

Did Unconventional Interventions Unfreeze the Credit Market?[†]

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This paper investigates whether and how unconventional interventions in 2008–2010 unfroze the credit market. We construct a dataset of 198 interventions for 16 countries during 2008–2010 and examine heterogeneous responses in stock prices to the interventions across 7,873 nonfinancial firms in those countries. Stock prices increase when the interventions are announced, particularly for firms with greater intrinsic need for external capital. This pattern is corroborated by subsequent expansions in firm investment, R&D expenditure, and employment. Among various forms of interventions, recapitalization of banks appears particularly effective in channeling the intervention effects from financial to nonfinancial sectors. (JEL E44, E58, G01, G14, G21, G31, G32)

During the height of the 2008–2010 global financial crisis, when the credit market in most countries was frozen even after the nominal interest rate was forced low by quantitative easing approaches, many governments undertook an additional set of “unconventional measures” to repair the central banks’ balance sheets and to induce them to be more willing to lend. These measures included injecting capital directly into the banks, allowing banks to use central banks’ discount windows with nongovernmental securities as collateral, buying toxic assets from the banks, guaranteeing bank debt, and announcing more generous deposit insurance. Fearful of a return to the Great Depression and inspired by the examples set by the US Federal Reserve and the Treasury, a long list of countries tried at least some of these unconventional measures, and many tried multiple measures over a period of time. Did these unconventional interventions achieve their intended policy objective of unfreezing the credit market? While prior research has established that firms benefit from the relaxation of financial constraints (Paravisini 2010, Chava and Purnanandam 2011), governments cannot directly order banks to lend; banks can simply use government interventions to repair their balance sheets rather than to increase bank loans. A reluctance by banks to lend in spite of government actions is

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especially likely (and worrisome) in the context of a deep and global recession. To prepare for policy responses in a future crisis, it would be useful to understand the consequences of the interventions in the most recent crisis.

In this paper, we pursue a systematic investigation of this question, using data on both stock prices and real variables, such as the investments of 7,873 listed nonfinancial firms in 16 countries. We will explore heterogeneous responses to the interventions by firms in different sectors, a methodology that allows us to better isolate the effect on credit supply from the interventions. Moreover, we will examine whether and how the effects transmit from financial to nonfinancial sectors, especially in terms of different intervention types.

We first construct a comprehensive dataset on unconventional government interventions in 16 countries. This combines searches of an electronic news database (Factiva) that covers all major financial newspapers and wire reports, and International Monetary Fund (IMF) publications that summarize national policy responses to financial crises. Our sample period is from January 2008 to July 2010, covering three major periods: the spillover of the global financial crisis after the Lehman Brothers declared bankruptcy (from September 2008 to March 2009), the alleviation of the crisis (from April 2009 to December 2009), and the 2010 European Debt Crisis.

We propose a simple framework that explores heterogeneity across nonfinancial firms based on their differential *ex ante* vulnerability to financial shocks. If the government interventions succeed in getting banks to make more loans, the effect is likely to be larger on firms that are relatively more financially constrained to start with. To determine cross-firm vulnerability to a supply-of-finance shock, we construct a sector-level measure for intrinsic liquidity need for working capital. As shown in Tong and Wei (2011), these sectors suffered a disproportionate amount of decline in stock values right after the Lehman Brothers declared bankruptcy, due to the freeze of the credit market.

We find that, on average, stock prices of nonfinancial firms rise when government interventions are implemented. Moreover, interventions have a greater impact on firms in sectors that have higher intrinsic liquidity need for working capital. Hence, judged by financial investors as reflected in the stock price responses, government interventions helped toward alleviating the liquidity constraint faced by nonfinancial firms. These results are robust to various specifications. For example, they carry through when abnormal stock returns are used as the dependent variable, and when we control for firm characteristics, such as firm size, sensitivity to aggregate demand, leverage ratio, and growth opportunity.

After establishing a positive average effect, we then examine differential effects across these interventions. First, we distinguish intervention dates with higher banking sector abnormal returns from those with smaller banking sector returns. When banks experience a higher abnormal return, nonfinancial firms in sectors with greater intrinsic liquidity need also exhibit a higher abnormal return. A likely interpretation is that the effect of interventions on nonfinancial firms is at least partially channeled through the banking sector. Second, we distinguish different types of interventions in transmitting the effects from financial to nonfinancial sectors. We find that the banking sector channel is particularly strong when the intervention is done through

bank recapitalization, consistent with the theoretical predictions of Philippon and Schnabl (2013).¹

Do firm-level real variables *ex post* validate the forecast by the stock prices? To answer this question, we track firm-level real activities subsequent to the interventions. In countries that have had an effective intervention based on our methodology, we find that *ex ante* liquidity-constrained firms experience a greater expansion in a range of real activities, such as capital expenditure, R&D, and employment, than unconstrained firms from 2007 to 2012.

This paper is related to the recent literature on the effects of unconventional interventions. The theories on the topic are understandably young. They study the economic efficiency of government bailouts in terms of promoting investment with the lowest intervention costs for taxpayers (e.g., Gertler and Kiyotaki 2010, Bebchuk and Goldstein 2011, Gertler and Karadi 2011, Tirole 2012, Philippon and Skreta 2012, Philippon and Schnabl 2013).² By focusing on different types of market failure, these papers often recommend different sets of interventions. For example, Gertler and Kiyotaki (2010) study financial intermediaries facing endogenous balance sheet constraints. Due to the capacity constraints on central banks (for example, the cost of monitoring), direct central bank lending is argued to be more desirable than equity injections for high-grade instruments such as commercial papers, while the opposite holds for low-grade instruments such as industrial loans. Bebchuk and Goldstein (2011) study how strategic complementarities among bank lending affect the effectiveness of government interventions. They argue that banks might take the capital and not lend it to operating firms due to a fear that other banks will not lend, and in this regard debt guarantee is close to recapitalization. Tirole (2012) focuses on the role of adverse selection in interventions for firms with legacy assets and recommends purchasing the weakest assets from firms. Philippon and Skreta (2012) address the unfreezing of the debt market and argue for direct lending or debt guarantees. Philippon and Schnabl (2013) analyze interventions in a model where a debt overhang problem is the source of a credit freeze. They argue that recapitalization would be more effective than debt guarantees and asset purchases in alleviating liquidity constraints.

While the optimal forms of interventions in theory depend on the nature of the market failure, the relative importance of various market failures in the data is a matter of debate. Several of the predictions from the theoretical literature are reasonably specific and therefore testable. As we will show, the prediction by Philippon and Schnabl (2013) that bank recapitalization is more effective than other interventions appears to receive the strongest support in our empirical analysis.

There is growing but still incomplete empirical evidence on the effect of unconventional interventions. The available evidence focuses on interventions in the United States and on financial sectors in particular. For example, Taylor and

¹Philippon and Schnabl (2013) argue that recapitalization would be more effective than debt guarantees and asset purchases in alleviating liquidity constraint due to the private information problem in asset quality (the “lemons problem”) combined with the debt-overhang problem. They recommend recapitalizing banks against their preferred stocks plus warrants.

²For earlier theoretical models on individual types of interventions, such as bank recapitalization, see Diamond and Rajan (2000), Diamond (2001), and Gorton and Huang (2004).

Williams (2009), Wu (2011), and Christensen, Lopez, and Rudebusch (2014) study Term Auction Facilities. We can glean insights on large-scale asset purchases from Gagnon et al. (2010); Neely (2010); Veronesi and Zingales (2010); Krishnamurthy and Vissing-Jorgensen (2011); Gilchrist and Zakrajšek (2013); Duchin and Sosyura (2014); Hattori, Schrimpf, and Sushko (2016), and the papers in the *Economic Journal* special issue on unconventional monetary policy (2012).³ In a cross-country setting, King (2009) examines the responses of bank CDS spreads to bank rescue packages in six countries. Ait-Sahalia et al. (2012) examine the effects of the interventions on LIBOR-OIS spreads and report a weakly positive effect, while Drechsler et al. (2016) find strong divergence among banks' take-up of lender of last resort (LOLR) assistance in the euro area from 2007 to 2011.

Few of these studies have examined the effects of unconventional interventions on nonfinancial sectors. One exception is Laeven and Valencia (2013), who examine the effects of annual government interventions on firm annual sales in 2009. Mariathasan and Merrouche (2012) also examine how bank recapitalizations affect bank loans in 15 countries belonging to the Organization for Economic Cooperation and Development (OECD) from 2008 to 2010 at an annual frequency. Since their interventions are measured annually, there can be many compounding events in a given year, making it more difficult to address simultaneity issues and cleanly identify differential effects of interventions.⁴

In this paper, we aim to fill the gap in the literature by examining daily stock market responses to 198 intervention announcements, distinguishing supply and demand effects, and also comparing different types of interventions in the context of effects on alleviating credit constraints faced by nonfinancial firms.

The paper proceeds as follows. Section I discusses patterns of unconventional interventions across countries. Section II presents our key specification, construction of key variables, and sources of data. Section III discusses the main empirical results and a slew of robustness checks and extensions. Section IV offers concluding remarks.

I. Taking Stock of Unconventional Interventions

In normal times, the set of conventional monetary policy tools in the sleeves of a central bank aiming at providing more liquidity into an economy consists of a reduction in the interest rate, an open market operation that buys government bills and bonds from commercial banks (and therefore puts more money into the hands

³For example, Veronesi and Zingales (2010) focus on the Paulson Plan in 2008, perform an event study by examining stock returns and credit default swaps, and show that this plan added \$130 billion to the banking sector at a taxpayer cost of between \$21 and \$44 billion. They further infer that the net benefit arises mostly from a reduction in the probability of bankruptcy.

⁴There are studies that examine the experience of Japanese bank bailouts in the 1990s. Allen, Chakraborty, and Watanabe (2011) find blanket infusions in the earlier Japanese bailouts ineffective in increasing aggregate credit. Giannetti and Simonov (2013) find that large capital injections can increase the supply of credit and result in positive returns for the clients of recapitalized banks. In comparison, we examine different types of interventions in a global setting. Our results on recapitalization are consistent with Giannetti and Simonov (2013), but we also examine intervention types not in their sample. Moreover, we empirically identify a key channel of interventions absent in the previous literature (i.e., through meeting firms' liquidity need for working capital).

of commercial banks), and a reduction in the required reserve ratio at which commercial banks are mandated to hold cash as a share of the deposits. The global financial crisis during 2008–2009 was anything but normal. Commercial banks were hit by massive mortgage defaults either directly (from not being able to collect principal and interest payments of the mortgages on their books) or indirectly (through loss in the value of mortgage asset backed securities, or dissipation of the value of credit default swaps that they bought from nearly defunct insurance companies), and therefore were looking for any way to conserve capital. Exacerbated by a fear of counterparty risk, they were reluctant to make new loans to firms, households, or each other. As a result, liquidity constraints faced by nonfinancial firms increased substantially in spite of the central banks' effort to lower the interest rate and the official discount rate. In other words, the conventional policy tools no longer appeared to work.

It is against this unusual background that central banks around the world started to experiment with unconventional policy tools. These measures are not part of the standard databases precisely because they are unconventional. The first task for our project is to collect systematic information on these unconventional interventions.

Our dataset draws from searches of an electronic news database (Factiva) that covers all major financial newspapers and wire reports, and IMF publications that summarize national policy responses to financial crises (e.g., IMF 2009). The database contains official announcements of significant crisis-related policy measures, and dates of official press releases or their first appearances in major newspapers and search engines. We exclude from our sample those announcements on implementation guidelines following previously announced interventions.

The dataset covers five categories of interventions: deposit insurance, debt guarantees, recapitalization, asset purchases, and central bank liquidity support.

<i>Deposit insurance</i>	Enhancement of deposit protection in commercial banks
<i>Debt guarantees</i>	Government guarantee of bank debt (all or new liabilities)
<i>Recapitalization</i>	Capital injection into banks (in exchange for either preferred equity or subordinated debt)
<i>Asset purchases</i>	Purchase of toxic assets or purchase of assets from toxic banks
<i>Liquidity support</i>	Longer funding terms, more auctions and/or higher credit lines; domestic system lender of last resort: wider collateral rule; other liquidity support (e.g., support of money market funds); foreign exchange lender of last resort: forex swap lines

Our methodology for identifying the effect of the interventions on liquidity constraint calls for firm-level data in multiple sectors; therefore, we focus on 16 economies with intervention announcements from 2008 to 2010, each of which has 50 or more nonfinancial firms in the Worldscope database. The country list includes

Canada, France, Germany, Greece, India, Indonesia, Italy, Japan, Singapore, South Korea, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States.⁵

For each intervention, we have data on the announcement date and the type of intervention. Sometimes we have information on the monetary value of the interventions but we do not have information on the monetary value of the need for interventions. We also use Bloomberg News, press releases, and newspaper coverage to identify the time when an unconventional intervention is publicly announced. We then compare the announcement time with the local stock market opening hours to decide whether we should use the same-day or the next-day stock closing price in constructing the one-day stock return around an intervention. We identify that 27 unconventional interventions were announced after closing hours of local stock markets, while the remaining 171 interventions were announced before closing hours. For those 27 interventions, we will then use the next-day stock closing price to construct the one-day stock return.⁶

Finally, due to the rapid unfolding of the crisis and the quick implementation of interventions, we drop the intervention days when there is at least one intervention in the previous two days. Doing so helps us to reduce the compounding effects from earlier interventions. This leaves us with a total of 198 country-date-level intervention announcements in these 16 countries from January 2008 to July 2010.⁷ Table 1 reports these 16 countries and the number of intervention days that have made it into our sample, as well as a breakdown of interventions by types for each country.

Figure 1 plots the number of interventions from March 2008 to July 2010. When unconventional interventions started in the first three quarters of 2008, they took the form of central bank liquidity support. Interventions skyrocketed in the fourth quarter of 2008 after the Lehman Brothers bankruptcy. In that quarter, there were 71 interventions, encompassing all types. In the first quarter of 2009, the number of interventions shrank by half to 36, in which the dominant types were direct

⁵We include up to 17 US interventions since 2008, covering the major initiatives such as Term Securities Lending Facility (TSLF), Primary Dealers Credit Facility (PDCF), TARP, Money Market Investor Funding Facility (MMIFF), Term Asset-Backed Securities Loan Facility (TALF), and Public-Private Investment Program for Legacy Assets. We exclude dates when an intervention announcement coincides with other major news of banks. For example, on September 29, 2008, when the Federal Reserve designed more Term Auction Facility (TAF), it was also the day when the US Congress rejected the initial \$700 billion bailout. Also, on October 7, 2008, when the Federal Reserve announced a new facility to provide a liquidity backstop to US issuers of commercial paper (Commercial Paper Funding Facility), there was also news about the negative earnings of BOFA and a potential breakdown of a merger between JP Morgan and a Japanese bank. Hence, we exclude the CPFF from our sample.

⁶In this paper, we study how an intervention by a country affects nonfinancial firms' stocks in that country rather than the global stock market. For example, suppose that an intervention is announced by the US Treasury at 11:30 AM on October 30, 2008; we then examine how that announcement affects the stock returns of US firms that day, without analyzing the spillovers to European firms. In this example, the close of European stock markets will not affect our analysis of US firms.

⁷In our analysis, we remove events that were reported to be fully expected or below expectations. For example, on October 22, 2008, the Reserve Bank of India injected \$8.8 billion into the financial system to spur lending, but analysts said they were surprised the RBI had not built on its recent aggressive easing of monetary policy with another rate cut. As a second example, on November 20, 2008, France announced a 20 billion euro fund to invest in viable firms in need of cash, and to shore up the balance sheets of companies deemed vulnerable in the face of falling stock prices. This program was reported to be below the market expectation as "the amount announced was far below the 100 billion euros initially floated as the planned startup capital last month when Sarkozy announced his French version of a sovereign wealth fund" (Agence France-Presse 2008).

TABLE 1—INTERVENTIONS BY COUNTRY AND TYPE (2008–2010)

Country	Intervention days	Deposit insurance	Deposit guarantees	Recapitalization	Asset purchases	Liquidity support
Canada	10	0	2	0	3	5
France	12	0	4	8	2	1
Germany	31	1	16	17	9	2
Greece	14	2	6	9	2	2
India	1	0	0	1	0	0
Indonesia	1	1	0	0	0	0
Italy	17	2	6	12	3	1
Japan	10	0	0	3	1	6
Singapore	5	1	1	0	0	3
South Korea	6	1	1	2	2	4
Spain	17	2	5	7	4	3
Sweden	24	2	10	7	2	8
Switzerland	5	2	0	0	2	2
Turkey	2	1	0	0	0	1
United Kingdom	26	2	5	10	12	6
United States	17	1	3	5	5	9

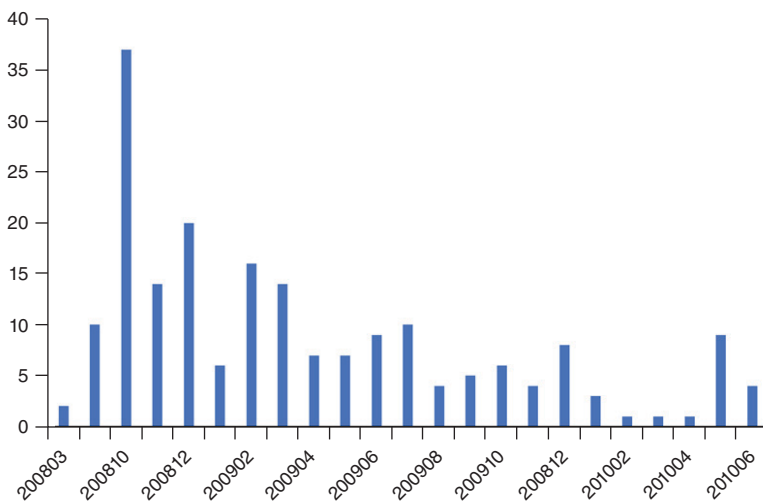


FIGURE 1. NUMBER OF INTERVENTIONS

recapitalizations and asset purchases.⁸ In the second quarter of 2009, the interventions declined further to 23. However, the pace of interventions picked up again in the second quarter of 2010, with the unfolding of the European Sovereign Debt Crisis.

Figure 2 plots the distribution of different types of intervention measures. Across the 198 country-date-level interventions, there are 258 intervention measures in total. Since a government may undertake more than one measure on a given day,

⁸ Certain interventions may have a natural physical limit on the number of possible actions. For example, governments generally can enact a deposit insurance scheme once.

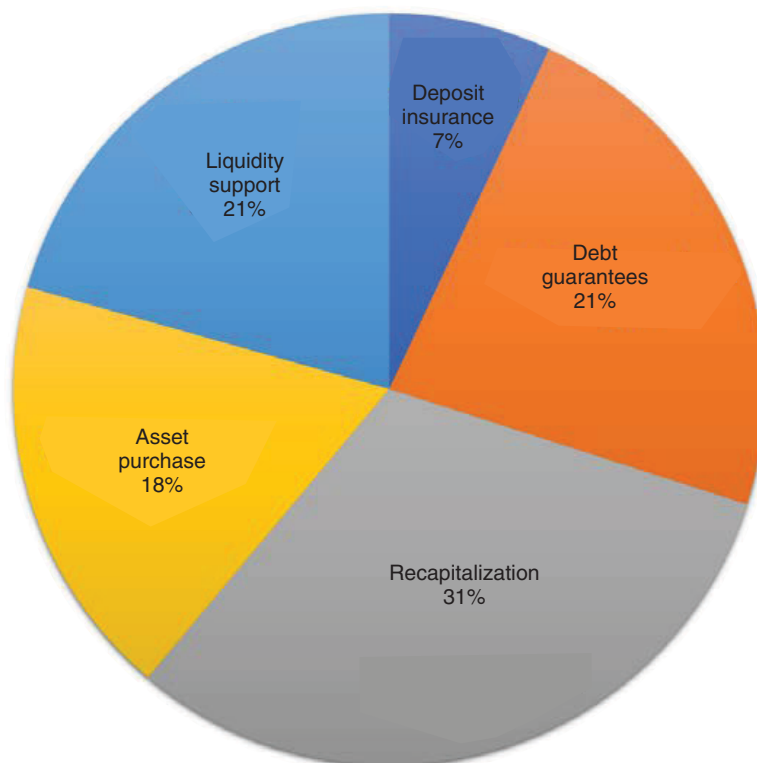


FIGURE 2. THE DISTRIBUTION OF INTERVENTION TYPES

the total number of measures exceeds the number of interventions.⁹ Overall, there are 18 enactments or enhancements of deposit insurance, 59 government guarantees of debt by financial institutions, 81 direct recapitalizations of financial institutions, 47 asset purchases, and 53 central bank liquidity supports.

II. Methodology

Our methodology might be labeled as an event study “plus.” That is, on top of an event study specification, we simultaneously perform a cross-country, cross-sector analysis that explores interactions between cross-sector differences in the intrinsic liquidity need for working capital and cross-country differences in the timing of intervention announcements.

An event study is a standard tool. For example, Veronesi and Zingales (2010) examine how bank stocks were affected by the US Treasury-Federal Deposit Insurance Corporation joint plan (Paulson’s Plan) on October 3, 2008. Event studies face their limitations, such as the challenge in measuring the aggregate effect of interventions, as other events may happen simultaneously. We aim to alleviate this concern by

⁹For example, on October 8, 2008, the United Kingdom announced both debt guarantee and bank recapitalization.

pooling over a relatively large sample of interventions. Most importantly, we focus on differential policy impacts across sectors with different degrees of liquidity need for working capital. If interventions alleviate the financial constraint, then it will likely be reflected in the relative price movement across these sectors.

It is useful to keep in mind the limitations of an event study approach. First, it assumes that the stock prices are informative. Second, because the event window is relatively narrow, it does not directly describe long run effects. In Section III E, we will also analyze the impact of the interventions on firm real activities, especially capital expenditure, R&D, and employment.

A. Basic Specification

Our basic empirical strategy is to check whether, in a given country, an ex ante classification of firms by their characteristics in terms of the degree of intrinsic liquidity need helps to predict the ex post magnitude of their stock price changes around intervention announcements. To be precise, our specification is given by the following equation:

$$(1) \quad \text{Stock return}_{i,j,k,t} = \phi \text{Intrinsic liquidity need}_j + \lambda \text{Control}_{i,j,k,t} \\ + \text{Intervention dummies}_{k,t} + e_{i,j,k,t},$$

where i stands for company, j for sector, k for country, and t for intervention day. To see how a government intervention affects the extent of a liquidity crunch in a country, we focus on the coefficient on nonfinancial firms' intrinsic liquidity need. The slope coefficient, ϕ , then captures the degree to which a credit crunch depends on government intervention.

We will start with stock return as our analysis to have a sense of the overall impact of unconventional policies on stocks. Then we will examine abnormal stock returns constructed from a market model. Reassuringly, the key results carry through when we study abnormal returns.

Asset pricing models provide guidance for control variables. We add the two factors from Fama and French (1992): firm size (log of assets in US dollars) and book-to-market ratio (the book value of equity divided by the market value of equity). We follow Whited and Wu (2006) and incorporate the two factors by entering the relevant firm characteristics directly in our regressions rather than entering them indirectly by going through a factor model first. For control variables, these two ways of incorporating the factors would be equivalent.¹⁰ Moreover, as stock prices may change due to the impact of an intervention on aggregated demand, we further control for sector-level intrinsic sensitivity to the demand shock as in Tong and Wei (2011).

¹⁰Entering firm characteristics directly in our regressions is easy to implement, though the interpretation of the coefficients on these factors is less straightforward.

B. Key Data

We describe here in more detail how we define stock return, the sector-level intrinsic liquidity need, and other explanatory variables.

Stock Returns.—To construct our dependent variable, we collect data on stock prices of 7,873 nonfinancial firms in the 16 countries over the period 2008 to 2010. The daily stock price index is retrieved from Datastream, which adjusts for dividends and capital actions such as stock splits and reverse splits. To reduce the inference of illiquid stocks, we drop the cases in which there is no single trade of the stock at the announcement day, the day before, and the day after. We measure stock return as the log difference between stock price at the announcement day (t) and that at the previous trading day ($t - 1$). For those 27 unconventional interventions that were announced after closing hours of local stock markets, we will then use the next-day stock closing price to construct the one-day stock return. We start with stock return as the dependent variable. We then use abnormal stock return as the dependent variable, which will be constructed from a market model.

Intrinsic Liquidity Need for Working Capital.—We develop a measure of intrinsic liquidity need for working capital. Working capital is required for a firm to operate and to satisfy both short-term debt payment and ongoing operational expenses. Firms may use lines of credit, term loans, or commercial papers to cover their working capital need. If a liquidity crunch strikes, those industries with greater intrinsic need for working capital should experience a larger decline in stock prices.

We construct a sector-level measure of intrinsic liquidity need for working capital by the concept of a “cash conversion cycle,” which has also been adopted by Raddatz (2006) and Kroszner, Laeven, and Klingebiel (2007). The cycle measures the time elapsed from the moment a firm pays for its inputs to the moment it receives payment for the goods it sells. We assume that this intrinsic liquidity need is due to pure technological reasons, such as the length of the production process and the mode of operation. For firms in the United States during a noncrisis period, when the supply of finance is as abundant as any country, the relative values of the cash conversion cycle across sectors reflect relative true need for working capital. More specifically,¹¹

Cash conversion cycle

$$= 365 \times \left(\frac{\text{inventories} - \text{accounts payable}}{\text{cost of goods sold}} + \frac{\text{accounts receivable}}{\text{total sales}} \right).$$

The sector-level proxy is constructed as follows. First, for each US firm from 1990 to 2006, we calculate the cash conversion cycle based on annual data from

¹¹ Inventories, accounts receivable, and accounts payable are year-end numbers, while costs of goods and sales are aggregated over the year. We follow the convention in the literature and multiply the ratio by 365 (i.e., the number of days in a year).

Compustat USA Industrial Annual. Then we calculate the median within each US SIC three-digit sector and apply it as the sector's intrinsic liquidity need for working capital. The index for the US firms is then extrapolated to other countries. As in Raddatz (2006), we rely on US firm data in that the supply of liquid funds is much more elastic in the United States. Hence, observed differences in relative working capital levels across industries are mainly driven by demand. Following Raddatz (2006), we also drop sectors in the utilities industry, service industry, and public administration because these sectors are subject to strict regulation and their financing needs are not comparable with those of other industries. In this paper, we add the sector of retail industries to reflect its need of working capital. This leaves us with 173 three-digit sectors. Finally, we take the log of the index to alleviate influence of potential outliers. The median and mean values of this log index are 4.48 and 4.43, respectively, and the standard deviation is 0.47.

Note that this index may be noisy, but this would work against us as it tends to increase standard errors and makes it harder for us to find significant coefficients on variables involving this index. As a robustness check, we will use a firm-level liquidity need based on the log of the median firm-level cash conversion cycle from the years 2000 to 2006. We use the precrisis firm-level liquidity need to alleviate potential endogenous issues between a firm's liquidity need and its stock returns.

This indicator is designed to capture the intrinsic need for working capital to satisfy a firm's short-term debt payment and ongoing operational expenses. Separately, we will also use an indicator to capture a firm's intrinsic financing need for long-term investment.

External Financing Needs for Capital Expenditure.—To measure an industry's intrinsic dependence on external finance for capital expenditure, we use the financial dependence measure proposed by Rajan and Zingales (1998). They compute an industry's dependence on external finance as:

$$\text{Financial dependence} = \frac{\text{Capital expenditures} - \text{Cash flow}}{\text{Capital expenditures}},$$

where *Cash flow* = cash flow from operations + decreases in inventories + decreases in receivables + increases in payables. The index is computed using data on listed US firms, which are judged to be least likely to suffer from financing constraints relative to firms in other countries. Conceptually, the Rajan and Zingales index aims to identify sectors that are naturally more dependent on external financing for their capital expenditure.¹² To calculate the Rajan and Zingales index, we take the following steps. We first sort every firm in the Compustat USA files based on their three-digit SIC sectoral classification and then calculate the ratio of dependence on external finance for each firm by aggregating cash flows and expenditures as in Rajan and Zingales over the period 1990–2006. We then calculate the financial

¹² While the original Rajan and Zingales (1998) paper covers only 40 (mainly SIC two-digit) sectors, we recompute their measure using data for the period 1990–2006 to expand the coverage to around 173 SIC three-digit sectors. We drop firms active in the utilities industry (SIC 4), financial industry (SIC 6), and public administration (SIC 9) because these firms are either subject to strict regulation or their financing needs are not comparable with those of other industries.

dependence index as the sector-level median value of these firm ratios for each SIC three-digit sector that contains at least five firm observations.

Control Variables and Summary Statistics.—Another regressor is an index of a sector's sensitivity to a contraction in aggregate demand. Tong and Wei (2011) propose such an index at the sector level based on the stock price reactions of the firms in that sector to the September 11, 2001 terrorist attack. Duchin, Ozbas, and Sensoy (2010) also follow this approach to control for the demand channel when examining US firms during the subprime crisis. To construct the index, we first compute the change in log stock price for each US firm from September 10, 2001 to September 28, 2001. We then look at the mean of log stock price change for each three-digit SIC sector, and use it as the sector-level demand sensitivity.¹³ Excluding the utilities industry (SIC 4), service industry (SIC 7 and 8), and public administration (SIC 9), we are left with 173 three-digit level sectors in total. The median and mean values of this index are 1.60 and 1.71, respectively, and the standard deviation is 1.24. (In robustness checks, we will also include additional firm characteristics, such as firm size, growth opportunity, and leverage. And again, the main results hold.)

Our baseline sample includes 95,792 firm-date observations for firms in countries with interventions on those dates. (Appendix Table A1 lists the number of firms in the sample for each country.) One extension that will be reported will expand the sample to include up to four trading dates before each intervention, resulting in a larger sample of 390,048 observations. Table 2 summarizes the dependent and key explanatory variables. The stock return in the first row captures the log difference in stock prices for nonfinancial firms from the day before the intervention ($t - 1$) to the intervention day (t). It has a mean of 0.06 percent and a median of 0. Note that the average stock return outside the intervention periods (from $t - 4$ to $t - 3$) for the same sample of nonfinancial firms is -0.62 percent. Hence stock prices tend to do better on intervention days than on nonintervention days.¹⁴

III. Results

A. Baseline Results

We start with the basic specification in equation (1) and report the results in Table 3. We find that government interventions on financial sectors have a significantly positive impact on alleviating the liquidity constraints of nonfinancial firms.

¹³We argue that this index primarily reflects the relative sensitivity of a firm's stock price to an unexpected shock in aggregate demand, and is less influenced by a firm's sensitivity to financial constraints or uncertainty shocks. First, we show that there was a large downward shift in expected aggregate demand, as reflected by a downward adjustment in the consensus forecast of US GDP growth in the aftermath of the shock. Second, because the Federal Reserve took timely actions, both the real interest rate and the TED spread, after initial spikes, quickly returned to the pre-9/11 level, suggesting the restoration of market liquidity. Third, the VIX index, a proxy for the degree of market uncertainty, returned to its pre-9/11 level by September 28, 2001. We therefore conclude that the stock price change from September 10 to 28 primarily reflects the shock in the aggregate demand (Tong and Wei 2011).

¹⁴The theoretical model of Pástor and Veronesi (2012) predicts that the stock returns on announcements tend to be negative because favorable policy changes tend to be anticipated whereas unfavorable policy changes tend to have a bigger element of surprise. Of course, this is an average statement, and the model does not rule out the actual announcement effect of a given policy change to be either positive or negative.

TABLE 2—SUMMARY STATISTICS

Variables	Observations	Median	Mean	SD	Min	Max
<i>Firm-level (for nonfinancial firms)</i>						
Stock return (percent)	95,792	0	0.06	5.44	-18.77	17.23
Abnormal stock return (percent)	95,792	0.0084	-0.15	4.92	-24.96	24.86
Firm size (2007)	7,873	12.21	12.32	2.04	2.83	20.49
Book-to-market ratio (2007)	7,873	0.57	0.72	0.54	0.0066	2.63
Firm leverage (2007)	7,824	0.15	0.19	0.17	0.00	0.90
Log change of capital expenditure ($\times 100$)	5,730	-2.85	-12.06	125.20	-510.0	347.9
Log change of R&D ($\times 100$)	2,960	10.23	11.64	63.73	-224.8	229.8
Log change of employee number ($\times 100$)	4,309	4.61	3.04	48.51	-249.3	191.3
<i>Sector-level</i>						
Liquidity need for working capital (log)	173	4.48	4.43	0.47	2.63	5.68
Demand sensitivity	173	1.60	1.71	1.24	-1.19	4.93
External financing needs for capital expenditure	173	-0.11	0.03	0.81	-2.57	4.41

Notes: The sample is for 7,873 listed nonfinancial firms in 16 countries from 2008 to 2010. Firm-level stock return is the log difference between the stock price at the announcement day (t) and that at the previous trading day ($t - 1$). The abnormal return is based on a market model. Firm size is the log of assets in US dollars at year 2007. Book-to-market ratio is the book value of equity divided by the market value of equity at year 2007. Firm leverage is measured as firm's total debt over total assets at year 2007. Changes of capital expenditure, R&D, and employee number are measured from 2007 to 2012. "Liquidity need for working capital," "Demand sensitivity," and "External financing needs for capital expenditure" are described in Section IIB.

TABLE 3—UNCONVENTIONAL INTERVENTIONS AND LIQUIDITY CONSTRAINTS

	Gross return (1)	Abnormal return (2)	Adding controls (3)	Adding leverage (4)	Remove bond issuance (5)
Liquidity need	0.10 [0.056]	0.072 [0.037]	0.075 [0.037]	0.072 [0.037]	0.096 [0.039]
Firm size			0.0049 [0.0078]	0.0024 [0.0083]	-0.0042 [0.0084]
Demand sensitivity			-0.020 [0.018]	-0.020 [0.018]	-0.018 [0.018]
Book-to-market ratio			0.012 [0.040]	0.015 [0.040]	0.018 [0.040]
Leverage				0.085 [0.090]	0.095 [0.087]
Intervention fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	95,792	95,792	95,792	95,229	88,653
R^2	0.263	0.057	0.057	0.057	0.059

Notes: The dependent variable is the abnormal stock returns of nonfinancial firms between the announcement day (t) and the previous trading day ($t - 1$), except in column 1 where it is the gross stock returns. Liquidity need denotes intrinsic liquidity need for working capital at the sector level. Column 5 drops firms that ever issued a bond from 2008 to 2011. Robust standard errors are in brackets. Standard errors are clustered at the three-digit sector level.

In column 1, we first examine the gross stock return. We include the intrinsic liquidity need for working capital, as well as intervention fixed effects. We cluster the standard errors at the level of the three-digit sector, as our key variable—liquidity need—is defined at this level. We find that stock return is significantly higher for sectors with large liquidity needs around the interventions. Hence, column 1 suggests the easing of liquidity constraint following an intervention.

In column 2, we examine the abnormal stock return. To compute the abnormal return, we employ a market model to construct the abnormal return as follows:

$$(2) \text{ Abnormal return}_{i,t} = \text{Stock return}_{i,t} - \text{Alpha}_i - \text{Beta}_i \times \text{Market return}_{k,t}.$$

We first construct each firm's beta annually based on the correlation of weekly firm-level stock returns and local market returns.¹⁵ We then construct each firm's alpha in a given year as the annual average of the firm's weekly average return minus the beta multiplied by the annual average market return. We use the one-year-lagged beta and alpha in constructing the abnormal return around a given intervention date.¹⁶ The abnormal return has a median of 0.01 percent, a mean of -0.15 percent, and a standard deviation of 4.92 percent.

Overall, the results for abnormal returns in column 2 are comparable to those for raw returns in column 1. Liquidity need has a positive coefficient of 0.072, significantly different from zero at the 10 percent level. Based on this estimated coefficient, on the intervention date, firms in sectors with liquidity need at the 90 percent level (such as Special Industry Machinery, with a liquidity need value of 5.02) will see a 0.1 percent higher stock return than firms in sectors with liquidity need at the 10 percent level (such as Beverages, with a liquidity need value of 3.84).

In column 3, we add demand sensitivity, firm size, and the book-to-market ratio. These three control variables are not significant here. Reassuringly, the coefficient on liquidity need remains significant at the 5 percent level.

In column 4, we include a proxy for firm-level financial constraint (i.e., leverage as measured by total debt over total assets at the year 2007). Nonfinancial firms with a higher precrisis leverage ratio may have more difficulty in rolling over their debt during a crisis. In addition, a higher leverage ratio may by itself trigger a larger decline in stock price for a given demand shock. However, to the extent that unintentional intervention increases the inflation expectation, the reduction in the real interest rate might benefit firms that normally rely more on debt financing (see Krishnamurthy and Vissing-Jorgensen 2011). Moreover, leverage might be higher for firms with good fundamentals, as these firms could have a higher probability of obtaining a loan approval from banks, which then affects the validity of leverage as a proxy for financial constraint. In any case, we include leverage as a control variable. To reduce the impact of endogeneity, we use the leverage measured at the end of year 2007, which is predetermined to government interventions in our sample. In column 4, we find that the leverage ratio has an insignificant albeit positive

¹⁵We use the domestic beta rather than a beta based on a world factor model. Griffin (2002) finds that domestic factor models perform better in explaining time-series variations in returns and have lower pricing errors than the world factor model. One could also use multifactor models to construct abnormal returns. But "gains from employing multifactor models for event studies are limited. The reason for the limited gains is the empirical fact that the marginal explanatory power of additional factors over the market factor is small, and hence, there is little reduction in the variance of the abnormal return" (MacKinlay 1997, 18).

¹⁶As the alpha is constructed from weekly stock data, we use $(1/5) \times \text{alpha}$ in constructing the abnormal stock return from day $t - 1$ to t .

coefficient. Important for the central question of this paper, the coefficient on liquidity need remains positive and significant at the 5 percent level.¹⁷

Some firms may also raise funding from the credit markets without obtaining funding from banks. On the one hand, as those firms do not borrow directly from the sample, the existence of those firms will likely bias the estimated coefficient for liquidity need toward zero. But on the other hand, the more availability of bank funding will likely bring better terms for these firms through the competition between banks and credit markets. The overall effect is less clear. In column 5, we hence drop firms that ever issued a bond from years 2008 to 2011. Based on the bond issuance data from Dealogic, around 5 percent of firms in the sample issued at least one bond over this period. For the subsample of firms without bond issuance, the coefficient of liquidity need increases from 0.072 to 0.096 (see column 5 of Table 3).

B. The Impact of the Banking Sector Stock Return

Our underlying hypothesis so far is that the intervention announcements potentially improve the stability and balance sheet of the banking system and hence allow or encourage banks to provide more liquidity. If the hypothesized banking channel holds, then the relaxation of the credit crunch experienced by nonfinancial firms should be more pronounced after a government intervention when the intervention is viewed to improve the financial health of the banking system. In other words, when the banking system experiences a higher abnormal return around the intervention announcements, sectors with higher liquidity need are more likely to experience a higher abnormal return as well.

To see if the data are consistent with this channel, we take the following steps. First, we run a market model of the daily bank-sector stock return onto the market return for each country-year separately from 2006 to 2010, and construct abnormal returns for the bank sector on the intervention days. Second, we interact the abnormal bank return with liquidity need and use it as an explanatory variable for the abnormal stock return of nonfinancial firms.

One needs to be careful about the interpretation of the coefficient on the interaction term. If interventions in financial sectors alleviate liquidity constraint faced by nonfinancial firms by first making the banks healthier and more willing to lend, one should expect to see that the firms would do especially well when the banks are also doing better. In this sense, a positive and significant coefficient on the interaction term is consistent with this interpretation. But we are not able to prove that the chain of causality has to go from government interventions to better bank health to less liquidity constraints on nonfinancial firms. If nonfinancial firms do better, for whatever reason, banks benefit indirectly since nonfinancial firms are the ultimate source of bank profits. This is a test

¹⁷Up to now, stock returns have been measured at the daily frequency between $t - 1$ and t , where t is the announcement date (adjusted according to the exact time of announcement). As a robustness check, we further analyze the abnormal stock return between $t - 1$ and $t + 1$. We find a slightly larger effect for liquidity need (0.08) than that in column 4 (0.072), but with a larger standard error of 0.06 as well. The larger effect of longer horizon suggests that the market may need time to digest the contents of interventions while the larger standard error is probably due to the additional noise introduced at time $t + 1$.

TABLE 4—IS THERE A BANKING CHANNEL FOR ALLEVIATION OF A CREDIT CRUNCH?

	No sector effects (1)	With sector effects (2)	Firm-level liquidity need (3)	Financing needs for investment (4)	Developed countries only (5)
Bank abnormal return \times liquidity need	0.054 [0.018]	0.052 [0.018]	0.016 [0.0084]		0.057 [0.019]
Liquidity need	0.036 [0.048]				
Bank abnormal return \times external financing needs for CapEx				0.024 [0.011]	
Firm size	0.0042 [0.0095]	0.0031 [0.010]	0.0082 [0.0099]	0.0030 [0.010]	0.0075 [0.011]
Sector fixed effects	No	Yes	Yes	Yes	Yes
Intervention fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	95,792	95,792	84,690	95,762	89,448
R^2	0.057	0.059	0.063	0.059	0.049

Notes: The dependent variable is the abnormal stock returns of nonfinancial firms between the announcement day (t) and the previous trading day ($t - 1$). Liquidity need denotes intrinsic liquidity need for working capital, measured at either the three-digit sector level (columns 1, 2, and 5) or the firm level (column 3). Firm-level liquidity need is the log of the median firm-level cash conversion cycle from 2000 to 2006. External financing needs for capital expenditure follows Rajan and Zingales (1998). Robust standard errors are in brackets. Standard errors are clustered at the country-date-sector level.

for a necessary but not sufficient condition for the bank channel. One suggestive piece of evidence in favor of our interpretation is that when the interventions are targeting banks, such as bank recapitalization, we find that sectors with a larger liquidity need for working capital perform better than other sectors with a smaller liquidity need. In Section IIIC, we will further expand the sample to include nonintervention dates and instrument bank return with an intervention dummy.

The regression results are presented in Table 4, with the abnormal stock returns of nonfinancial firms as the dependent variable. In column 1, we include the interaction term between bank sector abnormal returns and liquidity need. Bank sector abnormal returns itself is excluded as it is fully captured by intervention fixed effects. We find that the interaction term does have a positive coefficient, which is significant at the 1 percent level.

In column 2, we further include three-digit sector fixed effects to control for omitted factors at the sector level. Liquidity need is now excluded as it is fully captured by sector fixed effects. Reassuringly, the interaction of bank return and liquidity need remains significant at the 1 percent level.

We can gauge the economic magnitudes of the intervention. The sector at the ninetieth percentile of liquidity need is Special Industry Machinery (with a liquidity need value of 5.02), while the sector at the tenth percentile is Beverages (with a liquidity need value of 3.84). The ninetieth percentile of bank abnormal return is for the US intervention on October 21, 2008 (with a bank abnormal return of 4.57 percent), while the tenth percentile is for the German intervention on December 17, 2009 (with a bank abnormal return of -2 percent). Based on column 2 of Table 4

(with a coefficient of 0.052 for the interaction of liquidity need with bank abnormal return), the stock return of Special Industry Machinery should be 0.36 percent higher than that of Beverages in the United States (10/21/08) as compared to in Germany (12/17/09). The difference is not trivial compared to the median stock return of firms (0.01 percent).

In column 3, we include a measure of firm-level liquidity need, which is the log of the median firm-level cash conversion cycle from 2000 to 2006. We add its interaction with the bank abnormal return. The interaction term has a coefficient of 0.016, significantly different from zero at the 10 percent level.

In column 4, we include the interaction of sector-level external financing needs for capital expenditure with bank abnormal returns. We find the coefficient to be significantly positive at the 5 percent level. This suggests that the interventions also boost firm stock prices through the investment channel.

The country list of the sample includes sixteen countries: Canada, France, Germany, Greece, India, Indonesia, Italy, Japan, Singapore, South Korea, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States. As a robustness check, we perform the same exercise in column 2 of Table 4 but focus on developed economies only, which drops the sample size by 6 percent.¹⁸ The results are reported in column 5. There the coefficient of liquidity need interacted with bank return increases from 0.052 in column 2 to 0.057, and is significantly different from zero at the 1 percent level.

C. Instrumented Bank Returns

So far, we have looked at the stock market responses at the intervention date. We now expand the sample in column 5 of Table 3 to include four trading days before each intervention, which provides both cross-time and cross-intervention coverage and allows us to perform difference-in-difference analyses.¹⁹ The sample size is now expanded to 390,048.

The results with the expanded sample are reported in column 1 of Table 5. The interaction of liquidity need and bank abnormal return has a coefficient of 0.036, which is smaller than that for the sample of only intervention dates (0.057). But it remains significantly different from zero at the 1 percent level.

By including preintervention trading dates, we can further instrument bank abnormal returns by using the intervention dummy. In the first stage, we run a country-date-level regression of bank abnormal return onto the intervention dummy for the sample of intervention events and four trading days before each intervention event. (We find similar results if we include additional preintervention trading dates, such as five, six, or seven trading days.) The first-stage results are reported in Table 6, with the inclusion of country-year pair fixed effects. The intervention dummy has a coefficient of 0.53, significantly different from zero at the 5 percent

¹⁸ Per the classification of the United Nations, we drop India, Indonesia, Singapore, South Korea, and Turkey from the sample.

¹⁹ If a nonintervention date is one trading day after a previous intervention date, then it is excluded from the expanded sample.

TABLE 5—IS THERE A BANKING CHANNEL FOR ALLEVIATION OF A CREDIT CRUNCH?—
ADDING NONINTERVENTION DATES

	No-IV (1)	IV (2)
Bank abnormal return \times liquidity need	0.036 [0.0100]	
Instrumented bank abnormal return \times liquidity need		0.070 [0.040]
Sector fixed effects	Yes	Yes
Country-day fixed effects	Yes	Yes
Observations	390,048	390,048
R^2	0.058	0.058

Notes: The dependent variable is the daily abnormal stock returns of nonfinancial firms, covering the intervention day as well as four trading days before each intervention. Liquidity need denotes intrinsic liquidity need for working capital at the three-digit sector level. Robust standard errors are in brackets. Standard errors are clustered at the country-date-sector level.

TABLE 6—FIRST-STAGE ESTIMATION OF BANK SECTOR RETURN

	(1)
Intervention dummy	0.53 [0.22]
Country-year fixed effects	Yes
Observations	868
R^2	0.046

Notes: The dependent variable is the daily abnormal stock return of the banking sector in a country, covering the intervention day as well as four trading days before each intervention in that country. Standard errors are in brackets.

level. The estimated coefficient suggests that on average, the bank stock return at the intervention dates is 53 basis points higher than that at nonintervention dates.

In the second stage estimation for firm-level stock return, we then include liquidity need interacted with the predicted bank return from the first stage. The results are reported in column 2 of Table 5. The interaction term has a coefficient of 0.07, significantly different from zero at the 10 percent level. This point estimate is higher than that for the interaction term between the raw (un-instrumented) bank return with the measure of liquidity need (column 1 of Table 5), but the two estimates are not statistically different from each other.²⁰

We gauge the economic magnitudes of the interventions using a “relative-relative” approach. That is, we pick two sectors known to have a stronger and weaker intrinsic

²⁰Whether the OLS estimate is biased downward or upward depends on the relative importance of various sources of endogeneity. In particular, an OLS estimate could be biased downward if the measurement error in the explanatory variable of bank returns is sufficiently important. While we would want bank returns on intervention days to reflect only the effects of interventions on banks, other unobserved shocks could add noise to the bank returns. Such unobserved shocks may be especially large during a crisis period, making it difficult to accurately measure the effects of interventions on bank returns. By reducing the measurement errors, the IV estimation generates a larger estimate for the bank returns.

need for liquidity as well as two interventions estimated to have a relatively big and small effect on the banking sector stock prices, and do a double-difference comparison. The sector at the ninetieth percentile of liquidity need is Special Industry Machinery (with a liquidity value of 5.02), while the sector at the tenth percentile is Beverages (with a liquidity value of 3.84). The country-date at the ninetieth percentile of instrumented bank abnormal return is the United States on December 19, 2008 (with a value of 0.75), while the tenth percentile is Italy on January 12, 2009 (with a value of -0.60). Based on column 2 of Table 5 (with a coefficient of 0.07 for the interaction of liquidity need with bank return), the stock return of Special Industry Machinery should be 0.11 percent higher than that of Beverages in the United States (12/19/08) as compared to in Italy (1/12/09). The difference is not trivial compared to the median abnormal stock return of firms (0.01 percent).

D. Different Types of Interventions

As another extension, we examine the effects of interventions by type. We group them into the following five types: deposit insurance, debt guarantees, recapitalization, asset purchases, and central bank liquidity support. The disaggregated approach allows for the possibility that some types are more effective than others in alleviating the liquidity constraints faced by nonfinancial firms.²¹ The empirical evidence is still limited on the relative effectiveness of different intervention types. Ait-Sahalia et al. (2012) compare market recapitalization and liquidity support, and find that market recapitalization has more impact than central bank liquidity support in reducing the LIBOR-OIS spread. But there have been no studies yet on how different intervention types affect the liquidity constraints of nonfinancial firms.

To reduce the compounding (or contaminating) effects of other types of interventions, we choose to work on a reduced subsample consisting of dates when only one type of intervention is announced.²² Our results are reported in Table 7. Column 1 uses the instrumented bank return from Table 6, while column 2 uses the un-instrumented bank return for a robustness check.

In the first column, we include the interaction of intervention type, liquidity need, and instrumented bank abnormal return. Interestingly, the interaction between liquidity need and instrumented bank abnormal return is significantly positive at the 1 percent level only for recapitalization. All the other four types have positive but smaller and insignificant coefficients. This finding is consistent with the theoretical predictions of Philippon and Schnabl (2013). They argue that recapitalization would be more effective than debt guarantees and asset purchases in alleviating liquidity constraint due to the private information problem in asset quality (the “lemons problem”) combined with the debt-overhang problem.

²¹ As discussed earlier, there have been some theoretical debates on the effectiveness of different interventions in alleviating financial constraint, as different interventions address different components of the bank sector’s balance sheet and have different implications on the cost to the central bank and the government.

²² Hence, we have fewer observations as we drop dates with multiple types of interventions.

TABLE 7—DIFFERENTIAL EFFECTS ON FIRM STOCK RETURN BY INTERVENTION TYPES

	Instrumented bank return (1)	Un-instrumented bank return (2)
Bank abnormal return × liquidity need × recapitalization	0.52 [0.19]	0.11 [0.052]
Bank abnormal return × liquidity need × debt guarantee	0.42 [0.26]	0.0025 [0.031]
Bank abnormal return × liquidity need × asset purchase	0.091 [0.19]	0.078 [0.055]
Bank abnormal return × liquidity need × deposit insurance	0.48 [0.61]	0.078 [0.12]
Bank abnormal return × liquidity need × liquidity support	0.088 [0.14]	0.011 [0.040]
Sector fixed effects	Yes	Yes
Intervention fixed effects	Yes	Yes
Observations	72,748	72,748
R^2	0.057	0.057

Notes: The dependent variable is the abnormal stock returns of nonfinancial firms between the announcement day (t) and the previous trading day ($t - 1$). Liquidity need denotes intrinsic liquidity need for working capital at the three-digit sector level. Robust standard errors are in brackets. Standard errors are clustered at the country-date-sector level.

In column 2, we use the un-instrumented bank stock return, and include its interaction with dummies for types of interventions and liquidity need. Again, only the interaction term with bank recapitalization is significant at the 5 percent level.

We can assess the economic magnitudes of the interventions by type using a “relative-relative” approach. We take bank recapitalization as an example and compare the relatively unsuccessful Italy intervention on February 20, 2009 (which generated an increase in the instrumented bank abnormal return of 0.36 percent and put it at the tenth percentile on the distribution of abnormal bank returns during recapitalization), with the relatively more successful UK recapitalization announced on February 23, 2009 (which generated a bigger return of 0.88 percent and placed it at the ninetieth percentile of instrumented bank abnormal return during recapitalization). The sector at the ninetieth percentile of the distribution for liquidity need is Special Industry Machinery (with a value of 5.02), while the sector at the tenth percentile is Beverages (with a value of 3.84). Based on column 1 of Table 7 (with a coefficient of 0.52 for recapitalization), the stock return of Special Industry Machinery has been made higher by 0.34 percent than that of Beverages by the more successful UK intervention (February 23, 2009) relative to the less successful one in Italy (February 20, 2009). The difference is not trivial compared to the median abnormal stock return of the firms (0.01 percent).

E. Effects on Real Activities

How do the real activities of the firms change subsequent to the interventions? We assemble the relevant data from the listed firms’ financial statements from 2007

TABLE 8—THE IMPACTS OF INTERVENTIONS ON FIRM REAL ACTIVITIES

	Capital expenditure (1)	R&D (2)	Employment (3)	Capital expenditure (4)	R&D (5)	Employment (6)
Bank abnormal return	0.36	0.29	0.22			
× liquidity need	[0.21]	[0.17]	[0.12]			
Instrumented bank return				2.78	1.11	1.15
× liquidity need				[0.57]	[0.61]	[0.31]
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,730	2,960	4,309	5,730	2,960	4,309
R ²	0.08	0.13	0.11	0.09	0.13	0.11

Notes: The dependent variables in columns 1, 2, and 3 are the log changes ($\times 100$) of firm-level capital expenditure, R&D, and employee number from 2007 to 2012, respectively. “Liquidity need” denotes intrinsic liquidity need for working capital at the three-digit sector level. Standard errors are in brackets, clustered at the country-sector level.

to 2012. It is important to keep in mind some caveats. While most variables are only available at an annual frequency, more than one intervention event can happen in a given year. This makes it difficult to address the simultaneity issues and identify differential effects of the interventions in a clean way.

We modify the specifications in Table 3. First, on the right-hand side, we replace the contemporaneous abnormal bank returns with the abnormal bank returns accumulated over the intervention dates in the sample from 2008 to 2010, which is then interacted with a measure of intrinsic liquidity need at the sector level. On the left-hand side, we examine a range of firm-level real activities including capital expenditure, R&D, and employment.²³ We control for separate country and sector fixed effects.

The results are reported in Table 8. In countries with a bigger rise in the stock prices of the banks on the intervention dates, liquidity-constrained firms experience a greater increase in capital expenditure than other firms from 2007 to 2012 (column 1). These firms also exhibit a greater expansion in research and development (column 2), as well as in employment (column 3). These patterns are consistent with the view that firm-level real activities benefit from those interventions that are judged to be effective in saving the banks.

In columns 4 to 6, we repeat the same exercise but use an instrumented version of the returns on bank stocks. In countries that had an effective intervention by our methodology, firms that are liquidity constrained show significantly greater increases in capital expenditure, R&D, and employment. We infer from these results that the data patterns on the real variables validate the interpretations based on firm stock returns.²⁴

²³To reduce the influence of the outliers, in the analysis of R&D, the sample requires the firm’s R&D expenditure to be at least 1,000 in local currency unit in 2007. In the analysis of employment, the sample requires the listed firm to have at least 100 employees in 2007.

²⁴We also explore other real variables, such as inventory, cash holdings, and accounts payable with specifications similar to Table 8. We find that in countries with a larger rise in the stock prices of banks on the intervention dates, liquidity-constrained firms experience significantly larger increases in inventory and cash holdings than other firms from 2007 to 2012. The effect on accounts payable is not statistically significant.

We use the estimates in the last three columns to gauge the economic significance of the estimation. The results are best interpreted in a “relative-relative” manner—pick two sectors with a relatively strong and weak liquidity need, respectively, and two interventions with a relatively strong and weak effect on the banking sector, respectively, and do a double-difference comparison. The sector at the ninetyeth percentile of liquidity need is Special Industry Machinery (with a value for liquidity need at 5.02), while the sector at the tenth percentile is Beverages (with a value for liquidity need at 3.84). The relatively successful intervention that produces a rise in the instrumented abnormal bank returns at the ninetyeth percentile is the United States (with a value of 9.6 percent), while a relatively less successful intervention that produces an abnormal banking sector return at the tenth percentile is Indonesia (with a value of 0.17 percent). Based on column 4 of Table 8 (with a coefficient of 2.78 for the interaction of liquidity need with bank returns), the capital expenditure of Special Industry Machinery became higher by 31 percent ($= 2.78 \times (5.02 - 3.84) \times (9.6 - 0.17)$) than that of Beverages by the relatively successful interventions in the United States relative to the less successful interventions in Indonesia.

Similarly, based on column 5 of Table 8, the R&D by liquidity-constrained firms became higher by 12 percent by the more successful interventions in the United States relative to the less successful ones in Indonesia. The employment of the liquidity-constrained firms also expanded 13 percent more than that of Beverages by the more successful interventions in the United States relative to the less successful ones in Indonesia. All these estimates are economically significant when compared to the median changes of these variables in the sample.²⁵

In Table 7, we find that bank recapitalization programs appear to be the single most effective type of interventions, whereas other types of interventions do not produce a statistically different result. Motivated by that finding, we now investigate whether the real effects reported in Table 8 are primarily driven by countries that have undertaken intensive bank recapitalization during the sample period. To do this, we first calculate the number of recapitalizations as a fraction of the total number of interventions in each country.²⁶ We find that France, Greece, India, and Italy are the countries for which at least half of all the interventions are bank recapitalizations. We define an intensive recapitalization dummy that takes a value of one for these countries and zero otherwise. We then add a new regressor, which is an interaction term among this intensive recapitalization dummy, realized bank return, and liquidity need.

The results are reported in Table 9. In columns 1 to 3, we examine the effects of interventions on capital expenditure, R&D, and employment, respectively. Across the three columns, the new interaction term is significant at least at the 5 percent level, suggesting that the real effects are indeed larger in countries with intensive bank recapitalization programs. In columns 4 to 6, we repeat the same exercise but

²⁵The median change from 2007 to 2012 is -2.85 percent for capital expenditure, 10.2 percent for R&D, and 4.61 percent for employee number.

²⁶As in Table 7, we calculate the fraction based on a reduced subsample consisting of dates when only one type of intervention is announced.

TABLE 9—THE IMPACTS OF INTERVENTIONS ON FIRM REAL ACTIVITIES: THE ROLE OF BANK RECAPITALIZATION

	Capital expenditure (1)	R&D (2)	Employment (3)	Capital expenditure (4)	R&D (5)	Employment (6)
Bank abnormal return	0.29	0.24	0.17			
× liquidity need	[0.21]	[0.18]	[0.13]			
Bank abnormal return × liquidity need × intensive recapitalization	2.12 [0.83]	3.40 [0.89]	1.32 [0.39]			
Instrumented bank return				2.59	0.99	1.07
× liquidity need				[0.58]	[0.61]	[0.31]
Instrumented bank return × liquidity need × intensive recapitalization				3.43 [1.35]	3.41 [1.25]	2.13 [0.99]
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,730	2,960	4,309	5,730	2,960	4,309
R ²	0.08	0.13	0.11	0.09	0.13	0.11

Notes: The dependent variables in columns 1, 2, and 3, are the log changes ($\times 100$) of firm-level capital expenditure, R&D, and employee number from year 2007 to 2012, respectively. “Liquidity need” denotes intrinsic liquidity need for working capital at the three-digit sector level. Standard errors are in brackets, clustered at the country-sector level.

with instrumented bank returns. In this case, the new interaction term is again significant at the 5 percent level. Table 9 thus reinforces the earlier finding in Table 7 that recapitalization is particularly effective in alleviating liquidity constraint for nonfinancial firms.

IV. Conclusions

When the credit market froze during the 2008–2010 global financial crisis, many country authorities responded to a lower bound on the interest rate by undertaking a set of unconventional interventions, including deposit insurance, debt guarantees, bank recapitalization, purchase of bank toxic assets, and central bank liquidity support. This paper pursues a systematic investigation of whether and how these unconventional interventions achieved their intended policy objective of unfreezing the credit market.

We constructed a comprehensive dataset of 198 interventions for 16 countries from January 2008 to July 2010. We examine stock price responses to the announcement of the interventions for 7,873 publicly listed nonfinancial firms in countries around the world.

A key for injecting financial liquidity to a system is to help improve the financial health of the banking sector. We judge the relative success of an intervention program by the cumulative changes in the prices of the bank stocks.

We find that the stock prices of nonfinancial firms increased, on average, when the interventions were implemented, especially for firms in sectors with a large intrinsic liquidity need for working capital. Furthermore, these results become more pronounced if the banking sector exhibits a strong appreciation of the stock prices on the intervention date. Finally, consistent with some recent theories, we find that bank recapitalization appears particularly effective in transmitting credit relief to nonfinancial sectors.

The inferences based on stock price reactions are further validated by examining the trajectories of the real variables subsequent to the interventions. From 2007 to 2012, in countries that are judged to have a more successful intervention program by our bank stock return yardstick, liquidity-constrained firms also experience a stronger expansion of real activities, especially in employee number, capital expenditure, and R&D activities.

These findings suggest a number of other important topics for future research. While the paper finds evidence of a spillover effect, from bank bailouts to nonfinancial firms, it is only a building block to a comprehensive assessment of the net welfare effect of the interventions. To do that, we will need to evaluate not only the positive effects of the interventions on firms, but also the costs of the interventions, such as their effects on households and governments through higher tax burdens. This will be a fruitful topic for additional research.

APPENDIX

TABLE A1—NUMBER OF NONFINANCIAL FIRMS BY COUNTRY

Country	Number of firms
Canada	554
France	235
Germany	288
Greece	129
India	558
Indonesia	104
Italy	116
Japan	1,979
Singapore	280
South Korea	691
Spain	51
Sweden	173
Switzerland	109
Turkey	136
United Kingdom	587
United States	1,883
Total	7,873

REFERENCES

- Agence France-Presse.** 2008. "France's New 20-billion-euro Investment Fund." November 20, 2008.
- Ait-Sahalia, Yacine, Jochen Andritzky, Andreas Jobst, Sylwia Nowak, and Natalia Tamirisa.** 2012. "How to Stop a Herd of Running Bears? Market Response to Policy Initiatives during the Global Financial Crisis." *Journal of International Economics* 87 (1): 162–77.
- Allen, Linda, Suparna Chakraborty, and Wako Watanabe.** 2011. "Foreign Direct Investment and Regulatory Remedies for Banking Crises: Lessons from Japan." *Journal of International Business Studies* 42 (7): 875–93.
- Bebchuk, Lucian A., and Itay Goldstein.** 2011. "Self-fulfilling Credit Market Freezes." *Review of Financial Studies* 24 (11): 3519–55.
- Chava, Sudheer, and Amiyatosh Purnanandam.** 2011. "The Effect of Banking Crisis on Bank-Dependent Borrowers." *Journal of Financial Economics* 99 (1): 116–35.
- Christensen, Jens H.E., Jose A. Lopez, and Glenn D. Rudebusch.** 2014. "Do Central Bank Liquidity Facilities Affect Interbank Lending Rates?" *Journal of Business and Economic Statistics* 32 (1): 136–51.

- Diamond, Douglas W.** 2001. "Should Banks Be Recapitalized?" *Federal Reserve Bank of Richmond Economic Quarterly* 87 (4): 71–96.
- Diamond, Douglas W., and Raghuram G. Rajan.** 2000. "A Theory of Bank Capital." *Journal of Finance* 55 (6): 2431–65.
- Drechsler, Itamar, Thomas Drechsel, David Marques-Ibanez, and Philipp Schnabl.** 2016. "Who Borrows from the Lender of Last Resort?" *Journal of Finance* 71 (5): 1933–74.
- Duchin, Ran, Oguzhan Ozbas, and Berk A. Sensoy.** 2010. "Costly External Finance, Corporate Investment, and the Subprime Mortgage Credit Crisis." *Journal of Financial Economics* 97 (3): 418–35.
- Duchin, Ran, and Denis Sosyura.** 2014. "Safer Ratios, Riskier Portfolios: Banks' Response to Government Aid." *Journal of Financial Economics* 113 (1): 1–28.
- Economic Journal.** 2012. "Feature: Unconventional Monetary Policy After the Financial Crisis." *Economic Journal* 122 (564): F271–F486.
- Fama, Eugene F., and Kenneth R. French.** 1992. "The Cross-Section of Expected Stock Returns." *Journal of Finance* 47 (2): 427–65.
- Gagnon, Joseph, Matthew Raskin, Julie Remache, and Brian Sack.** 2010. *Large-Scale Asset Purchases by the Federal Reserve: Did They Work?* New York: Federal Reserve Bank of New York.
- Gertler, Mark, and Peter Karadi.** 2011. "A Model of Unconventional Monetary Policy." *Journal of Monetary Economics* 58 (1): 17–34.
- Gertler, Mark, and Nobuhiro Kiyotaki.** 2010. "Chapter 11—Financial Intermediation and Credit Policy in Business Cycle Analysis." In *Handbook of Monetary Economics*, Vol. 3, edited by Benjamin Friedman and Michael Woodford, 547–99. Amsterdam: North-Holland.
- Giannetti, Mariassunta, and Andrei Simonov.** 2013. "On the Real Effects of Bank Bailouts: Micro Evidence from Japan." *American Economic Journal: Macroeconomics* 5 (1): 135–67.
- Gilchrist, Simon, and Egon Zakrajšek.** 2013. "The Impact of the Federal Reserve's Large-Scale Asset Purchase Programs on Corporate Credit Risk." *Journal of Money, Credit and Banking* 45 (S2): 29–57.
- Gorton, Gary, and Lixin Huang.** 2004. "Liquidity, Efficiency, and Bank Bailouts." *American Economic Review* 94 (3): 455–83.
- Griffin, John M.** 2002. "Are the Fama and French Factors Global or Country-Specific?" *Review of Financial Studies* 15 (3): 783–803.
- Griffin, John M., and Michael L. Lemmon.** 2002. "Book-to-Market Equity, Distress Risk, and Stock Returns." *Journal of Finance* 57 (5): 2317–36.
- Hattori, Masazumi, Andreas Schrimpf, and Vladyslav Sushko.** 2016. "The Response of Tail Risk Perceptions to Unconventional Monetary Policy." *American Economic Journal: Macroeconomics* 8 (2): 111–36.
- IMF.** 2009. *Market Interventions During the Financial Crisis: How Effective and How to Disengage.* Washington, DC: IMF.
- King, Michael R.** 2009. "Time to Buy or Just Buying Time? The Market Reaction to Bank Rescue Packages." Bank for International Settlements (BIS) Working Paper 288.
- Krishnamurthy, Arvind, and Annette Vissing-Jorgensen.** 2011. "The Effects of Quantitative Easing on Interest Rates: Channels and Implications for Policy." *Brookings Papers on Economic Activity* 41 (2): 215–87.
- Kroszner, Randall S., Luc Laeven, and Daniela Klingebiel.** 2007. "Banking Crises, Financial Dependence, and Growth." *Journal of Financial Economics* 84 (1): 187–228.
- Laeven, Luc, and Fabián Valencia.** 2013. "The Real Effects of Financial Sector Interventions During Crises." *Journal of Money, Credit, and Banking* 45 (1): 147–77.
- MacKinlay, A. Craig.** 1997. "Event Studies in Economics and Finance." *Journal of Economic Literature* 35 (1): 13–39.
- Mariathasan, Mike, and Ouarda Merrouche.** 2012. "Recapitalization, Credit and Liquidity." *Economic Policy* 27 (72): 603–46.
- Neely, Christopher J.** 2010. "The Large Scale Asset Purchases Had Large International Effects." Federal Reserve Bank of St. Louis Working Paper 2010-018.
- Paravisini, Daniel.** 2010. "Local Bank Financial Constraints and Firm Access to External Finance." *Journal of Finance* 63 (5): 2161–93.
- Pástor, Lubos, and Pietro Veronesi.** 2012. "Uncertainty about Government Policy and Stock Prices." *Journal of Finance* 64 (4): 1219–64.
- Philippon, Thomas, and Philipp Schnabl.** 2013. "Efficient Recapitalization." *Journal of Finance* 68 (1): 1–42.
- Philippon, Thomas, and Vasiliki Skreta.** 2012. "Optimal Interventions in Markets with Adverse Selection." *American Economic Review* 102 (1): 1–28.

- Raddatz, Claudio.** 2006. "Liquidity Needs and Vulnerability to Financial Underdevelopment." *Journal of Financial Economics* 80 (3): 677–722.
- Rajan, Raghuram G., and Luigi Zingales.** 1998. "Financial Dependence and Growth." *American Economic Review* 88 (3): 559–86.
- Taylor, John B., and John C. Williams.** 2009. "A Black Swan in the Money Market." *American Economic Journal: Macroeconomics* 1 (1): 58–83.
- Tong, Hui, and Shang-Jin Wei.** 2011. "The Composition Matters: Capital Flows and Liquidity Crunch During a Global Economic Crisis." *Review of Financial Studies* 24 (6): 2023–52.
- Tirole, Jean.** 2012. "Overcoming Adverse Selection: How Public Intervention Can Restore Market Functioning." *American Economic Review* 102 (1): 25–59.
- Veronesi, Pietro, and Luigi Zingales.** 2010. "Paulson's Gift." *Journal of Financial Economics* 97 (3): 339–68.
- Whited, Toni M., and Guojun Wu.** 2006. "Financial Constraints Risk." *Review of Financial Studies* 19 (2): 531–59.
- Wu, Tao.** 2011. "The U.S. Money Market and the Term Auction Facility in the Financial Crisis of 2007–2009." *Review of Economics and Statistics* 93 (2): 617–31.