The impact of monetary policy on financial markets in small open economies: More or less effective during the global financial crisis?

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\textbf{Abstract}

This paper estimates the impact of monetary policy on exchange rates and stock prices of eight small open economies: Australia, Canada, the Republic of Korea, New Zealand, the United Kingdom, Indonesia, Malaysia, and Thailand. On average across these countries in the full sample, a one percentage point surprise rise in official interest rates leads to a 1\% appreciation of the exchange rate and a 0.5-1\% fall in stock prices, with somewhat stronger effects in OECD countries than non-OECD countries (though differences are sometimes not significant). We find little robust evidence of a change in the effect of monetary policy surprises during the recent financial crisis.

\textbf{Keywords}

Monetary policy effectiveness; Exchange rates; Stock prices; Crisis; Asian economies

\textbf{JEL classification}

E4; E5; G1

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An online appendix is available at \url{https://sites.google.com/site/stevenpennings/PRT_Final_OnlineAppendix.pdf}
1. Introduction

How monetary policy affects the economy is of key interest to policymakers and academics during normal times, and even more so during times of crisis. There is a growing theoretical literature which argues that the response of the economy to shocks varies greatly whether the economy is in a normal regime near the steady state, or far away from the steady state in a financial crisis (Brunnermeir and Sannikov 2014, Mendoza 2010). In these models, financial constraints do not bind in normal times. But when a crisis hits, dynamics are governed by binding debt constraints such that a fall in asset prices forces agents to sell assets to reduce borrowing, which further reduces asset prices (the “financial accelerator”). Brunnermeir and Pederson (2008) present a similar mechanism in a financial market context with forced sales during times of crisis (“liquidity spirals”).

Motivated by this literature, we test whether the effect of monetary policy shocks on financial markets (exchange rates and stock prices) might differ during the recent financial crisis. To generate a large enough sample of monetary policy shocks during the crisis we (i) focus on transmission to financial variables (which respond almost immediately)—rather than on transmission to real variables which have “long and variable lags”, and (ii) widen the sample to eight countries (Australia, Canada, New Zealand (NZ), the United Kingdom (UK), the Republic of Korea (Korea), Indonesia, Malaysia and Thailand).

We follow an event study approach which uses a short window around a monetary policy announcement to isolate causality from monetary policy surprises to financial variables. In general, the policy rate responds to the same economic data and financial conditions as other financial variables, leading to a simultaneity problem. However, if policymakers do not respond to new information on the day of the policy announcement, then the change in the policy rate on that day is relatively exogenous to movements in financial variables on the same day. As implied by theory, anticipated changes in the policy rate have no impact on financial variables, and so we focus on monetary policy surprises, identified by the change in 1-month market interbank interest rate in each country on the day of the announcement. Though the event study methodology is fairly standard, the financial crisis application is relatively novel, especially for our selection of countries. To our knowledge, we are one of the first to attempt to estimate the effect of domestic monetary policy shocks on financial markets in this sample of non-OECD Asian countries.

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1 There is some evidence that the effects of macroeconomic news on US stock prices varies with the business cycle (McQueen and Roley 1993).
2 Interbank loans, bank bills and bankers' acceptances are traded in many more countries than futures or other derivatives commonly used to identify monetary policy surprises. In using these instruments, this paper is able to examine the effect of monetary policy in countries that have been overlooked by the literature. A concern is that interbank-overnight index swap (OIS) spreads were elevated during the crisis evidence that rate cuts reduced these spreads (Ait-Sahalia et al. 2012). Online Appendix B investigates this issue and finds similar estimates (on a common sample) using either the change in OIS rates or the change in interbank rates as the monetary policy surprise measure.
3 For the US, Bernanke and Kuttner (2005) find a large effect of monetary surprises on stock prices using an event study approach, and Rigobon and Sack (2003) argue that monetary policy also responds to US stock prices (though over a longer period). Outside the US, there are relatively few papers estimating the effect of domestic monetary policy shocks on stock markets for the countries we consider, though Zettelmeyer (2004) and Kearns and Manners (2005) estimate the effect of monetary surprises on exchange rates for a subset of countries in our sample.
4 There is a literature on the effect of monetary policy interventions during the crisis, though it mainly focuses on large countries outside our sample (like the US) and/or unconventional measures (Ait-Sahalia et al. 2012, Needy 2013, Gagnon et al 2010, Joyce et al 2011, Abassi and Linzert 2012). Because few of the countries in our sample were involved in quantitative easing (with the UK being a notable exception), we focus on conventional monetary policy.
In general, we expect an unanticipated rate hike to (i) appreciate the exchange rate via uncovered interest parity and (ii) lead to a fall in stock prices by reducing expected future dividends, increasing the risk-free rate or raising equity risk premia (Bernanke and Kuttner 2005). For the full sample, this is what we find: a one percentage point surprise rise in official interest rates leads to around a 1% appreciation of the exchange rate and a 0.5-1% fall in stock prices (on average). We also expect possibly larger effects in OECD countries than non-OECD countries, with the former tending to have more liquid financial markets and a more developed monetary policy regime. There is some evidence that monetary policy shock have a larger effect in OECD countries, though this is not robust across specifications.

To estimate the differential effects of the crisis we split the sample into “crisis” and “non-crisis” periods and estimate the effect of monetary surprises separately during those two regimes. As the definition of the “crisis period” is open to debate, we use two methods. The first is based on a narrative of economic events, while the second tests for a break in parameters when the spread of corporate bonds to treasuries—a common measure of financial distress (Bernanke et al. 1999)—passes a certain estimated threshold.

We find little robust evidence of a change in the effect of monetary policy on financial markets during the recent crisis. The estimated effect of monetary policy surprises during crisis is not significantly different from that during non-crisis periods across all specifications, although point estimates suggest, if anything, weaker effects of monetary policy shocks on exchange rates during crisis periods.

2. Methodology

This paper analyzes the instantaneous impact of an unanticipated change in monetary policy on exchange rates and stock prices. This section describes (i) how a policy change can be separated into anticipated and unanticipated components and (ii) how the surprise component can be approximated by a change in market (interbank) rates. Section 2.1 and 2.2 present the estimated regressions.

A policy interest rate, typically an overnight rate, is set for a month or more, until the next policy meeting. This means that the day before the announcement, the expected return on the sequence of overnight loans for one month will reflect the expected policy rate over the coming month \((E_{t-1d}i_{1m,t}; \text{ where } d \text{ denotes days and } m \text{ denotes months})\). Clearly after the announcement, the expected policy rate is equal to the actual policy rate \((E_{t-1d}i_{1m,t} = i_{1m,t})\).

Hence, a change in the policy rate can be written as follows:

\[
\Delta i_t^p = i_{1m, t} - i_{1m, t-1d} = (E_{t-1d}i_{1m,t} - i_{1m,t-1d}) + (i_{1m,t} - E_{t-1d}i_{1m,t}) = \Delta i_t^a + \Delta i_t^u, \tag{1}
\]

where \(\Delta i_t^a\) is the anticipated component of the monetary policy change, which should not affect financial markets on the announcement day, and \(\Delta i_t^u\) is the unanticipated (surprise) element of the policy change on the day of policy announcement, which affects financial markets on the day of announcement. As investors must be indifferent between holding this sequence of overnight loans for one month and investing at the 1-month market rate \((i_{1m,t})\), the expectations hypothesis suggests that 1-month market rate must equal the expected policy rate over the coming month \((E_{t}i_{1m,t})\), plus a constant term premium \((TP)\), that is, \(i_{1m,t} = E_{t}i_{1m,t} + TP\). Therefore, the surprise element of monetary policy change can be represented by the following relationship:

\[5\] These conditions can be derived by taking logs of the actual compounded return and applying the approximation \(\ln(1+i)^n = ni\) where \(n=\text{periods}.\) Trading-day and compounding rules complicate the derivation but they do not materially affect the expression.
\[ \Delta i_{t}^{un} \equiv i_{t}^{p} - E_{t-1}i_{1m,t}^{p} = (E_{t}i_{1m,t}^{p} + TP) - (E_{t-1}i_{1m,t}^{p} + TP) \approx \Delta i_{t}^{H} \]

(2)

### 2.1 Baseline Specification

Our baseline model (Equation 3), tests whether the unanticipated change in the monetary policy \((\Delta i_{t}^{un})\) on the day of the policy announcement affects the financial variable \((\Delta f_{t})\) of interest: the exchange rate, \(er\), or the stock market index, \(st\).

\[ \Delta f_{t,t} = \alpha + \beta \Delta i_{t,t}^{un} + \delta' X_{t,t} + \epsilon_{t,t}; \quad f = er, st. \]

(3)

where \(X_{t,t}\) is vector of controls including (i) a dummy for non-OECD countries, (ii) a measure of the financial crisis, such as the spread between US corporate bonds and treasuries (more on this below), (iii) contemporaneous daily changes in the US/Euro exchange rate and the S&P 500. Although the small window around monetary policy announcement minimizes omitted variable bias, in small samples other developments can be influential.

Before investigating the effect of the financial crisis, we first separately estimate the effect of monetary policy in non-OECD countries with the addition of an interaction term between the interest rate surprise \(\Delta i_{t,t}^{un}\) and a non-OECD dummy variable \(d_{nonOECD,i}\) (Equation 4). The effect of monetary policy shocks in non-OECD countries will now be \(\beta + \varphi\), and we can test the hypothesis that the effect of monetary surprises is different in OECD from non-OECD countries \(\varphi \neq 0\).

\[ \Delta f_{t,t} = \alpha + \beta \Delta i_{t,t}^{un} + \varphi \Delta i_{t,t}^{un} d_{nonOECD,i} + \delta' X_{t,t} + \epsilon_{t,t}; \quad f = er, st. \]

(4)

### 2.2 Crisis Specification

To test if policy changes have a different effect during the global financial crisis (defined by a narrative approach in Section 2.4), we extend the baseline specification by including a term interacting the unexpected change in monetary policy and the crisis dummy variable \(d_{crisis,t}\) taking a value of one during the crisis and 0 otherwise (Equation 5). If monetary policy has a different effect on financial markets during the crisis, then \(\gamma \neq 0\). Note that the total effect of policy surprises during the crisis is \(\beta + \varphi\).

\[ \Delta f_{t,t} = \alpha + \beta \Delta i_{t,t}^{un} + \gamma \Delta i_{t,t}^{un} d_{crisis,t} + \delta' X_{t,t} + \epsilon_{t,t}; \quad f = er, st. \]

(5)

An alternative to narrative-based crisis definitions is to split the sample based on a measure of financial distress. Following Bernanke et al (1999), our preferred measure is the spread between US corporate bonds and treasury bills. Specifically, if the spread is less than some

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6 Individual country dummies—equivalent to fixed effects—yielded similar results.

7 These controls (i) enable more precise estimates (by reducing the error variance) and (ii) control for news released overnight which might affect financial markets. By our identification strategy, the monetary policy surprise should be uncorrelated with the contemporaneous news releases in large samples, though news releases could be influential in small samples. One day changes in the S&P 500 and US/Euro dollar exchange rate are taken from Bloomberg (series SPX Index and EUR Currency respectively). Because the countries in the sample are in different time zones, the trading period of stock markets/exchange rates usually differs from that of the S&P 500 and US/Euro dollar exchange rate controls. In this case we use the definition of the “day” that allows the dependent variable to respond to news on opening.

8 When estimating Equation 5, we replace the spread-based measure of financial crisis, with the dummy corresponding with either the standard or broad narrative crisis periods to allow the mean to vary across subsamples.

9 Specifically, the measure is the daily spread between A-rated US corporate bonds and treasuries taken from FRED (series BAML0A3CA BofA Merrill Lynch US Corporate A Option-Adjusted Spread).
cut-off value $\bar{s}$, we estimate Equation 6a representing the “normal” regime. If $\text{spread} > \bar{s}$ then we are in the crisis regime, and we Estimate 6b. Note that unlike Equation 5, Equation 6 allows the coefficient on all variables (including controls) to vary by regime.

The advantage of this approach is that we can estimate the regime threshold $\bar{s}$ using the LM test of Hansen (2000). Specifically, the test involves choosing the value of $\bar{s}$ which maximizes the probability of there being a sample split based on different estimated coefficients in each regime.$^{10}$

\begin{align*}
\Delta f_{1t} &= \alpha_1 + \beta_1 \Delta i_{1t}^{im} + \delta_1' X_{1t} + \epsilon_{1t} \text{ if } \text{spread}_{1t} \leq \bar{s} \\
\Delta f_{2t} &= \alpha_2 + \beta_2 \Delta i_{2t}^{im} + \delta_2' X_{2t} + \epsilon_{2t} \text{ if } \text{spread}_{1t} > \bar{s}
\end{align*}  

(6a)  

(6b)

2.3. Selection of countries

We extend the sample of developed, small and open economies studied in Kearns and Manners (2005)—Australia, NZ, Canada and the UK—to include Indonesia, Korea, Malaysia and Thailand. Besides allowing the study of monetary policy in these Asian economies, extending the sample approximately doubles the number of observations during the crisis period.

We follow Kearns and Manners in seeking to include small open economies which have relatively liquid financial markets, a market-based exchange rate, and a credible inflation targeting regime. Among the Asian economies, Korea fits all the criteria. Although, Thailand and Indonesia are inflation targeters, IMF classifies them as managed floaters.$^{11}$ Malaysia is chosen despite being neither an independent floater nor an inflation targeter because it adopts many features of the inflation targeting framework such as a sequence of policy meetings set out in advance on the central bank’s website, the policy instrument being well-defined (the overnight policy rate) and monetary policy decisions being publicly announced.$^{12}$

2.4. Narrative-based Crisis Definitions

Two narrative-based crisis definitions are used. The standard period, in essence, captures the peak of the global financial crisis from the failure of Lehman Brothers on 15 September 2008 until Chairman Bernanke’s “Green Shoots” speech (and the trough in the MSCI world equity market index) on 15 March 2009.$^{13}$

The broader crisis period starts on 1 January 2008 which is the (approximate) midpoint between the US recession starting in the final quarter of 2007, and the failure (and rescue) of

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$^{10}$ The test can be implemented using the Stata command `thresholdtest` using the ado files from Bruce Hansen’s website. Following Hansen (2000), we use heteroskedastic errors and search for thresholds that leave at least 15% of the sample in one of the regimes. The test is applied to Equation (3), though if a split is found, we estimate Equation 6. Because the test is based on detecting changes in all of the coefficients (not just $\beta$), the estimated split will depend on the included controls. With too many controls, the test has difficulty identifying a break date, and so we keep the vector of controls in the paper as parsimonious as possible.


$^{12}$ Other small open Asian countries are ruled out because of a disconnect between policy and t-bill/interbank rates (Philippines), because monetary policy effectively targets the exchange rate (Singapore and Hong Kong, China), or monetary policy that uses various policy instruments (People’s Republic of China, India). Japan was also excluded due to its near zero interest rates over the sample period.

$^{13}$ See US Federal Reserve Chairman Bernanke’s remarks, http://www.npr.org/blogs/money/2009/03/ bernanke_sees_green_shoots.html. The standard crisis period is consistent with Stages 3 and 4 of the global financial crisis, also its peak, as defined by BIS (2009).
Bear Sterns in March 2008 when spreads widened markedly. The broad crisis continues until the end of the sample in June 2010 reflecting continued heightened risk aversion, deleveraging and uncertainty in the crisis’s aftermath.

3. Data

Policy rates, market interest rates, exchange rates and stock price data are collected for eight countries: Australia, Canada, Indonesia, Korea, NZ, Malaysia, Thailand, and the UK. Appendix Table A1 lists the policy rates and their sample sizes with each observation being a monetary policy decision, not necessarily a policy change (as in some other studies). For each country, the sample size is quite small in the crisis period so we pool across all countries to estimate the effect of policy surprises during the crisis.

The market interest rate used to measure surprises is the 1-month interbank rate (from Bloomberg, Datastream or central bank websites) in each country and the stock price is the main index in each country (data from Bloomberg). The exchange rates are defined as US dollar per local currency, such that an increase reflects an appreciation of the local currency, and are taken from Bloomberg (except for NZ, which is from the Reserve Bank of New Zealand). Details of the data collected, sources and timing of the policy changes are reported in the Online Appendix A.

Great care needs to be taken with timing. For example, in Malaysia the policy announcement is at 6 pm local time, after markets have closed. This means the one-day change in the interbank rate, exchange rate and stock index need to be calculated the following day. In Canada, a 9 am announcement time means no lags are needed. For most countries, the timing is clear from the data source. However, for Korea, interbank rates are sampled at around the same time as the policy announcement, and so we choose the timing based on when interbank rates seem to move in response to interest rate changes. Note that this timing method says nothing about the response of dependent variables (stock prices or exchange rates) to monetary policy surprises, as it is just identifying the surprise itself.

3.1. Descriptive statistics/plots

Figure 1 shows the policy change on announcement dates for each country, and the change in the market interest rate—the monetary surprise measure (the difference between the actual change and the surprise is the anticipated policy change). For all countries (except Malaysia) the movement in the monetary surprise measure is noticeably smaller than the policy change, indicating that most of the policy changes are anticipated (see the Online Appendix for other descriptive statistics). The average monetary policy surprise is quite small (around 5-10 basis points (bps)) which means that even with a large estimated $\beta$-coefficient the predicted change in stock markets or exchange rates will also be small.

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14 As the non-OECD countries in the sample adopted inflation targeting after the OECD countries, their sample sizes are smaller than that of the OECD countries. As such, all-country pooled results are often closer to the results of the OECD countries.

15 These pooled estimates reflect an average effect across all countries in the sample. In Online Appendix C we test the extent to which the estimates of individual countries vary from the pooled average. We find that while there is some heterogeneity in point estimates, individual country estimates are less precisely estimated—there is no robust evidence of a significant differential response in any individual country.

16 Until March 2006, the interbank rate in Korea seemed to respond more strongly to policy changes with a one day lag. We were unable to find any information on whether the procedures of the Korean Federation of Banks, which collects the data, had changed around this period.

17 Among non-OECD countries monetary policy operated somewhat differently. In Malaysia, there were few changes in monetary policy, which were mostly unexpected. Bank Indonesia changed rates more often, but most of these also were unanticipated. In contrast, most rate changes were at least partially anticipated in Thailand.
3.2 Influential observations

The most prominent feature of these graphs is the large rate cuts in late 2008-09, which for most countries were unprecedented in recent history. Moreover, the magnitude of the cuts mostly were unanticipated by markets, leading to very large monetary surprises. For example, on 6 November 2008 the Bank of England cut rates by 1.5 percentage points, of which around a percentage point was unexpected.

Unfortunately, if there are extreme movements in stock prices and/or the exchange rates on the same day as these large unanticipated rate cuts (as is likely during a crisis), then individual observations can become extremely influential in a small sample. On the day of the 6 November 2008 rate cut, the UK stock market fell around 5.7%, which makes this observation extremely influential (three times as influential as the cut off used by Bernanke and Kuttner 2005). By coincidence there was a lot going on 6 November 2008: Japanese and US stock markets fell sharply, other central banks cut interest rates and the IMF released a report worsening the forecast for world growth – all unrelated to the UK monetary policy decision. Because of this, we exclude this observation from all ordinary least squares (OLS) stock price regressions (the data point is not influential for exchange rates).

There are several other observations that are also regarded as influential by Bernanke and Kuttner’s cutoff (and other widely used measures of influence such a Cook’s distance). Instead of going through these individually, we use a robust regression algorithm to downweight influential observations.

4. Results

4.1 Baseline results and differential effects in non-OECD countries

Before investigating the effect of monetary policy during the crisis, we first present pooled results over the full sample, allowing for a differential effect of monetary policy in our three non-OECD countries. The results are shown in Table 1.

Across the whole sample, a 100 bps surprise rate rise appreciates the exchange rate by around 1 percentage point (Column 1 OLS and Column 3 robust regression) with little variation across specifications (significant at the 5% level). The same 100 bps monetary surprise causes stock prices to fall by around 0.5-1 percentage points (significant at 5-10%) with a stronger response for OLS (Column 5) than the robust regression (Column 7).

Table 1 also adds an interaction term between a non-OECD dummy and the size of the monetary policy shock: the effect of monetary policy shocks is \( \beta \) in OECD countries and \( \beta + \varphi \) in non-OECD countries. We find some evidence of weaker effect of monetary policy

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18 Specifically, Bernanke and Kuttner’s influence statistic is \( \Delta \mathbf{b} \Sigma^{-1} \Delta \mathbf{b} \), where \( \Delta \mathbf{b} \) is the change in the estimated coefficient vector when a particular observation is excluded from the regression, and \( \Sigma \) is the estimated variance-covariance matrix of the original regression on the full sample. For our sample, these are calculated using Equation 3 without controls. Dropping 6 Nov 2008 more than triples the t-statistic on monetary shocks from Equation 3.


20 This is done via Stata’s rreg command. The algorithm initially screens for outliers using Cook’s distance greater than one as a threshold. It then uses two iterative procedures to downweight influential observations (Li 1985). Monte Carlo simulations by Hamilton (1991) suggest that this robust regression is almost (95%) as efficient as OLS with ideal data (normal errors, fixed \( \mathbf{X} \)), but more than twice as efficient with fat tailed errors and random \( \mathbf{X} \) which would best describe the data used here. Note that heteroskedasticity robust standard errors cannot be used with rreg (as the observations have already been reweighted).

21 One of the reasons for the different response is the 6 November 2008 UK outlier that is dropped from the OLS specification, but included (and downweighted) in the robust regression specification.
shocks in non-OECD countries—a smaller appreciation of the exchange rate (Columns 2 and 4) and a smaller fall (or even a small rise) in stock prices (Columns 6 and 8)—although the results are not robust across all specifications. In Online Appendix C, we show that while there is some heterogeneity in estimates across individual countries, it is generally not statistically significant.

Table 1
The general effects of monetary policy surprises and their differential effect in non-OECD countries

<table>
<thead>
<tr>
<th>Dep. Variable</th>
<th>Exchange rate</th>
<th>Stock Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS</td>
<td>RREG</td>
</tr>
<tr>
<td></td>
<td>Eq. 3</td>
<td>Eq. 4</td>
</tr>
<tr>
<td>$\beta[\Delta \text{un}]$</td>
<td>0.84**</td>
<td>1.10*</td>
</tr>
<tr>
<td></td>
<td>(2.20)</td>
<td>(1.90)</td>
</tr>
<tr>
<td>$\varphi \Delta \text{un}d_{\text{nonOECD}}$</td>
<td>-0.72</td>
<td>-0.76**</td>
</tr>
<tr>
<td></td>
<td>(-0.96)</td>
<td>(-2.13)</td>
</tr>
<tr>
<td>Controls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta S&amp;P500$ (ppt)</td>
<td>0.03</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>(0.96)</td>
<td>(0.71)</td>
</tr>
<tr>
<td>$\Delta US/Euro$ (ppt)</td>
<td>0.42***</td>
<td>0.42***</td>
</tr>
<tr>
<td></td>
<td>(7.32)</td>
<td>(7.14)</td>
</tr>
<tr>
<td>SpreadA (ppt)</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>(1.38)</td>
<td>(1.39)</td>
</tr>
<tr>
<td>$d_{\text{nonOECD}}$</td>
<td>0.03</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>(0.48)</td>
<td>(0.06)</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.08</td>
<td>-0.07</td>
</tr>
<tr>
<td></td>
<td>(-1.48)</td>
<td>(-1.40)</td>
</tr>
<tr>
<td>n</td>
<td>695</td>
<td>695</td>
</tr>
<tr>
<td>R²</td>
<td>0.15</td>
<td>0.15</td>
</tr>
</tbody>
</table>

Notes: $\Delta \text{un}$ measures the size of the monetary surprise, that is, the announcement day change in the 1-month interbank rate. $d_{\text{nonOECD}}$ is a dummy equal 1 for non-OECD countries. $\Delta S&P500$ is the announcement day percentage change of the S&P500 index. $\Delta US/Euro$ is the announcement day percentage change in the US dollar to Euro exchange rate. SpreadA is the daily spread of US corporate A yields to US treasury rates. *** refers to significance at 1%, ** at 5%, and * at 10%. Robust t-statistics are in parentheses. Equations 3 and 4 are defined in Section 2.1. *regression that drops UK 6 November 2008 influential observation (see Section 3.2). RREG refers to the regression algorithm that downweights influential observations.

A 100 bps rate surprise for the OECD group is estimated to appreciate the exchange rate by about 1.2% and is similar to estimates reported elsewhere in the literature. For example, Kearns and Manners (2005) report an average coefficient of 1.45 for a similar group of countries (and 1-month rates) and Faust et al (2007) report a coefficient of 0.66-1.23 for the US. For stock prices, our estimated coefficients of around -1.5 (OECD sample) are smaller than those of Bernanke and Kuttner’s (2005) estimate of -2.55 for the US, although the estimates are not significantly different. A smaller coefficient for our sample is not surprising as US monetary policy shocks affect world stock markets (Hausman and

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22 The average size of the monetary policy surprise is more than 50% larger in non-OECD countries, despite the average size of monetary policy changes being only marginally larger. To the extent that this reflects illiquidity, segmentation or other market imperfections, a smaller effect of monetary policy shocks is to be expected.

23 These estimates are smaller than those of Zettlemeyer (2004), but his monetary shocks are identified using 3-month rates, which tends to increase the coefficient (Kearns and Manners 2005).

24 This compares Bernanke and Kuttner’s (2005) ex-outlier estimate to our ex-outlier OLS estimate (Column 5).
4.2. The differential effects of monetary policy during the crisis

This section investigates our primary question: is the effect of monetary policy shocks on financial markets any different during the financial crisis? We use two narrative measures of the crisis (standard and broad, defined in Section 2.4), and also an estimated crisis period based on a threshold of the spread of corporate bonds to treasuries.

Table 2
Effect of monetary policy during financial crisis: Narrative definition

<table>
<thead>
<tr>
<th>Dep. Variable</th>
<th>Exchange rate</th>
<th>Stock Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crisis Definition Equation 5</td>
<td>Standard</td>
<td>Broad</td>
</tr>
<tr>
<td>OLS</td>
<td>RREG</td>
<td>OLS</td>
</tr>
<tr>
<td>( \beta [\Delta \text{i}^\text{mun}] )</td>
<td>1.46***</td>
<td>1.06***</td>
</tr>
<tr>
<td>(4.56)</td>
<td>(3.96)</td>
<td>(4.38)</td>
</tr>
<tr>
<td>( \gamma [\Delta \text{i}^\text{mun}d_{\text{crisis}}] )</td>
<td>-1.05</td>
<td>-0.31</td>
</tr>
<tr>
<td>(-1.39)</td>
<td>(-0.83)</td>
<td>(-2.07)</td>
</tr>
<tr>
<td>Controls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( d_{\text{crisis}} )</td>
<td>0.21</td>
<td>-0.00</td>
</tr>
<tr>
<td>(0.77)</td>
<td>(-0.01)</td>
<td>(0.10)</td>
</tr>
<tr>
<td>( \Delta \text{S&amp;P500 (ppt)} )</td>
<td>0.03</td>
<td>0.02</td>
</tr>
<tr>
<td>(1.13)</td>
<td>(0.79)</td>
<td>(0.83)</td>
</tr>
<tr>
<td>( \Delta \text{US/Eur} \text{o (ppt)} )</td>
<td>0.42***</td>
<td>0.35***</td>
</tr>
<tr>
<td>(7.33)</td>
<td>(11.16)</td>
<td>(7.18)</td>
</tr>
<tr>
<td>( d_{\text{nonOECD}} )</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td>(0.70)</td>
<td>(0.79)</td>
<td>(0.76)</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.01</td>
<td>-0.00</td>
</tr>
<tr>
<td>(-0.30)</td>
<td>(-0.05)</td>
<td>(-0.10)</td>
</tr>
<tr>
<td>( n )</td>
<td>695</td>
<td>695</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.16</td>
<td>0.19</td>
</tr>
</tbody>
</table>

Notes: \( \Delta \text{i}^\text{mun} \) measures the size of the monetary surprise, that is, the announcement day change in the 1-month interbank rate. \( d_{\text{nonOECD}} \) is a dummy equal 1 for non-OECD countries. \( \Delta \text{S&P500} \) is the announcement day percentage change of the S&P500 index. \( \Delta \text{US/Eur} \text{o} \) is the announcement day percentage change in the US dollar to Euro exchange rate. \( d_{\text{crisis}} \) is a dummy variable equal 1 during the standard or broad crisis periods (see Section 2.4). *** refers to significance at 1%, ** at 5%, and * at 10%. Robust t-statistics are in parentheses. Equation 5 defined in Section 2.2. \( R \) regression that drops UK 6 November 2008 influential observation (see Section 3.2). RREG refers to the regression algorithm that downweights influential observations.

25 Hayo and Neuenkirch (2010) argue that for the US, monetary policy communications can predict future interest rate changes. While it is unlikely that there would be secondary speeches/hearings on the same day as the monetary policy announcement, it is possible that the post-meeting statements would influence expectations of future rates, which could then affect exchange rates and stock prices. If the interest rate surprise was in the same direction as the future sentiment in the post-meeting statement, this would lead to larger estimated coefficients. Alternatively Florakis et. al. (2011) and Wingender (2011) raise the prospect that rate cuts (and associated announcements) could signal bad news during the crisis, leading to a weaker effect of monetary policy surprises. Unfortunately we cannot test for either specifically using our data, and so we note it as a caveat. In an earlier draft we investigated whether rates were driven by persistent level of interest rates beyond the first month (levels surprises) or changes in the timing of rate increase, with no change in the long run level of interest rates (timing surprises). In most of cases, level surprises were more important than timing surprises. Estimates also can vary somewhat across subsamples. When we re-estimate over a sample for which OIS are available (which starts several years later) in Online Appendix B (for the UK, Australia, NZ and Canada), we produce much larger estimates of around 2.1 for exchange rates and -2.6 for stock markets. For stock prices, the estimates are very close to Bernanke and Kuttner (2005), and for exchange rates (although point estimates differ) they are insignificantly different from those in Kearns and Manners (2005).
Narrative crisis definitions
For our narrative crisis definitions, there is some weak evidence of smaller effects of monetary policy surprises on exchange rates during the crisis, although no evidence of a differential effect on stock prices. For exchange rates, the interaction coefficient γ (shown in bold in Table 2) is negative, indicating a smaller effect of monetary policy surprises during the financial crisis (as β and γ have different signs). However γ is only significant in one of the four specifications in Table 2. In Online Appendix B (OIS results), with a shorter sample period and fewer countries, the negative interaction coefficient γ is significant in three of the four cases. For stock markets, the γ interaction coefficient varies in sign but is always insignificant (this is also true in Online Appendix B).

Table 3
Effect of monetary policy during the financial crisis: Estimated spread based threshold

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Exchange rate</th>
<th>Stock Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS</td>
<td>RREG</td>
</tr>
<tr>
<td>Equation</td>
<td>Crisis 6b</td>
<td>Normal 6b</td>
</tr>
<tr>
<td></td>
<td>Normal 6a</td>
<td>Crisis 6a</td>
</tr>
<tr>
<td>Spread threshold</td>
<td>&gt;2.1</td>
<td>&lt;2.1</td>
</tr>
<tr>
<td>Hansen test pval</td>
<td>0.2</td>
<td>0.2</td>
</tr>
</tbody>
</table>

\[ \beta[\Delta_{\text{mon}}] \]
(0.93) (4.69) (3.89) (4.08) (-1.81) (-1.64) (-1.79) (-1.49)
\[ H_0: \beta_{\text{crisis}} = \beta_{\text{normal}} \]
0.13 0.48 0.55 0.99
\[ \Delta US/Euro \] (ppt)
(3.59) (7.47) (6.93) (9.16) (-1.13) (2.59) (-1.09) (2.24)
\[ \Delta S&P500 \] (ppt)
(-0.53) (2.04) (-1.70) (2.18) (4.33) (8.66) (8.91) (9.43)
\[ SpreadA \] (ppt)
(1.51) (1.50) (2.48) (1.19) (-1.23) (1.21) (-1.65) (1.54)

n
139 556 139 556 123 571 124 571

Notes: Constant and non-OECD dummies are included but not reported. ' P-value of the Hansen test, where \( H_0 \): no change in coefficients, that is, no threshold. \( \Delta_{\text{mon}} \) measures the size of the monetary surprise, that is, the announcement day change in the 1-month interbank rate. \( d_{\text{nonOECD}} \) is a dummy equal 1 for non-OECD countries. \( \Delta S&P500 \) is the announcement day percentage change of the S&P500 index. \( \Delta US/Euro \) is the announcement day percentage change in the US dollar to Euro exchange rate. \( SpreadA \) is the daily spread of US corporate A yields and US treasury rates. ** refers to the level of significance at 1%, * at 5%, and at 10% levels. Robust t-statistics are in parentheses. Equations 6a and 6b are defined in Section 2.1. "regression that drops UK 6 November 2008 influential observation (see Section 3.2). RREG refers to the regression algorithm that downweights influential observations.

Estimated Crisis Period
The top panel of Table 3 reports the results of the Hansen (2000) test for a difference in estimated coefficients above/below the spread threshold (versus a null hypothesis of no break). For both exchange rate and stock price equations, we find no significant evidence of a structural break, although the threshold with the highest chance of a structural break is when spreads hit around 2.1-2.25 percentage points. The estimated “crisis” period for the exchange rate equation runs from January 2008 to around September 2009 (Figure 2).^{27}

In the lower part of Table 3, we report estimates of Equation 6a and 6b, when the sample is split at the estimated threshold. The results are fairly similar to those reported in Table 2: the coefficients in crisis and non-crisis times are not statistically different, though there is some weak evidence of a smaller effect on exchange rates during the crisis period.

^{27} The estimated “crisis” period can be quite sensitive to the specification.
Table 4
Testing for asymmetries

<table>
<thead>
<tr>
<th>Dep. Variable</th>
<th>Full sample</th>
<th>Pre-2008</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Exchange rate</td>
<td>Stock Price</td>
</tr>
<tr>
<td></td>
<td>OLS</td>
<td>RREG</td>
</tr>
<tr>
<td>$\beta[\Delta i_{m}]$</td>
<td>2.21***</td>
<td>2.03***</td>
</tr>
<tr>
<td></td>
<td>(3.78)</td>
<td>(4.15)</td>
</tr>
<tr>
<td>$\theta[\Delta u_{m}d_{\Delta i&lt;0}]$</td>
<td>-1.70**</td>
<td>-1.39**</td>
</tr>
<tr>
<td></td>
<td>(-2.08)</td>
<td>(-2.46)</td>
</tr>
</tbody>
</table>

Controls

$\Delta S&P500$, $\Delta US/Euro$, $SpreadA$, $d_{\text{nonOECD}}$, Constant

| n | 695 | 695 | 694 | 695 | 500 | 500 | 500 | 500 |

Notes: Constant, non-OECD dummy, $\Delta S&P500$, $\Delta US/Euro$ and $SpreadA$, are included but not reported. $\Delta i_{m}$ measures the size of the monetary surprise, that is, the announcement day change in the 1-month interbank rate. $d_{\Delta i<0}$ is a dummy variable equal 1 for negative surprises (where the central bank cuts rates more than expected, an expansionary shock). $[\Delta u_{m}d_{\Delta i<0}]$ is equal to $\Delta u_{m}$ for negative (expansionary) shocks, and zero otherwise. $d_{\text{nonOECD}}$ is a dummy equal 1 for non-OECD countries. $\Delta S&P500$ is the announcement day percentage change of the S&P500 index. $\Delta US/Euro$ is the announcement day percentage change in the US dollar to Euro exchange rate. $SpreadA$ is the daily spread of US corporate A yields and US treasury rates. $\theta$ refers to the level of significance at 1%, at 5%, and at 1% levels. Robust t-statistics are in parentheses. *regression that drops UK 6 November 2008 influential observation (see Section 3.2). RREG refers to the regression algorithm that downweights influential observations.

5. Asymmetries

Following Bernanke and Kuttner (2005) we test for asymmetries by adding an additional term $\theta\Delta u_{m} 1(\Delta i_{m} < 0)$ to Equation 3 (a negative surprise dummy $1(\Delta i_{m} < 0)$ interacted with the monetary surprise variable $\Delta i_{m}$). The response to a positive/contractionary monetary policy surprise is $\beta$ and to a negative/expansionary surprise (the cut in rates is larger than expected) is $\beta + \theta$. Over the full sample, $\theta$ is generally significant and the opposite sign to $\beta$, indicating that negative/expansionary surprises (unexpected rate cuts) have much less effect than positive/contractionary surprises (Table 4, Columns 1-4). However, the effect is entirely due to the large unanticipated rate cuts during the crisis: for a sample ending in 2007, there is little evidence of asymmetries (Table 4, Columns 5-8). Therefore we conclude that that there is little robust evidence of asymmetries, but if anything, surprise rate cuts have weaker effects.

For the US, the literature finds either no evidence of asymmetries (Bernanke and Kuttner 2005 for stock prices), or that contractionary monetary policy shocks have larger effects on output (Cover 1992). Our mixed results (depending on the subsample) are consistent with either result. Theoretically, the mechanism of occasionally binding financial constraints discussed in the introduction predicts potential asymmetry by financial regime (crisis or normal) rather than the direction of the monetary policy shock within each regime.28

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28 The estimated threshold is still insignificant (as in Table 3) if estimated using a model with asymmetries.

29 Ravn and Sola (2004) argue that traditional Keynesian models with downward nominal wage rigidities predict contractionary shocks have a larger effect on output, but that menu cost models predict that only small monetary policy shocks (of either direction) have a larger effect on output. The authors find that only small contractionary shocks have real effects.
6. Conclusions

How monetary policy affects the economy is of key interest to policymakers and academics during normal times, and even more so during times of crisis. Recent theoretical work has suggested that agents might respond differently to shocks during crisis periods because financial constraints become binding. This paper uses an event study approach to compare the effect of monetary policy shocks on financial markets (stock prices and exchange rates) before and during the recent financial crisis for eight small open OECD and Asian non-OECD economies. To the knowledge of the authors, this is first paper that uses this approach to investigate the effect of monetary policy shocks in Asia, and one of few papers which try to estimate the effect of domestic monetary policy during crises outside the US.

Overall, an unanticipated 100 bps increase in the policy rate appreciates the exchange rate by about 1%, and causes a 0.5-1% fall in stock prices. The effects are weaker for non-OECD countries (although the differences are sometimes insignificant) which could be driven by less liquid financial markets or more noisy measurement of monetary policy surprises. We find little robust evidence of differential effects of monetary policy on financial markets during the crisis, although point estimates suggest that, if anything, the effect of monetary policy shocks might be weaker for exchange rates during the crisis.

There are many reasons why the effect of monetary policy shocks on financial markets could be the same, or weaker, during a crisis. First, the average monetary surprises is around five times larger during the crisis than normal times, which would imply large movements in financial markets with a constant β-coefficient. There could be some sort of non-linearity with respect to the size of the surprise, although unfortunately our sample size is not large enough to estimate non-linear effects during the crisis. Second, it could be that the direction of the change is important—almost all of the large surprises during the crisis were negative—although again we do not have the sample size to test this hypothesis during the crisis. These non-linearities are interesting areas for future research. Finally, it is worth noting that the models with occasionally binding constraints referenced earlier have not been applied to our specific setting. If constrained borrowers tended to be in the non-financial sector, or the marginal trader is always debt-constrained, then there might be no reason for expect a stronger response to monetary policy shocks during the crisis. A proper theoretical investigation is needed to further explore these channels.

References


McQueen, G., Roley, V.V., 1993. Stock Prices, news and business conditions. Review of Financial Studies 6 (3) 683-707


Fig. 1. Changes in policy rate and market interest rate (percentage points). Notes: Rate changes based on policy announcement day. Sources (respectively): Reserve Bank of Australia; Bank of England and Datastream; Reserve Bank of New Zealand; Bank of Canada; Bank Indonesia and Bloomberg; Bank of Korea and Datastream; Bank Negara Malaysia and Bloomberg; Bank of Thailand and Bloomberg.
Fig 2. Spread between A-rated US corporate bonds and treasuries (percentage points). Note: Exchange rate threshold 2.1 ppts Stock price threshold 2.25 ppts. Source: Federal Reserve of St Louis Economic Database (FRED; series BAMLC0A3CA).

Appendix A

Table A1
Policy rate and number of policy changes (decisions).

<table>
<thead>
<tr>
<th>Country</th>
<th>Policy Rate</th>
<th>Sample</th>
<th>Full sample</th>
<th>Financial Crisis (Narrative defn)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Standard Period</td>
</tr>
<tr>
<td>New Zealand</td>
<td>Cash rate</td>
<td>4/1999–4/2010</td>
<td>37 (90)</td>
<td>4 (4)</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>Bank rate</td>
<td>7/1997–5/2010</td>
<td>44 (156)</td>
<td>6 (6)</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Bank Indonesia rate (overnight rate)</td>
<td>1/2006–6/2010</td>
<td>29 (54)</td>
<td>5 (6)</td>
</tr>
<tr>
<td>Malaysia</td>
<td>Overnight policy rate (OPR)</td>
<td>5/2004–5/2010</td>
<td>8 (43)</td>
<td>3 (4)</td>
</tr>
<tr>
<td>Thailand</td>
<td>14-day repurchase (repo) rate, 1-day repo rate and 1-day bilateral repo rate.</td>
<td>6/2002–6/2010</td>
<td>26 (67)</td>
<td>3 (4)</td>
</tr>
</tbody>
</table>

Notes: (i) For Australia, 1998 reflects the start of public announcements of policy changes by the Reserve Bank of Australia. (ii) For Canada, a fixed decision schedule started in 2000. (iii) Sample start dates for New Zealand and the United Kingdom are the same as Kearns and Manners (2005). (iv) For Thailand and the Republic of Korea, the start date reflects the availability of interbank rate data from Bloomberg and Datastream, respectively. (v) For Malaysia, all publicly available decisions are used. (vi) Decisions for Indonesia are available since July 2005, but observations 2005 are excluded due to extreme volatility in market interest rates during that period associated with a change in the monetary policy framework. * The Bank Indonesia (BI) rate is available since July 2005, before the start of our sample. Previously, the policy rate was 30-day BI certificate (SBI) rate. ** Refer to June 2002–16 January 2007, 16 January 2007–11 February 2008 and 12 February 2008–June 2010, respectively. Since 12 February 2008, with the closure of the Bank of Thailand operated repo market, the policy rate was switched to the 1-day bilateral repo rate.