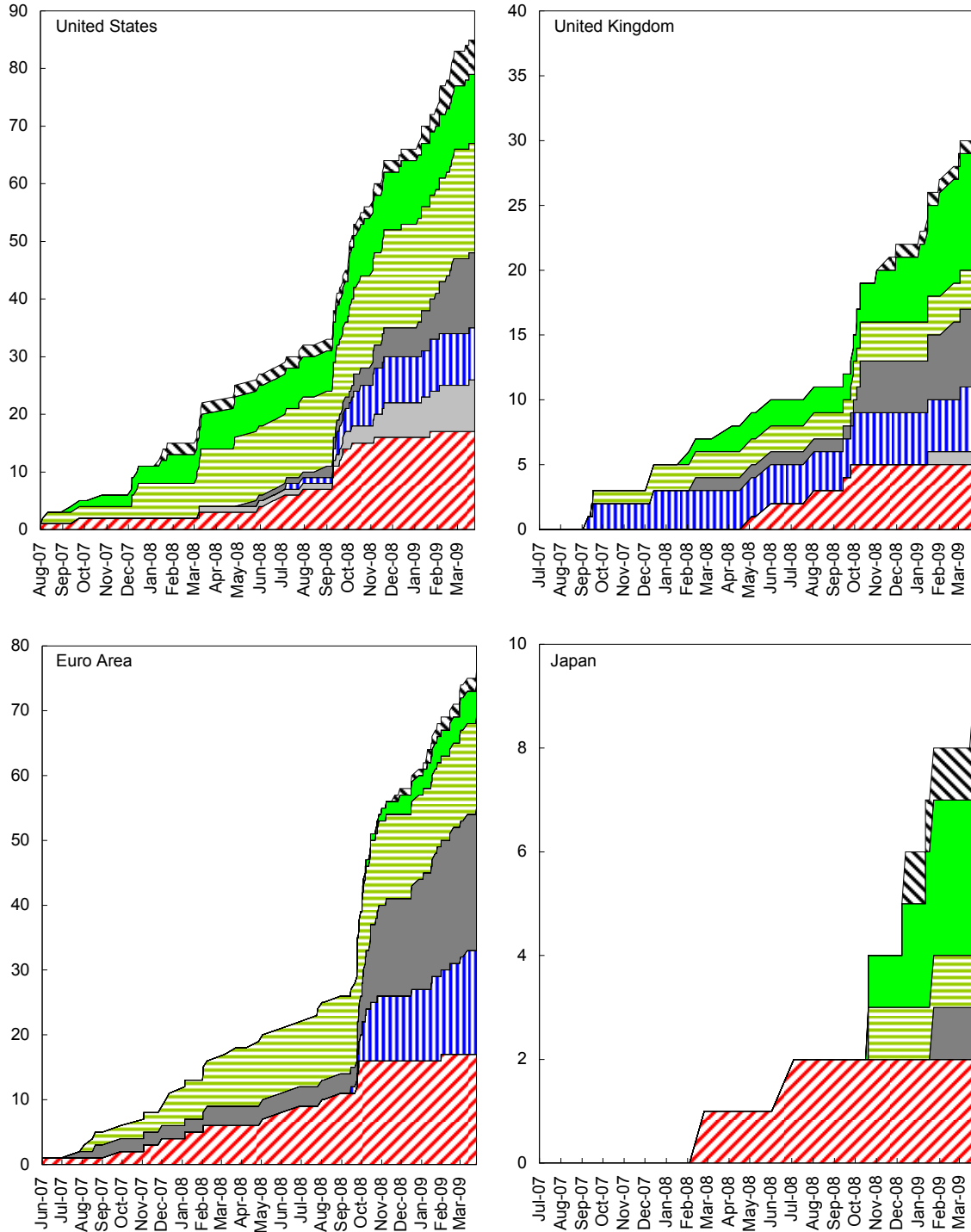(In basis points)
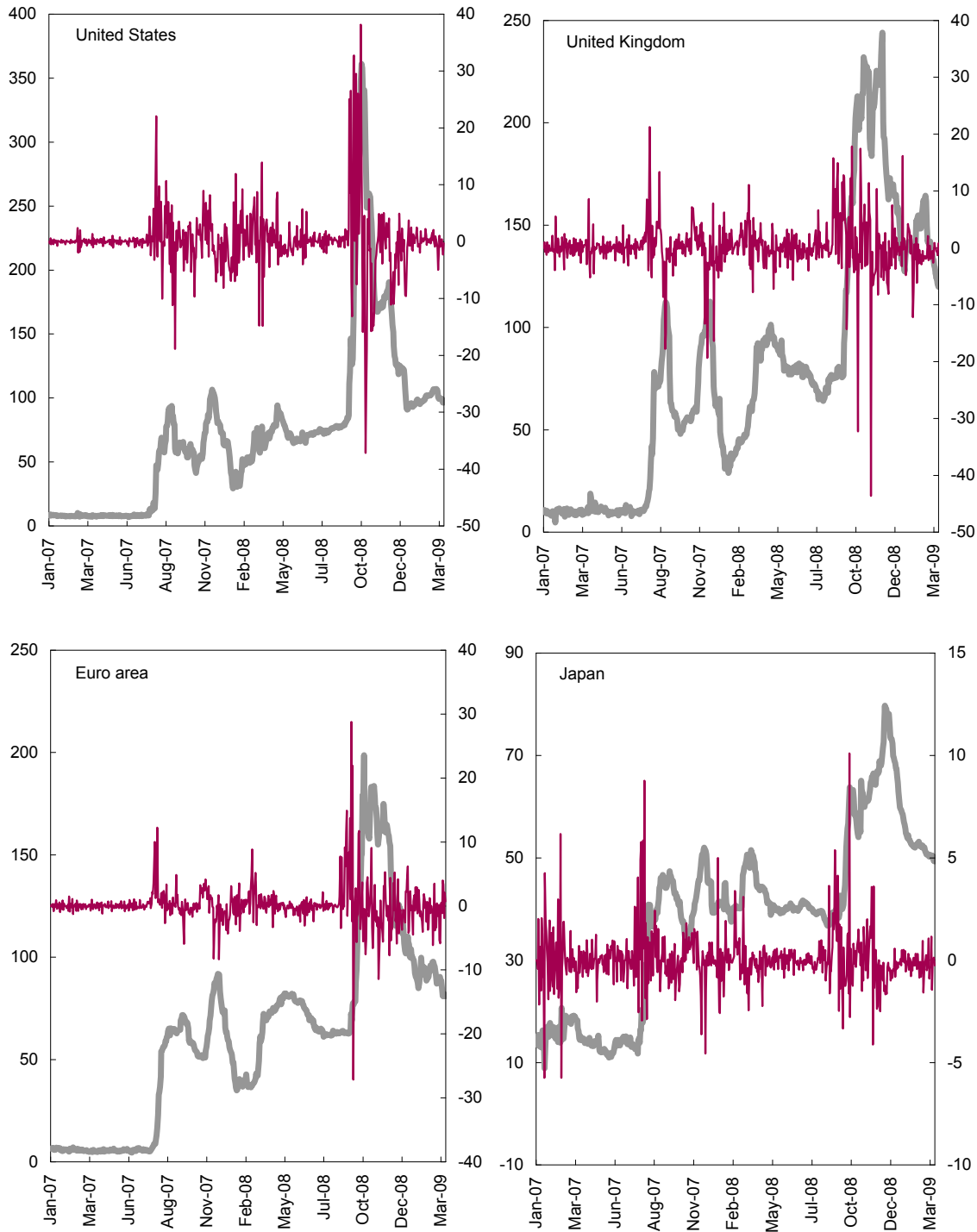
Source: Bloomberg and authors' estimates.
Note: Thick lines refer to the level of the Libor-OIS spreads and thin lines to the first differences. The latter are shown on the right-hand-side axis.

Figure 2. Cumulative Number of Front-Page Policy Announcements
June 1, 2007–March 31, 2009

- Policy inaction, bank bailouts and failures
- Liability guarantees
- Liquidity support and forex swaps
- Fiscal easing
- Asset purchases
- Recapitalization
- Monetary easing

Source: Authors' estimates.

Figure 3. Impact of Policy Announcements on the Libor-OIS Spread,
June 1, 2007–March 31, 2009
(In basis points)
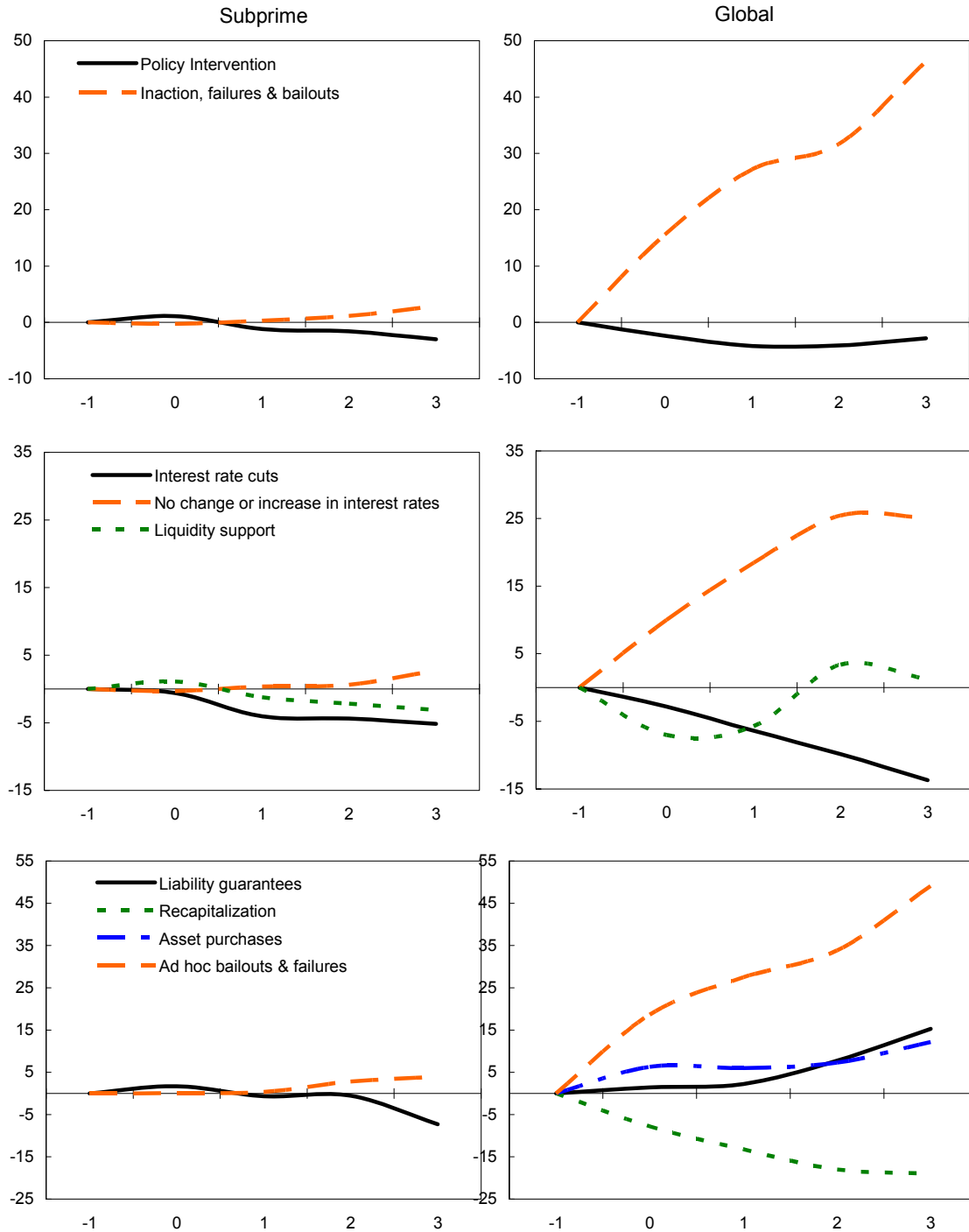
Source: Authors' estimates.
Note: The variable plotted on the vertical axis is the average cumulative abnormal differences in basis points within the event window of one day before the event and three days after the event. The horizontal axis shows days within the event window, with "0" corresponding to the day of the announcement.

Figure 4. Frequency Distribution of Changes in the Libor-OIS Spread in Response to
Policy Announcements
(In percent)
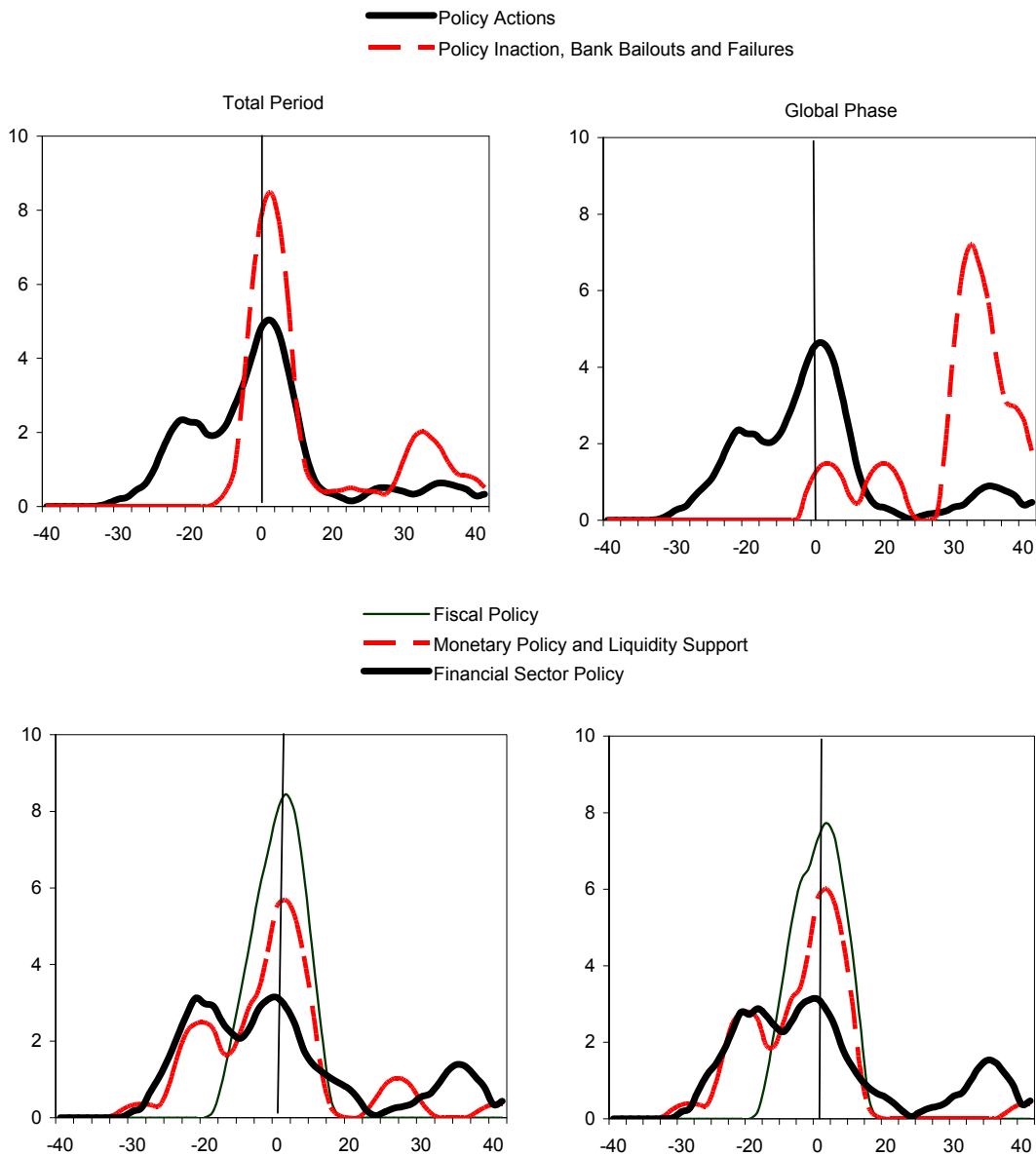
Source: Authors.
Note: The variable plotted on the horizontal axis is the average cumulative abnormal differences
(ACAD), in basis points, within the window of one day before the event and three days after the event.
The vertical axis shows density, in percent. The kernel density is estimated using Epanechnikov
kernel and linear binning. The bandwidth is set to 2.5 to minimize the asymptotic mean integrated
squared error compared to the reference (Epanechnikov) distribution. The category "policy actions"
includes all types of policy announcements, except policy inaction and ad hoc bank bailouts and
failures, which are plotted separately.

Figure 5. Time Profile of the Response of the Libor-OIS Spread to Policy
Announcements (In basis points)
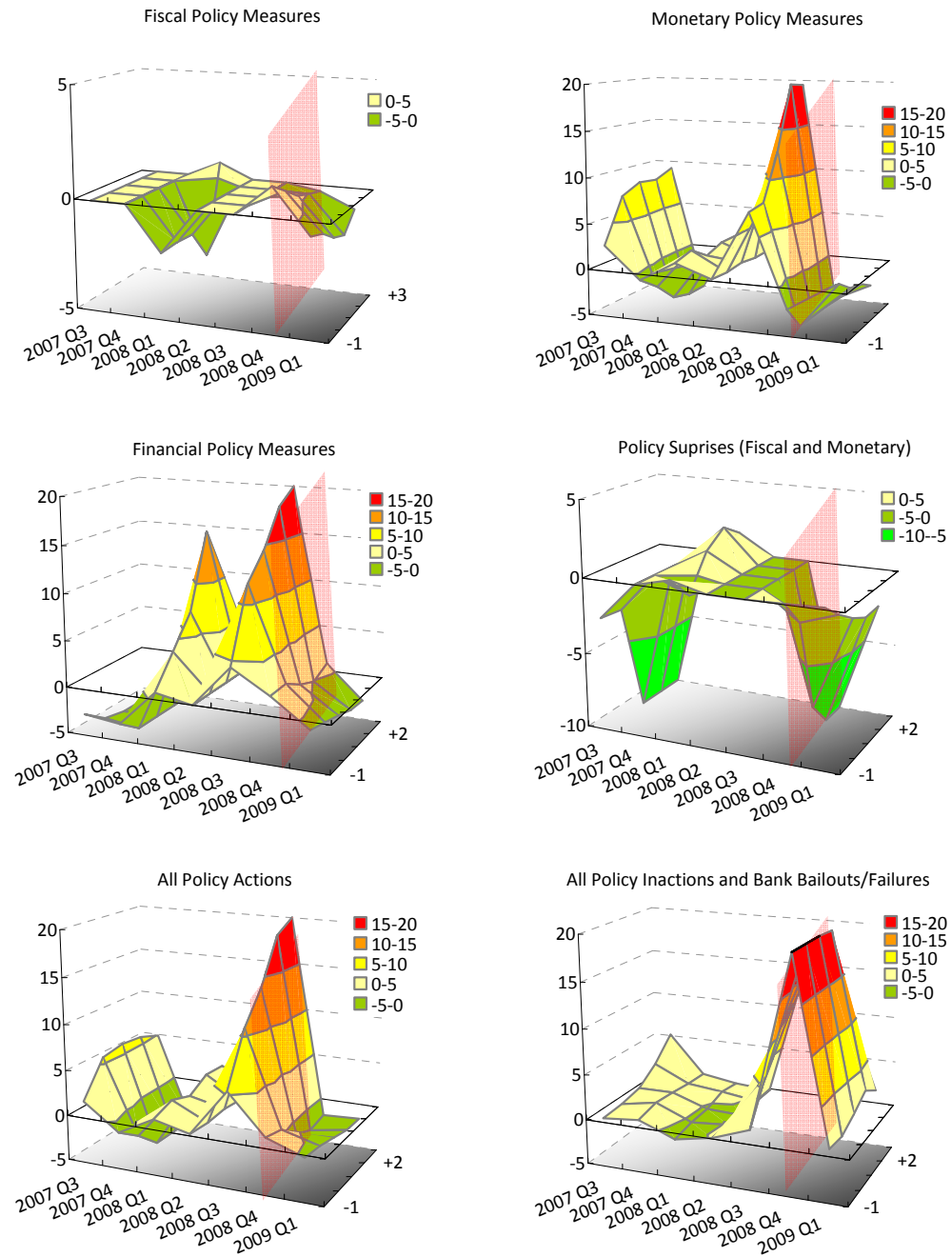
Source: Authors' estimates.
Note: The figure shows average cumulative abnormal differences (ACAD) within the window of one
day before the announcement and three days after the announcement, aggregated for each quarter
over the sample time period (Q3 2007 to Q4 2009). Analysis is performed on the pooled sample of all
country announcements and the U.S. dollar 3-month Libor-OIS spread. The red screens indicate the
quarter within which the collapse of Lehman Bros. occurred. Data for fiscal and monetary policy
surprises cover the United States and the United Kingdom only.

Figure 6. Magnitude and Statistical Significance of the Libor-OIS Spread Response to Policy Announcements (Pooled Sample)
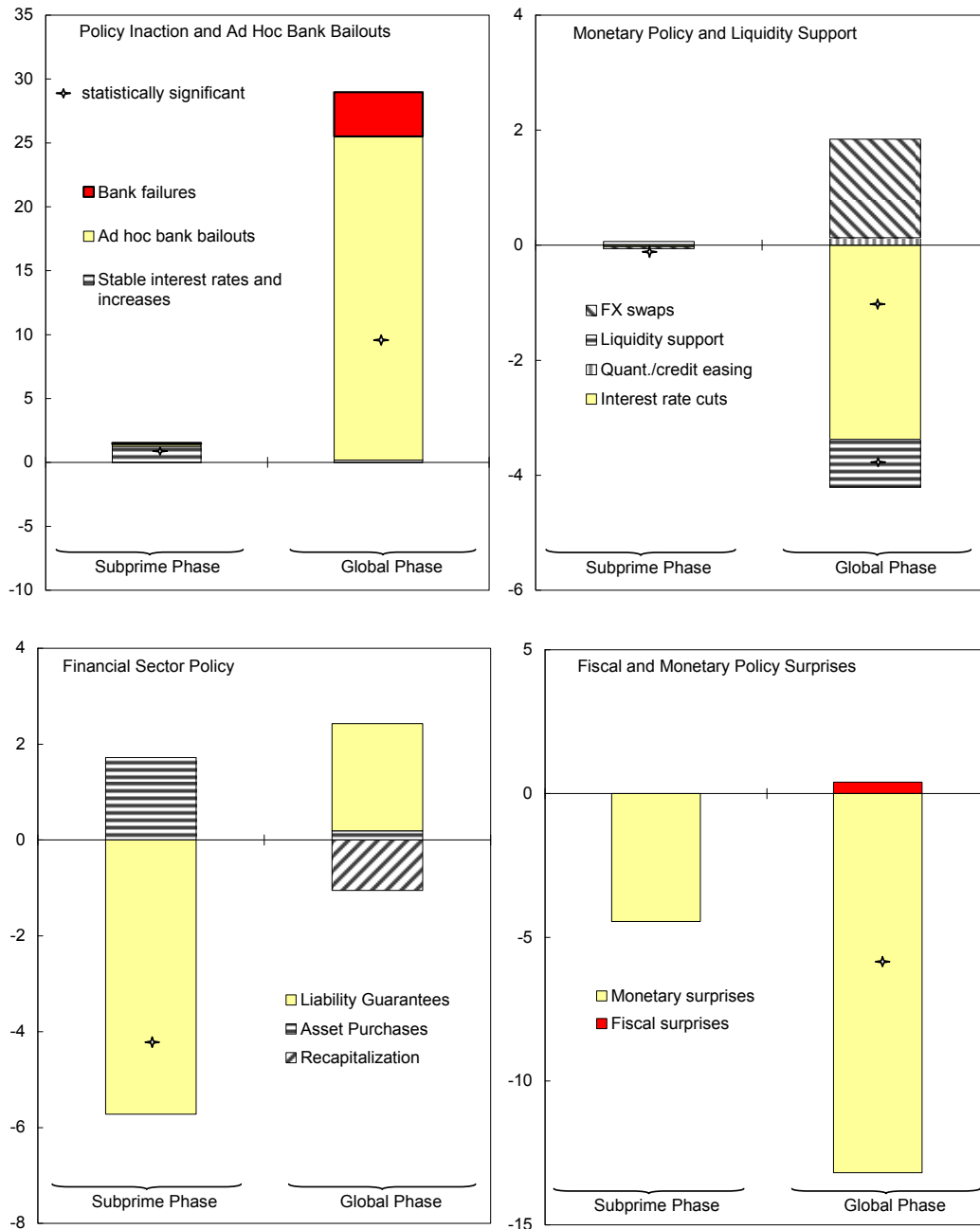
Source: Authors' estimates.

Note: The figure shows the contribution of different types of policy announcements to the overall impact of announcements in the respective policy category, in basis points. The contribution of each type of announcement is calculated according to the equation (10) in Appendix I, as the average cumulative abnormal differences (ACAD) for the respective type of announcement, scaled by the ACAD of the respective category of policy announcement, both within the window of 1 day before the announcement and 3 days after the announcement. Asterisks indicate statistical significance at the 10 percent level or less. Data for fiscal and monetary policy surprises cover the United States and the United Kingdom only.
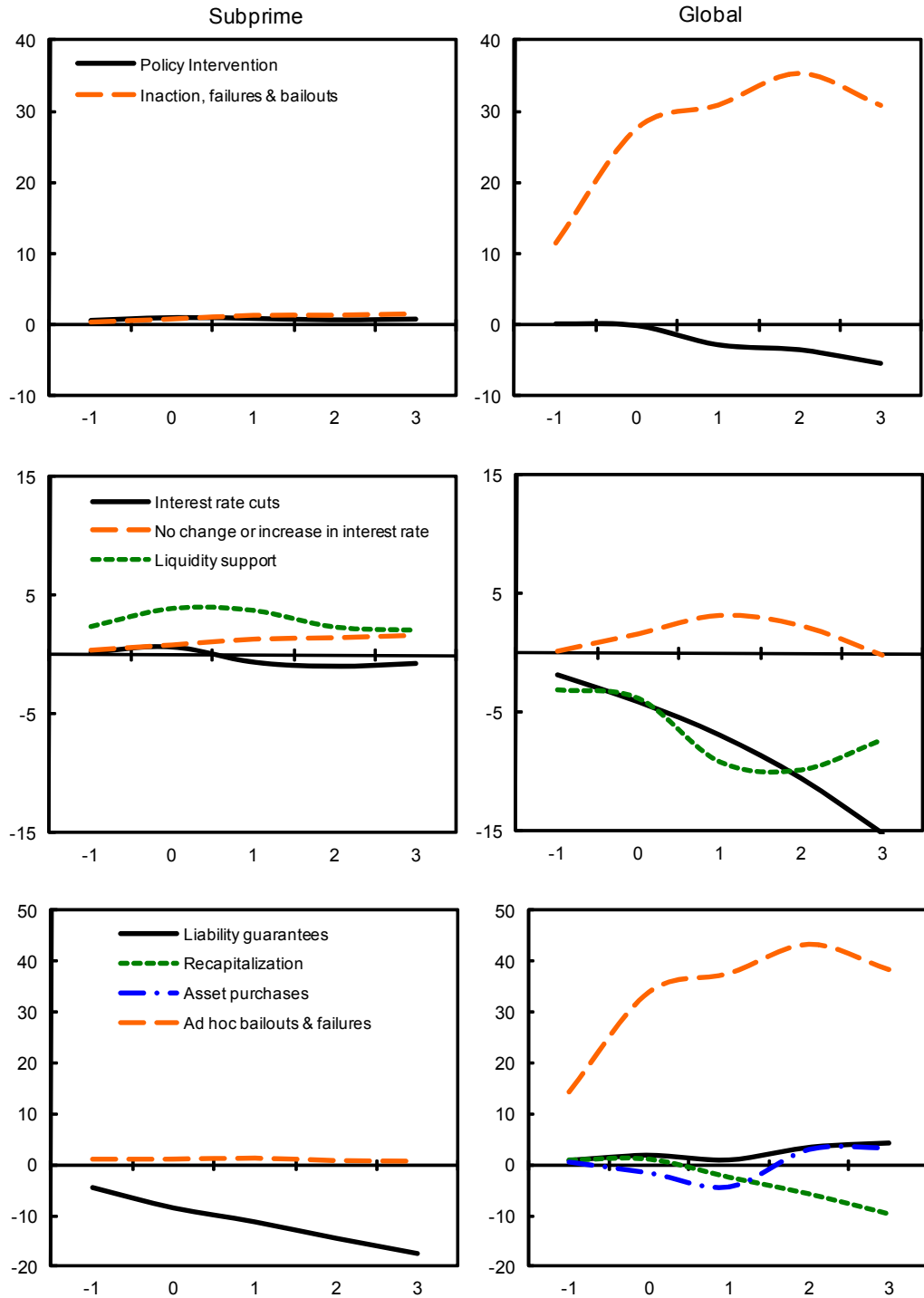
Figure 7. Impact of Policy Announcements on the NYFR-OIS Spread,
June 1, 2007–March 31, 2009
(In basis points)
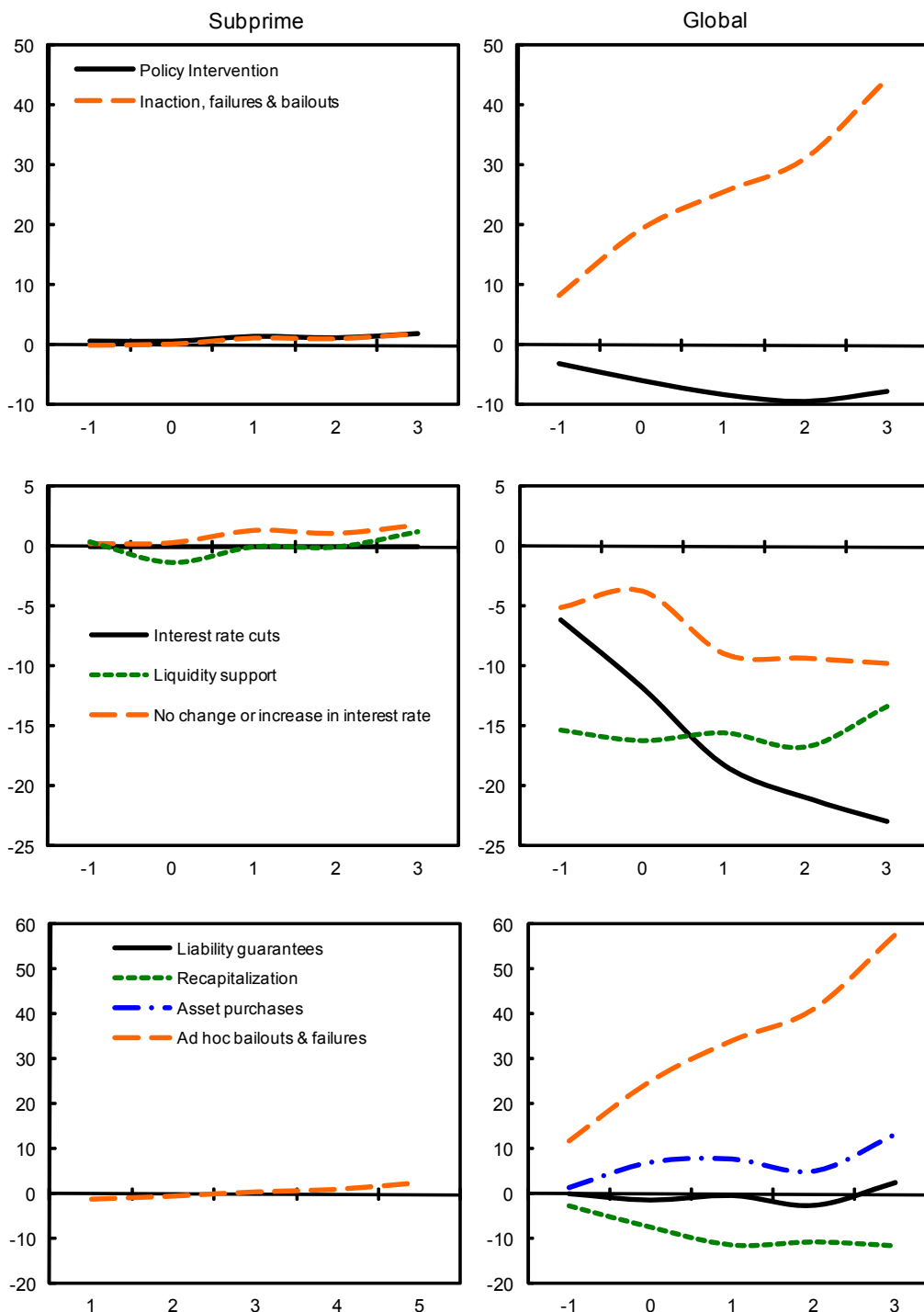
Source: Authors' estimates.
Note: The variable plotted on the vertical axis is the average cumulative abnormal
differences in basis points within the event window of one day before the event and three
days after the event. The horizontal axis shows days within the event window, with "0"
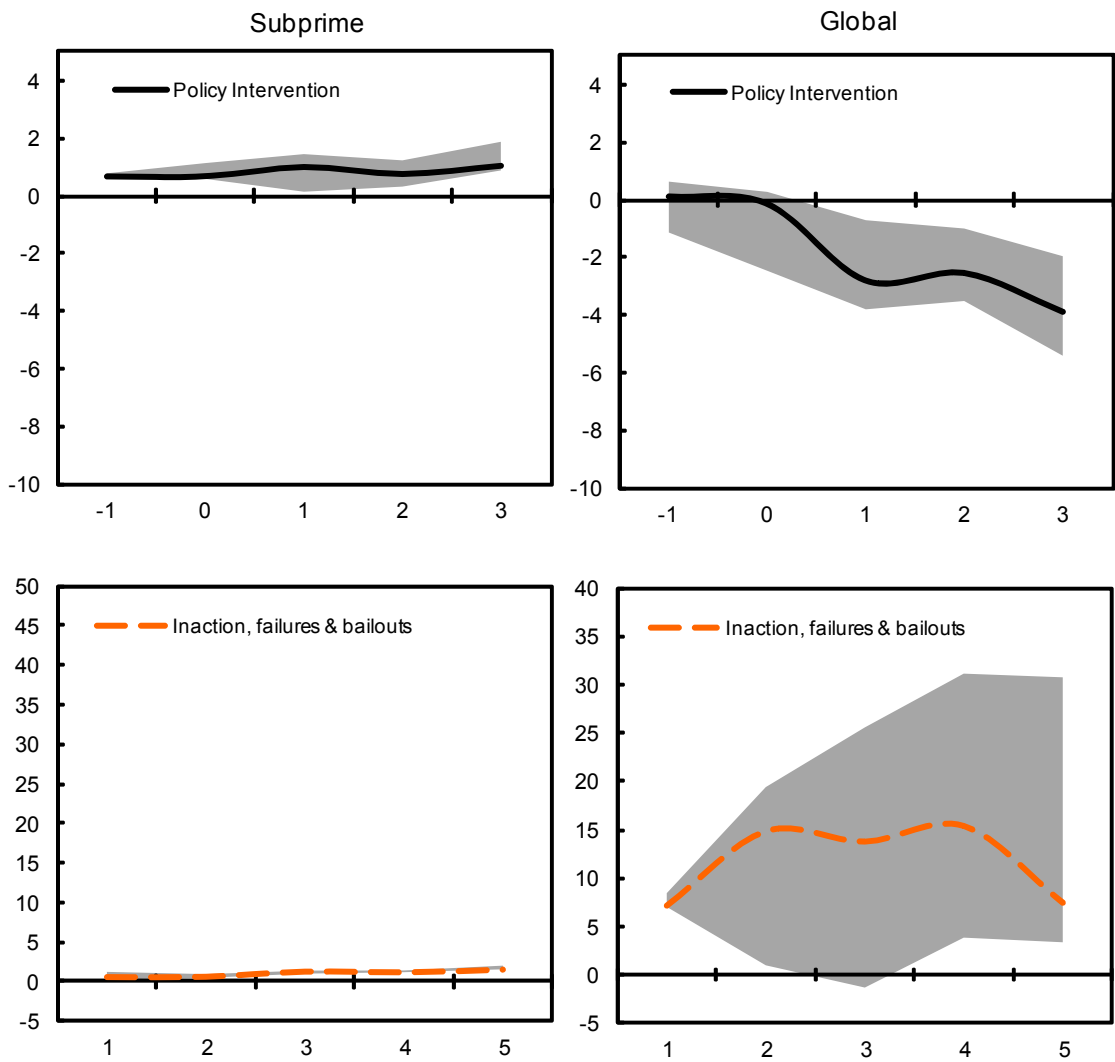corresponding to the day of the announcement.

Figure 8. Impact of Policy Announcements on the TED Spread,
June 1, 2007–March 31, 2009
(In basis points)

Source: Authors' estimates.
Note: The variable plotted on the vertical axis is the average cumulative abnormal differences in basis points within the event window of one day before the event and three days after the event. The horizontal axis shows days within the event window, with "0" corresponding to the day of the announcement.

Figure 9. Impact of Policy Announcements on Alternative Measures of Financial Distress, June 1, 2007–March 31, 2009
(In basis points)

Source: Authors' estimates.
Note: The variable plotted on the vertical axis is the median value of the average cumulative abnormal differences in basis points across five alternative measures of market response (TED spread, NYFR-OIS spread, repo-riskfree rate spread, LIBOR-OIS futures spread, and CDS spread composite of sample countries. The grey shaded area shows the inter-quartile range (IQR) of values between the 25th and 75th percentile. The horizontal axis shows days within the event window, with "0" corresponding to the day of the announcement.

Figure 10. Impact of Domestic and Foreign Policy Announcements on the Libor-OIS Spread, June 1, 2007–March 31, 2009 (by Country)
(In basis points)
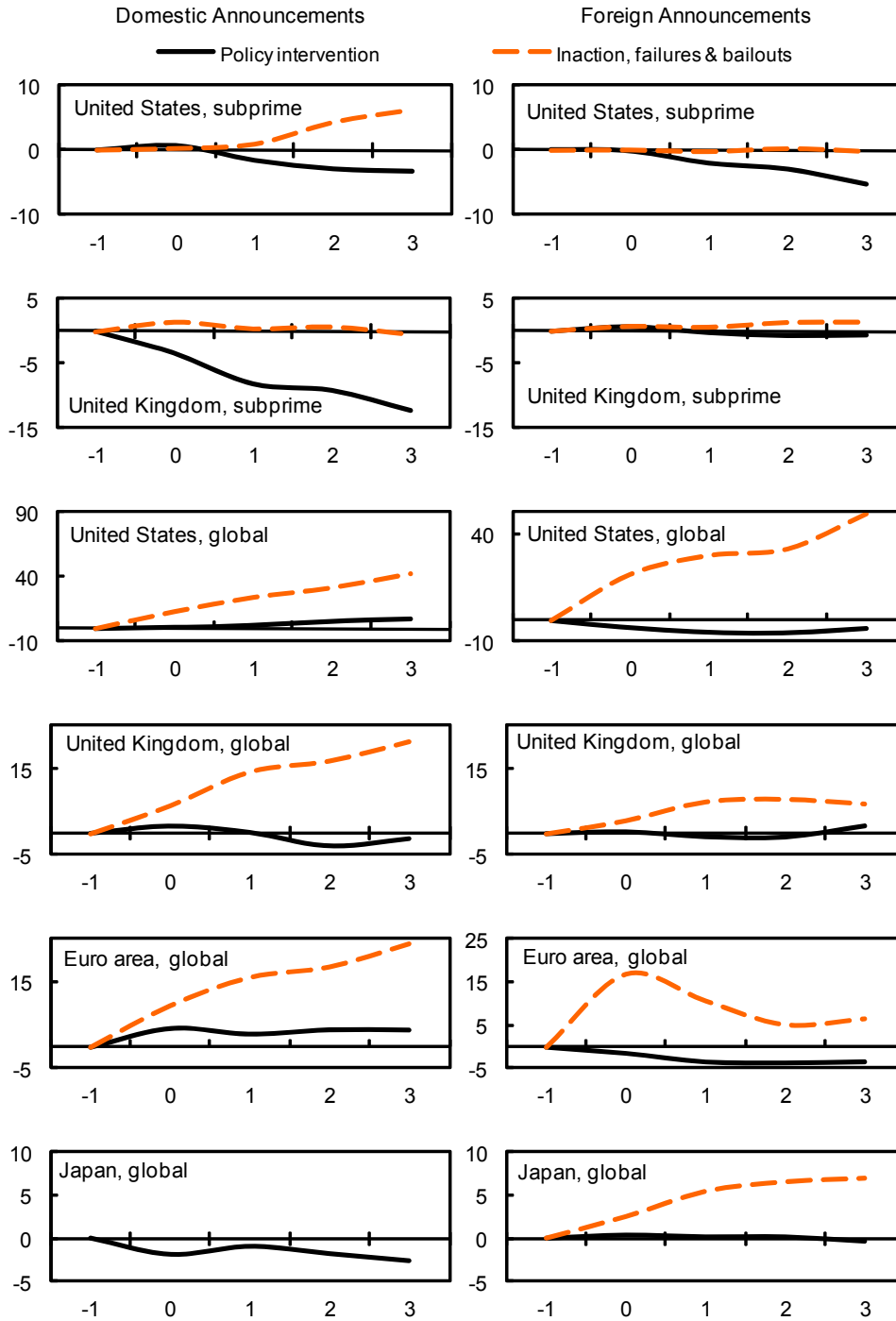
Source: Authors' estimates.
Note: The variable plotted on the vertical axis is the average cumulative abnormal differences (ACAD) in basis points within the event window of one day before the announcement and three days after the announcement. The horizontal axis shows days within the event window, with "0" corresponding to the day of the announcement.
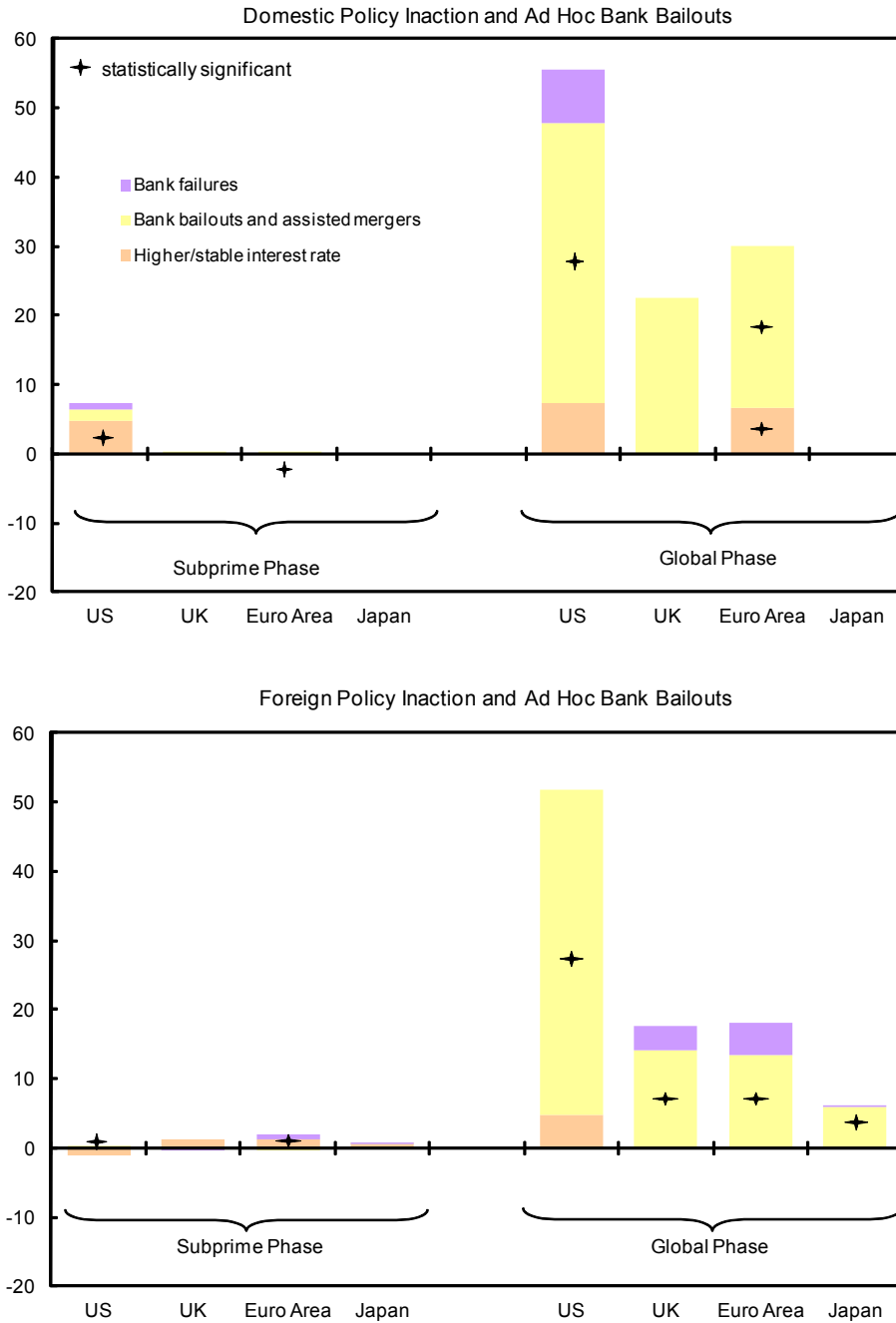
Figure 11. Magnitude and Statistical Significance of the Libor-OIS Spread
Response to Domestic and Foreign Policy Announcements (by Country)
(In basis points)
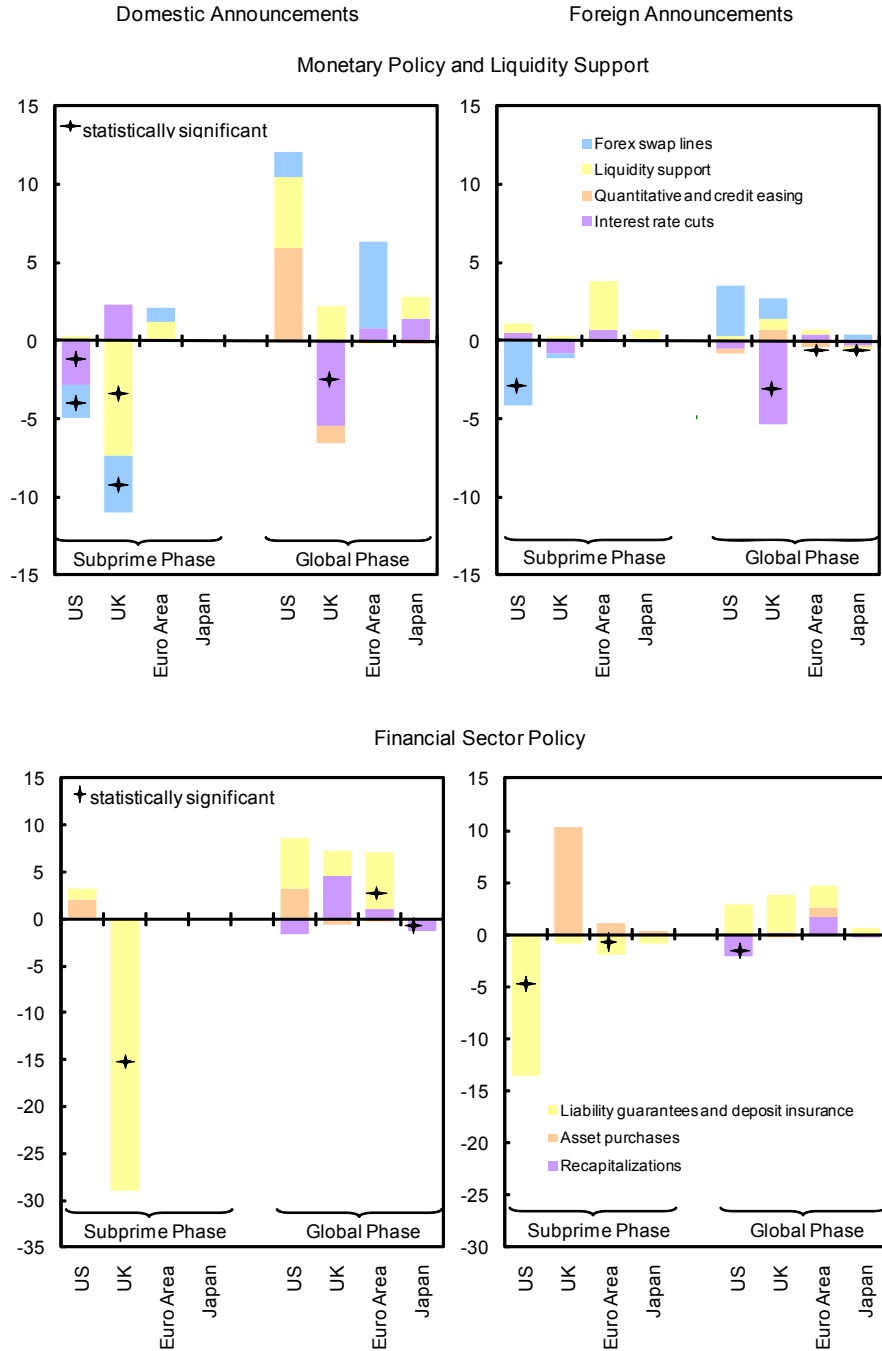
Source: Authors' estimates.
Note: The figures show the contribution of different types of policy announcements to the
overall impact of announcements in the respective policy category by country, in basis
points. The contribution of each type of announcement is calculated according to the
equation (10) in Appendix I, as the average cumulative abnormal differences (ACAD) for
the respective type of announcement, scaled by the ACAD of the respective category of
policy announcement, both within the window of 1 day before the announcement and 3
days after the announcement. Asterisks indicate statistical significance at the 10 percent
level or less.

Figure 12. Magnitude and Statistical Significance of the Libor-OIS Spread Response to Domestic and Foreign Policy Inaction and Ad Hoc Bank Bailouts (by Country)

Domestic Policy Inaction and Ad Hoc Bank Bailouts

Foreign Policy Inaction and Ad Hoc Bank Bailouts

Source: Authors' estimates.
Note: The figures show the contribution of different types of policy announcements to the overall impact of announcements in the respective policy category by country, in basis points. The contribution of each type of announcement is calculated according to the equation (10) in Appendix I, as the average cumulative abnormal differences (ACAD) for the respective type of announcement, scaled by the ACAD of the respective category of policy announcement, both within the window of 1 day before the announcement and 3 days after the announcement. Asterisks indicate statistical significance at the 10 percent level or less.

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Appendix: Statistical Tests

We use parametric and nonparametric tests of means to judge whether the given type of policy announcement induced a significant market response. The tests examine abnormal changes of the Libor-OIS spread over a short period of time before and after each policy announcement—the *event window*. The *abnormal difference* is computed as a difference between the expected daily change of the market indicator and its actual daily change, under an assumption that no other factors moved the Libor-OIS spread in the short run. Next, the day-to-day abnormal differences are aggregated throughout the event window, forming the *cumulative abnormal differences*. These differences are averaged across the same type of policy measure to estimate the *average cumulative abnormal differences* (ACAD) during each crisis phase.

Appendix 1: Parametric Tests

The parametric test statistic is a *t*-statistic with three different measures of historical volatility of the Libor-OIS spread over an estimation period of 20 days before the event window. This allows us to restrict the statistical significance only to those observations that were truly exceptional even at a time of large changes in the Libor-OIS spread prior to the policy event. The first estimator of volatility is based on Wayne H. Mikkelson and Megan M. Partch (1986) and equals to the square root of the sum of squared differences. This implies that the test statistic is computed as

$$
\text{(A1)} \quad \frac{ACAD_{i,\tau,m}}{\sigma_{i,l,m}(ACAD)} = \frac{\dfrac{1}{N_m T}\sum_{i\in N_m}\sum_{\tau\in T}\left(x_{i,\tau}-x_{i,\tau-1}\right)}{\sqrt{\dfrac{1}{N_m^2}\sum_{i\in N_m}\dfrac{\sum_{l\in L}\left(x_{i,l}-x_{i,l-1}\right)^2}{L-2}}} = \frac{\dfrac{1}{N_m T}\sum_{i\in N_m}\sum_{\tau\in T}AD_{i,\tau}}{\sqrt{\dfrac{1}{N_m^2}\sum_{i\in N_m}\dfrac{\sum_{l\in L}AD_{i,l}^2}{L-2}}} \sim \begin{cases}\Phi(0,1)\\ G(0,\sigma_x,\xi_x)\end{cases},
$$

where $\tau\in[-1,3]$ denotes a day within the event window (with the event occurring at $\tau=0$), $T=5$ denotes the total length of the event window of 5 days, $l\in[\tau-20,\tau-1]$ denotes a day within the pre-event estimation window, $L=20$ denotes the total length of the pre-event estimation window of 20 days, *m* denotes a type of crisis interventions, and *N* denotes the number of events of type *m* in our sample. Abnormal differences are generally defined as the daily changes $AD_{i,\tau,m}=x_{i,\tau,m}-x_{i,\tau-1,m}$ of an market stress variable *x* in response to policy announcement *i* of category *m* on event time day τ.[4] For the baseline results, we assume that this test statistic asymptotically converges to the standard normal distribution $\Phi(.)$. We also

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[4] As discussed in the preceding section, averages during the pre-event window are zero for changes in the Libor-OIS spread and nonzero for other indicators.

examine statistical significance based on the generalized extreme value distribution $G(.)$ which accounts for excess skewness and kurtosis of abnormal differences.[5]

The second estimator of volatility is also drawn on Mikkelson and Partch (1986) and equals to the standard deviation of the abnormal differences:
(A2)

$$\frac{ACAD_{i,\tau,m}}{\sigma_{i,\tau,m}(ACAD)} = \frac{\frac{1}{N_m}\sum_{i\in N_m}\sum_{\tau\in T}AD_{i,\tau}}{\frac{\sqrt{T}}{N_m}\sqrt{\sum_{i\in N_m}\frac{\sum_{l\in L}\left(AD_{i,l}-\overline{AD}_{i,l}\right)^2}{L}}} = \frac{\frac{1}{\sqrt{T}}\sum_{i\in N_m}\sum_{\tau\in T}AD_{i,\tau}}{\sqrt{\sum_{i\in N_m}\frac{\sum_{l\in L}\left(AD_{i,l}-\overline{AD}_{i,l}\right)^2}{L}}} \sim \begin{cases} \Phi(0,1) \\ G(0,\sigma_x,\xi_x) \end{cases},$$

This is a more balanced specification of volatility during the estimation window than the one given by (A1).

The third estimator of volatility is based on the expected prediction error that is derived from a simple autoregressive process and is adjusted by the ratio between volatility during both the estimation window and the event window. This accounts for changes in volatility on a day-to-day basis relative to the empirical experience within a short event window. Such specification is particularly relevant for cases when a policy measure was anticipated by markets and had an effect on the Libor-OIS spread before the event window. To calculate this test statistic, we first derive a measure of the standard deviation

$$\text{(A3)} \qquad \sigma_{i,\tau,l,m} = \sqrt{\text{var}\left(\varepsilon_{i,l}\right)\left(1+\frac{1}{L}+\frac{\left(AD_{i,\tau}-\overline{AD}_{i,l}\right)^2}{\sum_{l\in L}\left(AD_{i,l}-\overline{AD}_{i,l}\right)^2}\right)} \sim \text{student-t}\left(0,\frac{L}{L-2}\right)$$

where $\varepsilon_{i,l}$ denotes the ordinary prediction error of the AR(1) process of the Libor-OIS spread at first differences subject. Following Brown and Warner (1985), we obtain the (daily) standardized prediction error (SPE) as

$$\text{(A4)} \qquad SPE_{i,\tau,l,m} = \frac{1}{\sqrt{T+1}}\sum_{\tau\in T}\frac{AD_{i,\tau}}{\sigma_{i,\tau,m}}$$

---

[5] We calibrate a generalized extreme value distribution (GEV) as a means to capture asymptotic tail behavior at percentiles far removed from central observations. GEV prescribes that there exists a choice of constants $a_n>0$ and b_n, such that the probability of a n-sequence of normalized maxima $F_n^{[a_n x+b_n]}(x)$ converges to the non-degenerate limit distribution $G(x)=\exp\left(-\left(1+\xi(x-\mu)/\sigma\right)_+^{-1/\xi}\right)$ as $n\to\infty$ and $x\in\mathbb{R}$, after adjustment of scale parameter $\sigma>0$, location parameter μ and the shape parameter ξ, which indicates the velocity of asymptotic tail decay of a given limit distribution ("tail thickness"). We calibrate $G(x)$ for $\mu=0$.

and then derive the average standardized interval prediction error (ASIPE) as

(A5)
$$\frac{\sqrt{N_m}}{N_m}\sum_{i\in N_m}SPE_{i,\tau,m}\sim\begin{cases}\Phi(0,1)\\G(0,\sigma_x,\xi_x)\end{cases}$$

as our test statistic.

Appendix 2: Nonparametric Tests

Given the weak power of parametric tests in small samples of events with diverse effects on market indicators, we use nonparametric tests to remove priors about the distribution of abnormal differences from the measure of statistical significance. Based on Charles J. Corrado and Terry L. Zivney (1992), a standard sign test determines whether the incidence of positive or negative responses to a particular type of policy measure is statistically significant under normality:

(A6)
$$\left(\frac{N_m^+}{N_m}-0.5\right)\frac{\sqrt{N_m}}{0.5}\sim\Phi(0,1)$$

where N^+ denotes the number of cumulative abnormal differences (CAD) that exhibit the desired direction of market response every time a policy of type m is announced. However, such a test statistic captures only the dominant direction of market response and ignores the relative magnitude of market response in either direction.

To control for such relative market response, we introduce the sign-size test. It provides for a high degree of asymmetry in the magnitude of individual market responses to different types of announcements. In this test a given announcement type would be deemed statistically significant only if there is a positive market response (in the sense of a decline in the Libor-OIS spread), which, on average, is larger than any negative response to the same type of policy measure over the sample time period.

We control for the size of standardized $\widehat{CAD}$, which transforms equation (6) into the test statistic of the sign-size test:

A(7)
$$\left(\frac{\dfrac{1}{N_m^+}\sum_{i\in N_m^+}\left(k_m-\widehat{CAD}_{i,m}^+\right)}{\dfrac{1}{N_m^-}\sum_{i\in N_m^-}\left(\widehat{CAD}_{i,m}^--k_m\right)+\dfrac{1}{N_m^+}\sum_{i\in N_m^+}\left(k_m-\widehat{CAD}_{i,m}^+\right)}\frac{N_m^+}{N_m}-0.25\right)\frac{\sqrt{N_m}}{0.5}=$$

$$\left(\frac{\sum_{i\in N_m^+}\left(k_m-\widehat{CAD}_{i,m}^+\right)}{\dfrac{N_m^+N_m}{N_m^-}\sum_{i\in N_m^-}\left(\widehat{CAD}_{i,m}^--k_m\right)+N_m\sum_{i\in N_m^+}\left(k_m-\widehat{CAD}_{i,m}^+\right)}-0.25\right)\frac{\sqrt{N_m}}{0.5}\sim\Phi(0,1),$$

where

(A8)
$$\widehat{CAD}_i = \frac{\left|CAD_i\right| - \min\left(CAD_N\right)}{\left|\max\left(CAD_N\right)\right| + \left|\min\left(CAD_N\right)\right|} \in [0,1]$$

scales to unity all CAD_i^+ and CAD_i^- of individual counts of *positive* (i.e., Libor-OIS spread reducing) and *negative* (i.e., Libor-OIS spread increasing) market responses to a particular policy measure m, and the threshold value

(A9) $k_m = \begin{cases} \dfrac{\left|\min_{N_m}\left(CAD_i\right)\right|}{\left|\max_{N_m}\left(CAD_i\right)\right| + \left|\min_{N_m}\left(CAD_i\right)\right|} & \textit{if } \min_{N_m}\left(CAD_i\right) < 0 < \max_{N_m}\left(CAD_i\right) \\[4mm] 1 & \textit{if } \min_{N_m}\left(CAD_i\right) < \max_{N_m}\left(CAD_i\right) < 0, \textit{else } 0. \end{cases}$

which determines at which point the standardized $\widehat{CAD}$ indicates a positive or negative market response.

We apply the above statistical tests in (1)–(3), (5) and (6) to individual types and categories of announcements. In addition, we examine the *contribution* of each type to the overall impact of the respective broad policy category M, such as monetary policy, financial sector support, or policy inaction and ad hoc bank bailouts. For example, we calculate contribution of recapitalization announcements to the overall impact of announcements about financial sector measures. Since the tests are performed separately for each type and category of policy announcement, the analysis of contributions requires scaling the impact of individual types of announcements, especially if the constituent policy measures triggers opposite market responses on average. The scaled absolute contribution of an individual type of policy announcement m to the impact of the respective policy category is defined as

(A10)
$$\widehat{ACAD}_m = \frac{N_m}{N_M} ACAD_m \times \begin{cases} \dfrac{\sum_M ACAD_m}{\sum_M ACAD_m^+} & \textit{if } \sum_M ACAD_m > 0 \\[4mm] \dfrac{\sum_M ACAD_m}{\sum_M ACAD_m^-} & \textit{if } \sum_M ACAD_m < 0 \end{cases}$$

where $\sum_M ACAD_m^+$ and $\sum_M ACAD_m^-$ denote the sum of all positive and negative ACADs associated with the individual types of policy measures that make up the broader policy category M.