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Central bank target rates and term structure of interest rates: A study of six Asia-Pacific countries

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announcements

Abstract Granger causality tests find that the official interest rate (OIR) changes made by the central banks of Australia, China, India, South Korea, Philippines, and Taiwan cause OIR changes at other central banks, but no central bank dominates in its impact. Event study tests show that OIR announcements impact short-term market interest rates more than long-term market interest rates in their own countries. Our study shows that announcements by India and China have the largest impact on the other four countries. Markets anticipate OIR changes consistent with the objective of transparency by monetary authorities to reduce economy uncertainty for market participants.

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Introduction

Increased transparency by central banks has replaced bank independence as a major component of monetary policy. The move towards transparency began in 1990 when New Zealand became the first country to announce interest rate targets prior to their implementation (Poole, 2005). Other countries soon followed, including the United States. In 1997, the Federal Open Market Committee (FOMC) of the Federal Reserve Board (Fed) began announcing its targets

for interest rates.¹ In addition, the FOMC publicly releases minutes of the meeting three weeks after the committee's deliberations. Also, the committee's Chairperson meets with the press four times each year to publicly present the FOMC's economic outlook. Such transparency contrasts starkly with past practices when central bank decisions were made in secrecy.

Central bank announcements have a ubiquitous effect on the economy, affecting all economic participants. Any change in the target or official interest rate (OIR) provides information on the probable path of future interest rates. Households make purchasing and investment decisions based on expected borrowing and lending costs. Firms glean information about the economy's future course from central bank announcements to re-evaluate their business strategies. A cut in interest rates is often a signal of an impending slow-down or recession; consequently, firms might respond to this announcement by reducing inventories. A rate increase might signal an economic upturn, spurring increases in inventories

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¹ The Federal Open Market Committee (FOMC) meets eight times annually to evaluate the economic outlook of the United States and make policy decisions on interest rates. The announcements target two rates, the federal fund rates (fed funds) and the discount rate. The FOMC uses open market operations to ensure that the fed funds stay within the targetted range.

and hiring. Financial institutions are sensitive to OIR announcements as they can impact their lending rates. Similarly, central bank announcements provide portfolio managers and investors with information critical to asset allocation.

This paper examines the effects of OIR changes on the market interest rates of six Asia-Pacific countries namely, Australia, China, India, South Korea, Philippines and Taiwan.² Prior research in the United States has shown that bond yields, stocks prices and exchange rates all react on announcement dates. Fed watching has become a major event in the investment community with continuous coverage by the financial press during FOMC meetings. The same phenomenon is now widespread in other countries as well.

Empirical studies show that OIR changes by the FOMC have the greatest impact on short-term yields (Thornton, 1982; Roley & Sellon, 1995). Further, the response is stronger when announcements are unexpected (Kuttner, 2001). More recently, the impact of surprise or unexpected announcements has declined, suggesting that analysts' abilities to anticipate information and incorporate them into bond prices have improved, partially because of improved transparency (Swiston, 2007).

The bulk of earlier studies are U.S. centric and focussed on the impact of FOMC announcements, primarily because of data availability. In recent years, studies on the effects of central bank announcements in other countries have emerged with mixed results. Monticini, Peel and Vaciago (2011) find that OIR changes by the Bank of England (BOE) affect only United Kingdom interest rates while OIR changes by the European Central Bank (ECB) affect only Euro interest rates, even although both markets are partially affected by FOMC announcements. Rosa and Verga (2008) find that monetary policy statements by the ECB also impact short-term yields of Euribor futures. Rai, Seth and Mohanty (2007) examine OIR announcement effects on four countries: Germany, Japan, UK, and France, and find OIR changes have the largest impact on short-term rates. They also note that the impact is lower in Germany and Japan where central banks made fewer announcements than in the UK or France. Finally, Andersson, Dillén and Sellin (2002) find that unexpected changes in the repo rate in Sweden have an impact on both short- and medium-term rates relative to other macroeconomic announcements.

Studies have also documented the impact of FOMC announcements on interest rates in other countries. Small countries whose economies are tied to larger economic partners such as the US, UK and Europe often are impacted by their monetary actions. Hausman and Wongswan (2011) find that FOMC announcements affect security index returns in 49 countries and short-term interest rates in 20 countries. Kim and Nguyen (2008) find that OIR announcements by the FOMC and the Reserve Bank of Australia have similar impacts on Australian bond markets. Valente (2009) finds that FOMC announcements impact local interest rates in Hong Kong and Singapore. Gravelle and Moessner (2001) find that unexpected macroeconomic announcements in the US account for a large part of interest rate movements in Canada.

² We use the term central bank announcements and OIR changes interchangeably as we consider events only when central banks announce changes to the official interest rates.

Finally, Bredin, Gavin and O'Reilly (2004) find that the DIBOR (Dublin Interbank Offer Rate) in Ireland is affected by unanticipated changes in the Euro and U.S. rates but not for expected rate changes.

Studies of OIR announcements on emerging markets have been limited. Part of the reason is that interest rates in many emerging markets are controlled and display minor variations between announcements. Historically, central banks in emerging countries have focussed on maintaining the stability of their exchange rates. The 1990s saw many emerging countries liberalise their financial markets, resulting in more data availability. This paper examines the impact of central bank announcements of six countries in the Asia-Pacific region - three emerging markets: India, China and the Philippines; and three small, open and developed economies: Australia, South Korea and Taiwan. We exclude other countries in this region such as Malaysia and Indonesia for lack of data, and New Zealand because of its small size. Apart from the research on Australia, there is limited research on the impact of central bank announcements for the remaining five countries.

Two different effects of OIR changes are examined. First, we determine whether OIR changes by central banks trigger similar announcements at other central banks. Historically, central banks change official interest rates to accommodate monetary policy objectives in their own (domestic) economies. In recent years, central banks have coordinated monetary policies with other countries because of the integration of global financial markets.³ If the announcement of an OIR change by a central bank triggers an announcement at another central bank, market participants can anticipate rate changes before their own central bank's announcement. To the best of our knowledge, there are no studies looking at the impact of central bank OIR changes on other central bank OIRs for these six countries.

Second, we look at the impact of OIR changes on the term structure of interest rates in each country. An announcement of a rate change should cause an equal change in bond yields across all maturities, i.e., a parallel shift in the term structure of interest rates. Several studies have documented that OIR announcements primarily impact short term rates. Our study differs from others in that we study the impact of OIR changes by a central bank on its own domestic market rates as well as the market rates of the other countries in the sample. We also include the OIR changes of the FOMC, BOE and ECB because their announcements generally take centre stage in the global financial press.⁴ The only paper that has examined OIR changes on the interest rates of the six countries is that of Berument and Ceylan (2010), who look at FOMC announcements and not domestic central bank

³ The success of the 1988 Accord specifying minimum capital standards for global banks by the Basel Committee on Banking Supervision (BCBS) paved the way for further coordination among central banks. As of mid-2017, the BCBS was made up of 45 entities consisting of central banks and regulatory agencies from 28 jurisdictions. In addition, bi-monthly meetings between central banks of the G-20 countries are held regularly to increase coordination of policies worldwide.

⁴ We omit Japan because there have been very few announcements of OIR changes in recent years due to the country's low interest rates.

announcements. Another study by [Kim and Nguyen \(2009\)](#) looks at the impact of FOMC and ECB announcements on 12 Asia-Pacific countries but only on their stock markets.

Our results show that a country's OIR announcement affects OIR announcements in the other countries. No single central bank dominates to trigger OIR announcements in other countries. We show next that a country's OIR announcement affects short-term rates more than long-term rates in their own country. We also show that an OIR announcement in one country impacts market interest rates in the other five countries. India and China are the dominant countries whose OIR announcements affect market rates in all the other countries. China is also, in turn, impacted by the OIR announcement of the other five countries. Finally, we find that separating the data to test for the impact of technological advances and the recession of 2008 produces mixed and inconclusive results.

Data

Official target rates

Data pertaining to the OIR announcements of each country in our sample were obtained from Bloomberg News. The specific benchmark rates targetted by central banks can vary across countries; most countries use repo rates to achieve their targets. [Table 1](#) shows the number of announcements made in each of the six countries for the period 2001-2011. For most countries, the time period spans at least three business cycles with central banks tightening monetary policy during the upward phase and loosening it during the downward phase

[Table 1](#) shows that between 2001 and 2011, Taiwan's central bank announced 42 changes to their target rates, and ten-day loan rates to banks. India uses three different policy instruments to manage monetary policy: repos, reverse repos, and cash reserve ratios. We use only repos in our sample to eliminate any idiosyncratic effects of the other instruments. A total of 26 non-zero rate changes occurred during the sample period. China combines three instruments to manage its monetary policy: the one-year lending rate, the one-year deposit rate, and reserve requirements. We examine only announcements on the lending rate of which there were 16 during the period of the study. The Reserve Bank of Australia targets the cash rate or the overnight money market interest rate. During the sample period, the Reserve Bank of Australia made 31 announcements. The South Korean central bank targets the seven-day repurchase rate. There were 28 non-zero changes to this rate between 2001 and 2011. The Philippine central bank targets overnight commercial bank lending rates. There were 23 announcements of non-zero changes.

[Table 1](#) also presents data on target rates changes announced by the FOMC, ECB and the BOE. These announcements are used to determine whether FOMC, ECB and BOE announcements have an impact on the six countries. The FOMC targets the federal funds rate by purchasing and selling repos and government securities. Prior to the formation of the euro, the Bundesbank of Germany targetted the discount and Lombard rates, and used repos to manage them. Currently, the ECB targets

the main refinancing rate, essentially repos, and the marginal lending facility rate. The Bank of England's Monetary Policy Committee targets the official bank rate paid on commercial bank reserves.

Market interest rates

The impact of OIR changes on each country's fixed-income instruments of varying maturities is examined ([Table 2](#)). The maturities range from 30 days to 10 years, and the data is obtained from DataStream. The short-term instruments include government bills, interbank lending, negotiable certificate of deposits (NCDs) and dealer bill rates. The longer-term instruments are government bonds, except for China, where the Shanghai interbank rate is used. Some instruments were eliminated because of insufficient data and others because they were sticky; rates remained the same for long time periods. We narrowed our choices by selecting instruments whose rates were sufficiently variable to indicate liquidity and independence. Although the instruments are not all comparable, the criteria used for inclusion ensures that they provide a reasonable measure of the market's response to OIR announcements.

Methodology

Granger causality test

We use Granger causality tests to identify whether an announcement of an OIR change (Granger) causes OIR changes in other countries. Contemporaneous correlations across OIR announcements pose a challenge to finding the cause and effect of OIR announcements. The standard Granger causality test specifies a series X_t can (Granger) cause series Y_t , if Y_t is better explained by the series X_t and its lagged values than by other information such as the lagged values of Y_t .

Specifically:

$$Y_t = \alpha_0 + \sum_{i=1}^r \beta_i Y_{t-i} + \sum_{j=1}^s \gamma_j X_{t-j} + \varepsilon_t \quad (1)$$

Y_t and X_t are changes in discount rates (in percent) for paired countries in the sample. If the γ s are statistically different from zero, found by using an F-test with a reduced form equation, X is considered to (Granger) cause Y . Similarly, the reverse equation will be specified to determine if Y (Granger) causes X . Since Granger causality tests are sensitive to the number of lags chosen, the two series must be stationary. To ensure this condition is satisfied, the augmented Dickey-Fuller (ADF) test of unit root is performed to check whether the series are integrated of order (1).

Event study

We use the event methodology applied in [Rai et al. \(2007\)](#) to examine the impact of a central bank's announcements on interest rates in its own country and in the other five countries in the sample. To examine announcement effects, market rate changes in four windows around the announcement date are specified as the dependent variable: $(-1-0)$, $(-1+1)$, $(-5+5)$,

Table 1 Official interest rate (OIR) changes for selected countries.

Period: January 2001 to June 2011			
Countries	Central bank	Data available since	Number of OIR changes
Philippines	Bangko Sentral ng Pilipinas	01/17/2002	23
China	People's Bank of China	08/18/2006	16
Australia	Reserve Bank of Australia	03/10/2001	31
India	Reserve Bank of India	1/24/2006	26
Taiwan	Central Bank of the Republic of China	02/01/2001	42
South Korea	Bank of Korea	02/08/2001	28
USA	Federal Reserve Board	01/31/2001	39
ECB	European Central Bank	02/8/2001	24
UK	Bank of England	02/01/2001	42

Data sources: Bloomberg and central bank websites.

(-10 to $+10$), where 0 is the date of the central bank's announcement.⁵ This rolling window provides a better (and conservative) estimate of announcement effects by correcting for the over- or underestimation of responses during the days immediately surrounding the announcement.

The regression model is specified as follows:

$$R_{t,t+n} = \alpha_0 + \beta_1 \Delta OIR + \beta_2 Technology + \beta_3 Recession + \varepsilon \quad (2)$$

where

$R_{t,t+n}$ = Log change in short- and long-term interest rates over the time interval (in days) around an OIR announcement, (-1 to 0), (-1 to $+1$), (-10 to $+5$), and (-10 to $+10$).

ΔOIR = Log change in the official interest rate (OIR), measured as $\text{Log}(OIR_0) - \text{Log}(OIR_{-1})$ where 0 is the day of the announcement and rate change.

Technology = Dummy variable equals 1 if OIR announcement is in 2005 or later, 0 otherwise

Recession = Dummy variable equals 1 if the OIR announcement is in 2008 or later, 0 otherwise

ε = Error term

If $\beta_1 = 1$, then the change in OIR is fully reflected in market interest rates. If the coefficients of both the short-term and long-term rates are one, this indicates a parallel shift in the yield curve. Under the efficient market hypothesis, the change should be reflected as quickly as possible. Most empirical studies only examine changes in the immediate aftermath of the announcement using daily or intra-day data. Our methodology allows us to examine whether the change has occurred for up to two weeks prior to and after the announcement. Prior changes may occur because of the increased transparency of central banks in OIR announcements, allowing market participants to anticipate changes to interest rates ahead of time. Full certainty on the amount of the change, however, is resolved only after the official announcement. The ability of market participants to interpret the announcement and adjust expectations can lead to a delayed response. Hausman and Wongsman (2011) test for two effects based on a model proposed by Gürkaynak, Sack and Swanson (2005): new, unanticipated information and a revision to the expectations on the paths of future rates. Such uncertainty leads to a longer period of response as markets take

time to determine the future path of interest rates. If there is persistence in the adjustment of interest rates, however, there will be opportunities for arbitrage.

The dummy variable *Technology* is included to determine if technological developments in each country's financial markets result in a different market response to OIR announcements. For most of the Asian countries, the liberalization of financial markets in the 1990s coincided with technological advances that improved information access for investors. The rate of progress in technological improvements in both stock and bond markets varied during the sample period. The Bombay Stock Exchange, for example, introduced T-2 settlement systems in 2003 and the Unified Corporate Bond Reporting platform in 2007, later than in the other countries. In China, bonds were issued through an auction system in 1997, but the book-entry issuance of bonds to the stock exchange and inter-bank market did not begin till 2005 (Bai, Fleming & Horan, 2013). To incorporate the impact of financial liberalization and technological sophistication in the markets, we introduce a time dummy equal to "1" for OIR announcements after 2005, 0 otherwise. We expect a positive coefficient if technological improvements allow more access to information and result in a larger market response to OIR announcements. On the other hand, increased transparency may dilute the contribution of information and result in a lower market response. Whether the coefficient is positive or negative is an empirical issue.

A second dummy variable, *Recession*, is also included in the model to control for the global recession that began in the United States in 2008 and spread gradually throughout the world. The recession dampened bond market activity and increased scrutiny of central bank actions to mitigate the effects of recession. We expect a negative coefficient because of the increased uncertainty during this period about the future direction of interest rates, and predict a lower transmission of the rate changes.⁶

Results

Following Engle and Granger (1987), we performed unit root tests to ensure stationarity of our series for the Granger

⁵ We also estimated using (-5 to $+10$) and (-10 to $+5$) windows but do not report the results in the interests of brevity.

⁶ We also ran the regressions using the dummy variables separately. The results are not materially affected and we report results using both dummies.

Table 2 Government bonds and money market instruments of the six countries.

Country	3-month rate	90-day rate	180-day rate	1-year rate	5-year rate	10-year rate
Taiwan	Money market 30-day Middle rate	Money market 90-day middle rate		Government Bond 1-year middle rate	Government bond 5-year middle rate	Government bond 10-year middle rate
South Korea	Korea NCD 30-day middle rate	Korea NCD 91-day middle rate		Treasury Bond 1-year red. yield	Treasury Bond 5-year red. yield	Treasury Bond 10-year red. yield
Australia	Dealer bill 30-day middle rate	Dealer bill 90-day middle rate	Dealer bill 180-day middle rate		Bond yield 5-year Red. Yield	Bond yield 10-year middle rate
India		Bank CD 91-day middle rate		T-bond 1-year red. yield	T-bond 5-year red. yield	T-bond 10-year red. yield
China	Shanghai interbank rate 1-month middle rate	Shanghai interbank rate 3-month middle rate	Shanghai interbank rate 6-Month Middle Rate	Shanghai interbank rate 1-year middle rate		
Philippines		Treasury bill 91-day middle rate	Treasury bill 182-day middle rate	Treasury bill 364-day middle rate		

Note: Red. yield = redemption yield, NCD = negotiable certificates of deposit, CD = certificates of deposits.
Data sources: DataStream.

causality test. The presence of unit roots could necessitate additional co-integration tests. A problem with running the ADF and Granger tests on discrete events that are spread over time is the presence of zeroes in the data. In many cases, there are long periods between changes in OIRs. Although most central banks meet regularly, changes to target rates are few and far between. To avoid large gaps in changes, we grouped the data into four intervals per month: interval one includes the 1st-7th of each month, interval two the 8th-15th, interval three the 16th to the 22nd and interval four, the 23rd-31st of each month. Even with such consolidation, there were several intervals with zero changes. Consequently, we created another dataset where the periods with zero intervals for all countries were eliminated.

Table 3 shows the results from the ADF tests on the six Asian series of central bank announcements and those for the FOMC, ECB and BOE. The presence of a unit root is rejected for all cases and the data are stationary, requiring no co-integration tests. The results are similar for both data sets. Next, we perform Granger causality tests to determine whether any country Granger caused other countries to announce OIR changes.

Table 4 reports the results of tests performed on our two data sets, one with zeroes and the other without zeroes. The results show that no one country dominates or exclusively Granger causes OIR changes in other countries. The only exception is the Philippines which Granger causes Australia (Panel A) but results in Panel B, where we report tests with no zero gaps, show no such causation. The FOMC Granger causes OIR changes in two countries, UK and China (Panel B). China and UK in turn Granger cause changes in the United States (Panel A).

The results are similarly mixed for other countries, making it difficult to interpret them because of the multi-directional causation. For example, Taiwan Granger causes OIR changes in the United States; the UK Granger causes Taiwan; the United States Granger causes the UK. Therefore, we conclude, that for this sample, no one country's central bank's OIR changes can be identified as a trigger for OIR changes in other countries. This may be the result of increased global coordination by central banks in recent years.

Table 5 shows the results from estimating Eq. (2), the responses of market interest rates to OIR changes. The results for only two interest rates are reported for each country: the 90-day and 10-year rates for Taiwan, South Korea, India, and Australia, 90-day and 1-year rates for China and the Philippines. For brevity, only the (-1+ 0), (-1+1), (-5+5) and (-10+10) are reported. Table 5 has six panels and shows the responses of market interest rates to OIR announcements from the six countries and the FOMC, ECB and BOE. We describe the results in two parts. The first part looks at the market responses in the six countries to OIR announcements by their own central banks. The second part looks at the market responses in each of the six countries to OIR announcements by the other eight central banks.

OIR announcements and impact on domestic markets rates

Panel A of Table 5 shows the results for Taiwan. Changes in market interest rates on days (-1-0) are insignificant.

However, for 90-day rates, changes on days ($-+1$), ($-5+5$) and ($-10+10$) are statistically significant with coefficients of 0.49, 0.74 and 0.89, respectively, indicating that 89% of the OIR change is impounded into the 90-day rate during the 4-week interval.⁷ Responses for long-term bonds are statistically significant at 0.10 for the ($-1+1$) interval. Results from ($-5+10$) and ($-10+5$) intervals (not reported) show that markets anticipated announcements, but their impact was mainly on short-term rates.

The results for South Korea, in Panel B, also show that OIR changes had the largest impact on short-term rates, like Taiwan. For the 91-day rate, up to 80% of the OIR change is reflected in the ($-10+10$) interval. The information appears to have been anticipated because the coefficient of 0.35 for the ($-1-0$) interval is also statistically significant. Market responses to OIR announcements reflected in the 10-year Treasury Bond rates are not statistically significant.

Results for Australia, in Panel C, are also like those reported for South Korea and Taiwan. Announcements of OIR changes by Australia's central bank caused short-term market rates to increase by 80% over the ($-10+10$) interval. Announcements in Australia also appeared to be anticipated; rates increased by 14% over the ($-1-0$) interval. Announcement effects on the 10-year bond rates are negligible and insignificant for all intervals.

Panel D shows that the OIR announcement effects on market rates in India are statistically significant for both short and long-term securities. The 91-day Bank CD (Certificate of Deposit) rate changed by 79% over the ($-10+10$) interval. Furthermore, the coefficient for the ($-1-0$) interval was 0.18 and statistically significant indicating that the OIR change was anticipated. Unlike Taiwan, South Korea and Australia, the coefficients for the 10-year bond rates are statistically significant and equal 0.12 and 0.48 for the ($-1+1$) and ($-10+10$) intervals, indicating that OIR changes impacted long-term rates.

The results for China are shown in Panel E of Table 5. Only short-term instruments are available for the study: we use the 3-month and 12-month Shanghai interbank rates.⁸ Market interest rates are very responsive to OIR announcements; the 3-month Shanghai interbank rate increased by 98% in the ($-1+1$) interval. The ($-10+10$) interval shows an increase of over 212%. Comparable results are found for the one-year bond rate. Market rates changed by 97% over the ($-1+1$) interval, and by 215% in the ($-10+10$) interval. Markets not only impound current changes in central bank rates but anticipate future OIR changes.

Panel F of Table 5 shows the results for the Philippines. Results for the intervals ($-1, 0$) and ($-1, +1$) are unavailable because interest rates were constant during the sample period. Rate changes for the 91-day and the 364-day Treasury bills are statistically insignificant for the other time intervals. Part of the insignificance can be explained by the stickiness and low variability of their rates.

Overall, we find interesting differences in the responses of market interest rates to OIR announcements in the six countries. A large amount of the OIR change was impounded into market rates over time, indicating that the rates were

⁷ Five business days represent a week for a total of four weeks in the ($-10+10$) interval.

⁸ Yields for bonds with maturities greater than a year were sticky with little variation.

Table 3 Augmented Dickey-Fuller unit root tests.

N = 512	Lag=1	Lag=4	Lag=7
Europe (ECB)	-16.09 (0.001)***	-7.39 (0.001)***	-5.08 (0.001)***
South Korea	-14.84 (0.001)***	-7.28 (0.001)***	-4.19 (0.001)***
United Kingdom (BOE)	-16.0 (0.001)***	-5.86 (0.001)***	-5.03 (0.001)***
USA (FOMC)	-15.23 (0.001)***	-8.16 (0.001)***	-4.25 (0.007)***
India	14.24 (0.001)***	-6.95 (0.001)***	-4.20 (0.008)***
Philippines	-16.04 (0.001)***	-8.07 (0.001)***	-6.44 (0.001)***
Taiwan	-14.26 (0.001)***	-7.06 (0.001)***	-4.93 (0.001)***
Australia	15.94 (0.001)***	-6.69 (0.001)***	-4.09 (0.001)***
China	-15.49 (0.001)***	-7.94 (0.001)***	-5.61 (0.001)***

Note: *** Significant at the 1% level of confidence.

Data sources: Bloomberg and central bank websites.

anticipated, and responses delayed as markets continued to respond after the announcements. Results by country show that Taiwan, South Korea and Australia saw short-term rates impacted, but not long-term rates. In the case of India, OIR changes impacted both short- and long-term rates. Short- and long-term rates were impacted in China too, but the response rates were higher than in the case of India. For China, the response was over 200% for the ($-10+10$) interval, suggesting that markets were anticipating further changes. Five of the six countries saw market rates change prior to announcements, indicating that OIR announcements were anticipated. There was no impact of OIR announcements on market rates in the Philippines.

OIR announcements and impact on market rates on other countries

This section examines the impact of OIR announcements of the other eight central banks on the market interest rates of a country, shown in rows 2 and below each panel. Panel A of Table 5 shows that OIR announcements by India and South Korea impacted Taiwan's short-term rates with coefficients of 1.26 and 0.89, respectively, for the ($-10+10$) interval. For long-term rates, the coefficient of China is 1.02 for the ($-10+10$) interval followed by Australia at 0.43. Taiwan's short-term market rates also responded to the FOMC's OIR announcement. Although coefficients were significant for all four intervals, the signs are mixed, negative for ($-0+1$), ($-1+1$), and positive for ($-5+5$), ($-10+10$). The coefficients for the ($-1-0$) interval are significant for four of the countries, indicating that the OIR announcements were anticipated. We conclude that OIR announcements by India and South Korea had the strongest impact on Taiwan's short-term interest rates, while OIR announcements by China impacted the long-term rates.

Table 4 Granger causality tests.

PANEL A: The intermediate zeroes between OIR changes were kept as is. Some countries had gaps of over a year.	
USA Granger caused	- ECB, UK, Taiwan, India, China, South Korea
ECB Granger caused	- USA, UK, Taiwan, Philippines, India, China, Australia, South Korea
UK Granger caused	- USA, ECB, Taiwan, Philippines, India, China, Australia, South Korea
Taiwan Granger caused	- USA, ECB, UK, Philippines, India, Australia, South Korea
Philippines Granger caused	- Australia
India Granger caused	- USA, ECB, UK, Taiwan, Philippines, China, Australia, South Korea
China Granger caused	- USA, ECB, UK, Taiwan, Philippines, India, Australia, South Korea
Australia Granger caused	- USA, ECB, UK, Taiwan, India, China, South Korea
South Korea Granger caused	- USA, ECB, UK, Taiwan, Philippines, India, China, Australia
PANEL B: The intermediate zeroes between OIR changes were removed from the sample.	
USA Granger caused	- UK, China
ECB Granger caused	- USA, UK, Taiwan, Philippines, India, South Korea
UK Granger caused	- USA, ECB, Taiwan, India, China, Australia, South Korea
Taiwan Granger caused	- USA, ECB, UK, Philippines, Australia
Philippines Granger caused	- None
India Granger caused	- ECB, UK, Taiwan, Philippines, Australia, South Korea
China Granger caused	- USA, ECB, UK, Taiwan, India, Australia, South Korea
Australia Granger caused	- ECB, UK, Taiwan, India, China, South Korea
South Korea Granger caused	- USA, ECB, UK, Taiwan, China, Australia
Official interest rate (OIR) changes caused by one country on another country. Equation tested $Y_t = \alpha_0 + \sum_{j=1-r}^r \beta_j Y_{t-j} + \sum_{j=1-s}^s \gamma_j X_{t-j} + \varepsilon_t$ where r and s are lags = 7. X_t and Y_t are OIR changes in percentages.	

Panel B shows that both short- and long-term market interest rates of South Korea are impacted by OIR announcements from Taiwan with a coefficient of 0.60 for the (−10+10) interval. The rates are also sensitive to OIR announcements by India where the (−10+10) intervals are statistically significant at 1.12 and 0.44 for short- and long-term rates, respectively. Finally, OIR announcements by China impacted two of the four long term rates with the highest coefficient at 0.63 for the 10-year rate in the (−10+10) interval. Short-term rates are also impacted by FOMC announcements; the negative and statistically significant coefficients for all four intervals are below −0.17. We conclude that OIR announcements by India and Taiwan had the strongest impact on South Korea's short-term interest rates and the OIR announcement by China on the long-term rates.

Panel C shows that the OIR changes by India had the strongest impact on short-term rates in Australia with regression coefficients significant for three of the four intervals, the highest at 0.64 for the (−10+10) interval. Long-term rates appear to be influenced only by OIR announcements from China, with statistically significant coefficients for two of the four intervals and the highest at 0.58 for the (−10+10) interval. Other countries showed occasional significant coefficients, but they were all lower than 0.37. The FOMC announcement was negative and significant at −0.06 in the (−5+5) interval. We conclude that OIR announcements by India had the strongest impact on Australia's short-term interest rates and the OIR announcement by China on the long-term rates.

Panel D shows that OIR announcements by China have the biggest impact on short- and long-term market interest rates of India with coefficients of 1.66 and 0.81, respectively, for the (−10+10) window. Philippines also had a significant

impact on India's short-term rates with a statistically significant coefficient of 0.78 in the (−10+10) interval. Three other countries had significant coefficients, Taiwan, Australia and South Korea but their coefficients, although statistically significant, were below 0.52. The FOMC, similar to earlier results, has negative coefficients for three of the four intervals for long-term rates but they were all below 0.20. We conclude that OIR announcements by China and the Philippines had the strongest impact on India's short-term interest rates and the OIR announcement by China on the long-term rates.

Panel E shows OIR announcements by central banks of every country in the study, except the Philippines and the United Kingdom, impacted China's short and long-term market interest rates. In the short-term market, regression coefficients for the (−10+10) day interval are 0.90, 0.88, 1.71 and 0.97, for South Korea, Australia, India and Taiwan, respectively. For long-term rates, the coefficients are 0.60, 0.61, 1.19, and 0.70, respectively. Short-term and long-term rates in the Chinese market also responded to FOMC announcements but the negative coefficients are low at −0.33 and −0.28, respectively, for the short- and long-term rates. Rates also responded to ECB announcements; the short-term coefficient was −0.44 for the (−10+10) day interval. In our sample, market interest rates in China are very sensitive to announcements by five of the six countries.

Panel F shows that central bank announcements by China and India have the biggest impact on short-term rates in the Philippines, with coefficients of 1.68 and 0.98, respectively, for the (−5+5) interval. For South Korea, Australia and Taiwan, the coefficients are statistically significant but lower than 0.51. Market interest rates are also influenced by OIR

Table 5 Event study regressions.

		Panel A - Taiwan							
Central bank		-1-0	-1-+1	-5-+5	-10-+10	Technology	Recession	Adj R ²	N
Taiwan	90-day rate	0.07 (0.203)	0.49 (0.000)***	0.74 (0.000)***	0.89 (0.000)***	-0.02, -0.06,** -0.05, -0.03	0.01, 0.02, 0.01, -0.00	0.00, 0.36, 0.49, 0.70	41
	10-year rate	-0.05 (0.185)	0.10 (0.056)*	-0.01 (0.898)	-0.06 (0.709)	-0.03**, -0.03, -0.04, -0.05	-0.01, -0.01, -0.03, -0.08**	0.19, 0.27, 0.10, 0.19	29
ECB	90-day rate	0.01 (0.864)	0.00 (0.942)	-0.14 (0.387)	-0.36 (0.225)	-0.02, -0.03, -0.03, -0.03	0.02, 0.02, 0.04, 0.09	-0.06, 0.01, 0.02, 0.12	24
	10-year rate	0.00 (0.977)	-0.01 (0.741)	0.06 (0.590)	0.01 (0.930)	-0.02, -0.02, -0.04, 0.02	0.00, 0.00, 0.05, 0.04	-0.12, -0.03, -0.08, -0.12	19
FOMC	90-day rate	-0.03 (0.000)***	-0.07 (0.000)***	0.21 (0.000)***	0.27 (0.000)***	0.00, -0.00 -0.04, -0.05	-0.01*, -0.01, -0.04*, -0.04	0.62, 0.52, 0.75, 0.71	38
	10-year rate	0.02 (0.201)	-0.02 (0.248)	0.01 (0.851)	0.08 (0.218)	-0.01, 0.00, -0.01, 0.03	0.01, 0.01, 0.03, 0.09**	0.05, 0.08, 0.01, 0.11	28
BOE	90-day rate	-0.01 (0.893)	-0.01 (0.889)	-0.04 (0.782)	-0.15 (0.369)	-0.00, -0.02, -0.03, -0.05	0.03, 0.04, 0.07, 0.07	0.01, 0.00, 0.00, 0.09	28
	10-year rate	0.00 (0.923)	-0.02 (0.668)	0.04 (0.705)	0.03 (0.844)	0.00, 0.01, 0.05, 0.11	0.02, 0.02, 0.03, 0.05	0.00, 0.19, 0.06, 0.22	21
South Korea	90-day rate	0.01 (0.573)	0.11 (0.004)***	0.61 (0.000)***	0.89 (0.000)***	0.00, 0.000, -0.02, -0.05	0.00, 0.00, -0.02, -0.00	-0.07, 0.24, 0.49, 0.68	28
	10-year rate	0.07 (0.022)**	0.11 (0.011)**	0.11 (0.361)	0.17 (0.345)	0.00, 0.00, -0.07, 0.09	0.00, -0.01, 0.01, -0.02	0.23, 0.29, 0.01, 0.08	21
Australia	90-day rate	0.02 (0.458)	0.04 (0.094)*	0.18 (0.004)***	0.30 (0.002)***	-0.00, -0.00, -0.00, 0.03	0.00, 0.00, -0.00, -0.00	-0.07, 0.01, 0.22, 0.29	30
	10-year rate	0.06 (0.009)***	0.07 (0.062)**	0.13 (0.171)	0.43 (0.048)**	0.01, -0.00, -0.03, -0.03	-0.01, 0.01, 0.02, -0.00	0.29, 0.04 0.01, 0.10	23
India	90-day rate	0.01 (0.363)	0.01 (0.363)	0.62 (0.007)***	1.26 (0.000)***	NA	-0.00, -0.00 -0.10, -0.02	-0.01, -0.01, 0.25, 0.55	25
	10-year rate	-0.14 (0.008)***	-0.26 (0.000)***	-0.02 (0.877)	-0.03 (0.869)	NA	0.00, -0.00, -0.00, 0.00	0.22, 0.49, -0.09, -0.09	25
China	90-day rate	0.01 (0.353)	0.03 (0.664)	0.55 (0.096)*	0.75 (0.014)	NA	0.01, 0.00, -0.02, -0.02	-0.15, -0.01, 0.75, 0.54	15
	10-year rate	0.02 (0.883)	0.12 (0.430)	0.67 (0.000)***	1.02 (0.005)***	NA	0.01, 0.00, -0.02, -0.02	-0.15, -0.01, 0.75, 0.54	15
Philippines	90-day rate	-0.15 (0.316)	-0.11 (0.467)	0.17 (0.476)	0.32 (0.199)	0.00, 0.00, 0.05, 0.07	0.00, -0.01, -0.05, -0.05	-0.05, -0.06, -0.01, 0.05	24
	10-year rate	-0.05 (0.345)	-0.06 (0.645)	0.04 (0.798)	-0.24 (0.435)	-0.01, -0.04, -0.20, *** -0.27**	0.00, -0.01, -0.01, -0.02	-0.05, -0.03, 0.43, 0.27	22

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Table 5 (Continued)

		Panel B - South Korea							
Central bank		-1-0	-1+1	-5+5	-10+10	Technology	Recession	Adj R ²	N
South Korea	90-day rate	0.35 (0.000)***	0.38 (0.000)***	0.66 (0.000)***	0.80 (0.000)***	0.00, 0.00, -0.01, -0.01	0.02, * 0.02, * 0.02, 0.02	0.83, 0.81, 0.75, 0.80	28
	10-year rate	0.01 (0.749)	0.02 (0.663)	0.06 (0.590)	0.14 (0.322)	0.01, 0.01, 0.01, 0.00	-0.01, 0.00, -0.01, -0.01	-0.08, -0.09, -0.10, -0.06	27
ECB	90-day rate	-0.01 (0.175)	-0.01 (0.361)	-0.154 (0.042)**	-0.321 (0.023)**	0.00, 0.00, 0.06, ** 0.10*	0.00, 0.00, 0.00, 0.00	0.03, 0.02, 0.32, 0.29	24
	10-year rate	0.03 (0.303)	-0.00 (0.938)	-0.07 (0.422)	-0.13 (0.333)	0.01, 0.00, 0.04, 0.03	0.00, 0.00, 0.00, 0.00	0.04, -0.13, -0.04, -0.07	24
FOMC	90-day rate	-0.03 (0.000)***	-0.04 (0.000)***	-0.16 (0.000)***	-0.17 (0.000)***	0.00, 0.00, -0.01, -0.03	0.00, 0.00, 0.00, 0.02	0.61, 0.39, 0.48, 0.42	38
	10-year rate	0.00 (0.906)	0.01 (0.296)	-0.04 (0.150)	-0.11 (0.055)	0.00, 0.00, -0.02, -0.02	0.00, 0.01, 0.01, 0.04	-0.09, -0.04, 0.10, 0.18	38
BOE	90-day rate	-0.00 (0.945)	-0.02 (0.738)	-0.09 (0.282)	-0.14 (0.252)	-0.00, -0.01, -0.02, -0.03	0.02, 0.03, 0.06, 0.09	-0.02, -0.00, 0.24, 0.30	28
	10-year rate	0.023 (0.261)	0.02 (0.319)	0.04 (0.668)	0.02 (0.895)	0.00, 0.00, 0.02, 0.00	0.01, 0.02, 0.02, 0.04	-0.04, -0.01, -0.10, -0.09	28
Taiwan	90-day rate	0.11 (0.002)***	0.26 (0.000)***	0.48 (0.000)***	0.60 (0.000)***	-0.01, -0.02** -0.04, ** -0.04, *	0.00, 0.00, -0.01, -0.01	0.22, 0.49, 0.61, 0.58	41
	10-year rate	0.02 (0.516)	0.08 (0.03)**	0.19 (0.006)***	0.23 (0.048)**	0.00, -0.01, -0.02, -0.03	-0.01, -0.01, 0.00, -0.02	0.05, 0.16, 0.16, 0.11	41
Australia	90-day rate	-0.01 (0.318)	-0.01 (0.523)	-0.01 (0.011)	0.33 (0.011)**	0.00, 0.00, -0.01, -0.01	-0.01, -0.02, * -0.03, -0.04	0.05, 0.04, 0.03, 0.27	30
	10-year rate	-0.00 (0.98)	0.02 (0.609)	0.02 (0.369)	-0.10 (0.751)	-0.00, -0.01, -0.02, -0.02	-0.00, -0.00, 0.00, 0.00	0.04, 0.15, 0.01, -0.06	30
India	90-day rate	0.01 (0.562)	0.01 (0.362)	0.63 (0.000)***	1.12 (0.000)***	NA	0.00, 0.00, 0.00, 0.00	0.01, 0.03, 0.56, 0.55,	25
	10-year rate	-0.04 (0.114)	-0.01 (0.624)	0.36 (0.009)***	0.44 (0.029)**	NA	0.00, 0.00, 0.00, -0.01	0.03, -0.06, 0.22, 0.16	25
China	90-day rate	0.03 (0.298)	0.05 (0.347)	0.21 (0.397)	0.41 (0.357)	NA	-0.00, -0.00 -0.01, -0.03	-0.03, -0.05 -0.04, 0.00	15
	10-year rate	0.09 (0.165)	0.18 (0.079)*	0.55 (0.007)***	0.63 (0.084)*	NA	0.01, 0.01, 0.01, 0.00	0.05, 0.11, 0.40, 0.14	15
Philippines	90-day rate	0.01 (0.669)	0.02 (0.493)	0.24 (0.109)	0.50 (0.049)**	0.00, 0.00, 0.00, 0.02	-0.00, * -0.00, * -0.03, * -0.07, **	0.06, 0.06, 0.13, 0.18	24
	10-year rate	-0.06 (0.038)	-0.06 (0.281)	-0.04 (0.828)	0.81 (0.756)	0.00, 0.00, -0.02, -0.05	0.00, 0.00, 0.01, -0.03	0.08, -0.04, -0.09, -0.02	24

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Table 5 (Continued)

		Panel C - Australia							
Central bank		-1-0	-1-+1	-5-+5	-10-+10	Technology	Recession	Adj R^2	N
Australia	90-day rate	0.14 (0.030)**	0.13 (0.078)*	0.45 (0.000)***	0.80 (0.000)***	-0.01, -0.01, 0.00, 0.00	0.00, 0.01, 0.02, 0.01	0.08, 0.01, 0.36, 0.60	30
	10-year rate	0.02 (0.501)	0.01 (0.788)	0.05 (0.543)	0.14 (0.307)	0.00, -0.02, -0.01, 0.00	0.00, 0.00, 0.00, 0.00	-0.05, 0.02, -0.01, -0.07	30
ECB	90-day rate	0.00 (0.783)	-0.02 (0.526)	-0.08 (0.404)	-0.12 (0.407)	0.00, 0.00, 0.01, 0.01	0.00, 0.00, 0.04, 0.06	-0.13, -0.06, 0.14, 0.11	24
	10-year rate	-0.02 (0.495)	-0.03 (0.292)	0.00 (0.968)	-0.01 (0.905)	0.01, 0.01, -0.01, 0.00	0.00, 0.00, 0.02, 0.02	-0.04, -0.07, -0.06, -0.12	24
FOMC	90-day rate	0.00 (0.266)	-0.01 (0.199)	-0.06 (0.021)**	-0.05 (0.233)	0.00, 0.00, 0.00, -0.01	0.00, 0.00, 0.03, 0.05	0.09, -0.025, 0.32, 0.16	38
	10-year rate	-0.01 (0.084)*	-0.03 (0.018)	-0.03 (0.268)	-0.03 (0.383)	0.00, 0.01, 0.00, -0.01	0.01, * 0.00, 0.00, 0.03	0.30, 0.14, -0.02, 0.05	38
BOE	90-day rate	0.00 (0.826)	0.00 (0.808)	-0.05 (0.545)	-0.10 (0.372)	0.00, 0.00, -0.01, -0.01	0.00, 0.00, 0.05, 0.07	0.02, -0.10, 0.14, 0.23	28
	10-year rate	0.01 (0.727)	-0.05 (0.047)**	-0.02 (0.718)	-0.07 (0.398)	0.00, 0.00, -0.01, 0.02	0.01, 0.00, 0.02, 0.01	0.03, 0.11, -0.04, 0.04	28
South Korea	90-day rate	0.00 (0.566)	0.01 (0.589)	0.09 (0.222)	0.37 (0.000)***	0.00, 0.00, -0.01, -0.01	0.00, 0.00, -0.04, -0.06	0.01, 0.01, 0.23, 0.62	27
	10-year rate	0.02 (0.527)	0.01 (0.883)	0.02 (0.692)	0.13 (0.128)	0.01, 0.00, -0.02, 0.00	0.00, 0.00, 0.00, -0.02	-0.02, -0.11, -0.02, 0.06	27
Taiwan	90-day rate	-0.02 (0.130)	-0.02 (0.415)	0.17 (0.052)*	0.304 (0.010)***	0.00, 0.00, -0.01, -0.01	0.00, -0.01, -0.02, -0.04	0.02, 0.10, 0.13, 0.20	41
	10-year rate	0.05 (0.065)*	0.04 (0.191)	0.05 (0.287)	0.09 (0.246)	0.00, -0.01, -0.01, -0.00	0.00, 0.00, -0.02 -0.05**	0.06, 0.02, 0.14, 0.21	41
India	90-day rate	0.08 (0.031)**	0.10 (0.165)	0.19 (0.078)*	0.64 (0.001)***	NA	0.00, 0.00, -0.01, -0.02	0.13, 0.02, 0.12, 0.39	25
	10-year rate	0.01 (0.795)	-0.08 (0.168)	0.05 (0.574)	0.02 (0.882)	NA	0.00, 0.00, 0.00, 0.00	-0.06, 0.00, -0.07, -0.09	25
China	90-day rate	0.00 (0.949)	-0.06 (0.484)	0.28 (0.310)	0.60 (0.125)	NA	-0.00, -0.00, -0.02, -0.05	-0.16, -0.11, 0.04, 0.25	15
	10-year rate	0.06 (0.384)	0.03 (0.677)	0.51 (0.019)**	0.58 (0.005)***	NA	-0.00, -0.00, 0.01, -0.01	-0.05, -0.13, 0.29, 0.48	15
Philippines	90-day rate	0.02 (0.251)	0.05 (0.236)	0.13 (0.211)	0.17 (0.379)	0.00, -0.01, -0.03, -0.03	0.00, 0.00, 0.00, -0.03	0.13, 0.12, 0.07, 0.03	24
	10-year rate	0.00 (0.892)	0.03 (0.571)	0.02 (0.831)	-0.15 (0.506)	-0.01, -0.01, 0.00, 0.00	0.00, 0.00, -0.04, -0.06	-0.02, -0.05, 0.08, -0.02	24

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Table 5 (Continued)

		Panel D - India							
Central bank		-1-0	-1-+1	-5-+5	-10-+10	Technology	Recession	Adj R ²	N
India	90-day rate	0.18 (0.079)*	0.45 (0.006)***	0.63 (0.010)***	0.79 (0.05)**	NA	-0.02, -0.02, -0.01, -0.02	0.12, 0.29, 0.23, 0.12	25
	10-year rate	0.03 (0.461)	0.12 (0.034)**	0.16 (0.226)	0.48 (0.015)**	NA	0.00, 0.00, 0.00, -0.01	-0.06, 0.11, -0.02, 0.20	25
ECB	90-day rate	-0.07 (0.518)	-0.05 (0.640)	-0.09 (0.639)	-0.13 (0.596)	-0.00, -0.00, -0.01, 0.00	0.01, 0.01, 0.06, 0.10	-0.09, -0.10, -0.02, 0.05	24
	10-year rate	-0.01 (0.343)	0.02 (0.459)	-0.04 (0.565)	-0.11 (0.492)	-0.00, -0.01, 0.00, 0.02	0.00, 0.01, 0.00, -0.01	0.03, -0.11, -0.11, -0.12	24
FOMC	90-day rate	-0.02 (0.120)	-0.01 (0.382)	0.00 (0.880)	-0.07 (0.074)*	0.00, 0.00, -0.01, -0.01	-0.03, ** -0.02, -0.01, 0.00	0.07, 0.00, -0.06, 0.07	38
	10-year rate	-0.01 (0.273)	-0.04 (0.000)***	-0.10 (0.000)***	-0.20 (0.000)***	0.00, 0.00, 0.00, 0.00	0.01, 0.00, 0.00, -0.01	0.23, 0.57, 0.59, 0.62	37
BOE	90-day rate	0.00 (0.723)	0.05 (0.28)	-0.12 (0.344)	0.08 (0.621)	0.00, 0.00, 0.02, 0.04	0.00, 0.03, 0.00, 0.07	-0.06, 0.29, -0.01, 0.02	28
	10-year rate	0.00 (0.595)	0.03 (0.296)	0.06 (0.313)	-0.04 (0.769)	0.00, 0.00, 0.01, 0.03	0.00, 0.00, 0.01, 0.00	-0.09, -0.03, -0.03, -0.06	28
South Korea	90-day rate	-0.06 (0.223)	-0.17 (0.007)***	0.20 (0.135)	0.49 (0.025)**	0.02, 0.05*** -0.02, -0.03	0.00, -0.02, 0.00, -0.02	0.01, 0.29, 0.01, 0.15	28
	10-year rate	0.03 (0.139)	0.11 (0.000)***	0.21 (0.010)***	0.23 (0.039)**	0.00, 0.00, -0.03, -0.02	0.00, 0.00, 0.00, 0.00	0.00, 0.00, 0.00, 0.00	28
Australia	90-day rate	0.07 (0.192)	0.14 (0.183)	0.19 (0.378)	0.52 (0.09)*	0.01, 0.02, 0.03, 0.06	0.00, -0.02, -0.06, -0.11	0.00, 0.03, 0.00, 0.00	30
	10-year rate	-0.03 (0.189)	0.00 (0.932)	0.05 (0.496)	0.19 (0.176)	0.01, 0.01, -0.01, -0.01	0.00, -0.01, 0.01, 0.00	0.01, -0.08, -0.05, -0.01	30
Taiwan	90-day rate	0.03 (0.444)	-0.04 (0.407)	0.16 (0.086)*	0.41 (0.007)***	0.00, 0.01, -0.01, -0.02	-0.01, -0.01, -0.05, -0.02	0.01, -0.03, 0.21, 0.17	41
	10-year rate	-0.04 (0.190)	0.03 (0.512)	0.21 (0.002)***	0.31 (0.001)***	0.01, 0.00, -0.01, -0.01	0.00, 0.00, 0.00, 0.00	0.01, -0.05, 0.19, 0.24	41
China	90-day rate	-0.08 (0.671)	-0.16 (0.502)	0.52 (0.193)	1.66 (0.021)**	-0.00, -0.00, 0.02, -0.01	-0.00, -0.00, 0.02, -0.01	-0.15, -0.12, -0.01, 0.32	15
	10-year rate	0.02 (0.703)	0.04 (0.471)	0.41 (0.010)**	0.81 (0.019)**	0.00, 0.00, 0.00, -0.01	0.00, 0.00, 0.00, -0.01	-0.13, -0.09, 0.38, 0.35	15
Philippines	90-day rate	-0.03 (0.636)	-0.00 (0.962)	0.52 (0.096)*	0.78 (0.057)*	0.00, 0.00, -0.05, -0.05	-0.01, -0.02, 0.00, 0.00	-0.02, -0.06, 0.03, 0.06	24
	10-year rate	0.02 (0.679)	-0.04 (0.573)	0.02 (0.922)	0.27 (0.299)	0.00, 0.00, 0.02, 0.01	0.00, 0.00, -0.01, -0.02	0.00, -0.08, -0.13, -0.08	24

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Table 5 (Continued)

		Panel E - China							
Central bank		-1-0	-1-+1	-5-+5	-10-+10	Technology	Recession	Adj R ²	N
China	90-day rate	0.11 (0.115)	0.97 (0.000)***	1.411 (0.01)***	2.119 (0.002)***	NA	0.01, 0.02, -0.02, -0.02	0.06, 0.79, 0.48, 0.58	15
	1-year	0.08 (0.101)	0.98 (0.000)***	1.61 (0.000)***	2.15 (0.000)***	NA	0.01, 0.02, 0.02, 0.04	0.08, 0.84, 0.83, 0.77	15
ECB	90-day rate	-0.01 (0.037)**	-0.02 (0.128)	-0.12 (0.168)	-0.36 (0.168)	NA	0.00, 0.00, 0.02, 0.04	0.27, 0.15, 0.13, 0.11	13
	1-year	-0.02 (0.009)***	-0.04 (0.018)**	-0.19 (0.028)**	-0.44 (0.07)*	NA	0.00, 0.00, 0.00, 0.01	0.42, 0.36, 0.32, 0.22	13
FOMC	90-day rate	-0.01 (0.012)**	-0.02 (0.003)**	-0.17 (0.002)***	-0.33 (0.000)***	NA	0.00, 0.01, 0.05, 0.05	0.70, 0.78, 0.80, 0.90	10
	1-year	-0.01 (0.006)***	-0.02 (0.011)**	-0.13 (0.000)***	-0.28 (0.000)***	NA	0.00, 0.01, 0.02, 0.03	0.77, 0.75, 0.90, 0.96	10
BOE	90-day rate	0.00 (0.659)	0.00 (0.801)	-0.09 (0.361)	-0.22 (0.379)	NA	0.00, 0.01, 0.04, 0.09	0.18, 0.11, 0.27, 0.18	13
	1-year	0.00 (0.812)	-0.01 (0.516)	-0.07 (0.417)	-0.22 (0.335)	NA	0.00, 0.01, 0.04, 0.07	0.09, 0.21, 0.22, 0.19	13
South Korea	90-day rate	0.04 (0.011)**	0.09 (0.010)***	0.44 (0.010)***	0.90 (0.008)***	NA	-0.01, -0.00, 0.01, 0.02	0.46, 0.45, 0.33, 0.44	13
	1-year	0.02 (0.003)***	0.05 (0.001)***	0.25 (0.001)***	0.60 (0.0010)***	NA	-0.00, -0.00, -0.00, -0.02	0.53, 0.61, 0.68, 0.76	13
Australia	90-day rate	0.03 (0.001)***	0.04 (0.002)***	0.49 (0.002)***	0.88 (0.001)***	NA	-0.00, ** -0.01, ** -0.04, -0.05	0.65, 0.64, 0.46, 0.54	18
	1-year	0.02 (0.004)***	0.04 (0.002)	0.41 (0.014)**	0.61 (0.000)***	NA	-0.00, -0.00, -0.01, -0.02	0.43, 0.48, 0.28, 0.35	18
India	90-day rate	0.05 (0.300)	0.15 (0.052)*	0.77 (0.019)**	1.71 (0.000)***	NA	0.00, 0.01, 0.03, 0.01	-0.03, 0.10, 0.18, 0.45	23
	1-year	0.02 (0.064)*	0.08 (0.002)***	0.41 (0.000)***	1.19 (0.000)***	NA	0.00, -0.00, -0.00, -0.00	0.07, 0.32, 0.48, 0.55	23
Taiwan	90-day rate	0.05 (0.004)***	0.11 (0.002)***	0.49 (0.000)***	0.97 (0.000)***	NA	0.00, 0.01, 0.01, -0.01	0.47, 0.51, 0.66, 0.79	19
	1-year	0.03 (0.000)***	0.06 (0.000)***	0.31 (0.000)***	0.70 (0.000)***	NA	-0.00, -0.00, -0.00, -0.00	0.55, 0.66, 0.71, 0.78	19
Philippines	90-day rate	0.00 (0.994)	0.01 (0.878)	0.20 (0.679)	0.45 (0.508)	NA	0.00, 0.00, -0.05, -0.11	-0.13, -0.13, -0.11, -0.06	18
	1-year	0.800 (0.894)	0.01 (0.781)	0.17 (0.573)	0.32 (0.453)	NA	-0.01, -0.01, -0.06, -0.11	-0.03, -0.05, -0.04, 0.01	18

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Table 5 (Continued)

		Panel F - Philippines							
Central bank		-1-0	-1-+1	-5-+5	-10-+10	Technology	Recession	Adj R ²	N
Philippines	90-day rate	NA	NA	0.22 (0.521)	0.84 (0.289)	NA, NA, 0.63, 0.16	NA, NA, 0.46, 0.05	NA, NA, 0.02, 0.02	24
	1-year rate	NA	NA	0.17 (0.524)	0.07 (0.871)	NA, NA, 0.00, 0.02	NA, NA, 0.01, -0.02	NA, NA, -0.12, -0.14	24
ECB	90-day rate	0.00 (0.933)	0.00 (0.933)	0.02 (0.990)	0.24 (0.458)	0.00, 0.00, 0.40, -0.02	0.00, 0.00, 0.35, 0.03	0.00, 0.00, -0.06 -0.11	24
	1-year rate	0.00 (0.924)	0.00 (0.924)	0.40 (0.035)**	0.36 (0.228)	0.00, 0.00, -0.08 -0.08	0.00, 0.00, 0.14, 0.13	-0.01, -0.01, 0.16, -0.02	23
FOMC	90-day rate	0.00 (0.896)	0.00 (0.896)	-0.01 (0.772)	0.03 (0.528)	0.00, 0.00, -0.02, -0.02	0.00, 0.00, 0.00, 0.01	-0.07, -0.07, -0.03, -0.05	38
	1-year rate	0.00 (0.768)	0.00 (0.768)	0.00 (0.949)	-0.07 (0.196)	0.00, 0.00, -0.02, 0.00	0.00, 0.00, -0.02, 0.00	-0.05, -0.05, -0.06, -0.03	38
BOE	90-day rate	1.29 (0.555)	NA	0.07 (0.574)	0.01 (0.932)	-0.60, NA, 0.06, 0.08	0.41, NA, -0.01, -0.02	-0.06, NA, -0.01, -0.02	28
	1-year rate	1.603 (0.555)	NA	-0.02 (0.803)	-0.11 (0.483)	-0.74, NA, 0.06, * 0.04	0.51, NA, -0.03, -0.04	-0.06, NA, 0.02, -0.05	28
South Korea	90-day rate	NA ()	0.20 (0.085)*	0.51 (0.002)***	-0.73 (0.208)	0.00, -0.02, 0.44, 0.12	0.00, 0.02, 1.21, -0.25,	0.00, 0.01, 0.54, 0.01	28
	1-year rate	NA ()	0.23 (0.121)	0.04 (0.870)	0.02 (0.952)	NA, -0.02, 0.00, 0.00	NA, 0.04, -0.04, -0.03	NA, -0.00, -0.09, -0.11	28
Australia	90-day rate	-0.01 (0.582)	-0.01 (0.582)	0.33 (0.001)***	-0.14 (0.713)	0.00, 0.00, 0.67, *** -0.04	0.00, 0.00, 0.45, ** -0.05	-0.05, -0.05, 0.65, -0.06	30
	1-year rate	0.00 (0.299)	0.00 (0.299)	0.07 (0.469)	0.07 (0.781)	0.00, 0.00, -0.03, -0.04	0.00, 0.00, 0.03, 0.00	-0.06, -0.06, -0.04, -0.08	30
India	90-day rate	-0.11 (0.040)**	-0.10 (0.083)*	0.98 (0.011)**	0.75 (0.460)	NA	0.00, 0.01, 0.82, 0.14	0.10, 0.10, 0.18, -0.04	25
	1-year rate	0.14 (0.032)	0.13 (0.039)**	0.22 (0.397)	0.39 (0.475)	NA	0.00, 0.00, 0.07, * 0.08	0.13, 0.12, 0.05, -0.04	24
China	90-day rate	NA	-0.01 (0.583)	1.68 (0.008)***	-0.29 (0.837)	NA	NA, 0.00, 1.32, * -0.02	NA, 0.03, 0.37, -0.16	15
	1-year rate	NA	0.17 (0.583)	0.01 (0.987)	0.33 (0.634)	NA	NA, -0.04, -0.05, -0.06	NA, 0.03, -0.12 -0.07	15
Taiwan	90-day rate	0.00 (0.965)	0.00 (0.576)	0.32 (0.026)**	0.09 (0.619)	0.00, * 0.00, 0.78, ** 0.01	0.00, 0.00, 0.80, ** -0.01	0.06, 0.02, 0.45, -0.06	41
	1-year rate	0.00 (0.767)	0.00 (0.969)	0.14 (0.260)	0.17 (0.271)	0.00, 0.00, 0.00, -0.02	0.00, 0.00, -0.03, 0.00	0.02, -0.03, 0.01, -0.04	41

Regression results of $R_{t,t+n} = \alpha_0 + \beta_1 \Delta OIR + \beta_2 Technology + \beta_3 Recession + \varepsilon_t$, here $R_{t,t+n}$ is the log change in interest rates for various intervals, $t = -10, -5, -1$ and $n = 0, 1, 5$ and 10). For example, $R_{(-5,5)}$ is $\text{Log}(R_5) - \text{Log}(R_{-5})$. ΔOIR equals $\text{Log}(OIR_0) - \text{Log}(OIR_{-1})$ where $0 =$ date of announcement and rate change. P -value in parentheses. *, **, *** represent 1%, 5% and 10% levels of confidence, respectively.

announcements by the ECB, but the coefficient is also low at 0.40. We conclude that OIR announcements by India and China had the strongest impact on the Philippines' short-term interest rates.

Overall, we conclude that announcements by the central banks of six Asia-Pacific countries impact the market interest rates of the other countries in the study. The two dominant countries were India and China whose OIR announcements affected the market rates of all other countries with coefficients close to 1.0 or above. Interestingly, the OIR announcements by India affected primarily short-term rates while OIR announcements by China affected long-term rates. One likely explanation is that infrequent announcements by China signal long-term policy changes and hence affect the long-term rates of other countries. Finally, announcements by the three dominant central banks, FOMC, ECB and BOE, seem to have less impact on interest rates in the Asia-Pacific. In addition, their coefficients were generally negative for five of the six countries, indicating that rate increases in the West triggered opposite reactions in the Asia-Pacific region.

Dummy variables

The *Technology* dummy variable provides information on the impact of technological advances and financial liberalisation on market responses to OIR announcements. In the case of Taiwan in Panel A, the technology coefficient is negative and significant for two of the four intervals on announcements by its own central bank (-0.06 for 90-day and -0.03 for 10-year rates). The results indicate that the market responses on average are lower in the post-2005 period. The results are similar for South Korea in Panel B where the average responses are lower in the post-2005 period for Taiwan's announcements. The technology coefficients of South Korea are positive and statistically significant for ECB announcements indicating that average responses are higher in the post-2005 period. Panel D shows the technology dummy in India for OIR announcements by South Korea is 0.05 for short-term rates in the $(-1-+1)$ interval. Finally, Panel F shows the technology dummy is positive and statistically significant for two coefficients for the market rates in the Philippines in response to OIR announcements by Australia and Taiwan. Overall, we conclude that results are mixed, indicating that the technological advances and financial liberalisation have impacted market rates in diverse ways. Lower responses in Taiwan and South Korea indicate that increased transparency has made OIR information less valuable while it has increased the market responses in India and the Philippines.

The *Recession* dummy also showed mixed results. For Taiwan, market rates for the 10-year rates in the $(-10-+10)$ interval were lower in response to announcements by its own central bank after 2008. The responses are also lower for short-term rates following OIR announcements by the FOMC in the $(-1-0)$ and $(-5-+5)$ intervals, and positive for long-term rates in the $(-10-+10)$ interval. For South Korea, the coefficients for short-term rates are positive for announcements by its central bank but negative for announcements by Australia and the Philippines. The responses of 10-year interest rates in Australia are higher for announcements by the FOMC in the $(-1-0)$ interval but lower for Taiwan in the $(-10-+10)$ interval. In the case of India, short-term market rates were lower for

OIR announcements by the FOMC but higher for announcements by Australia. Finally, short-term rates responded lower in China for OIR announcements by Australia but were higher in the Philippines, in addition to announcements by Taiwan and the BOE. These results indicate that the recession dummy has both positive and negative coefficients for most of the countries.

We conclude that the mixed results of the dummy variables, *Technology* and *Recession*, play a role in market responses to OIR announcements but additional analysis is required to explain the differences, which is beyond the scope of this paper.

Conclusions

Anticipation of the actions of monetary authorities (Fed watching) is now an integral job function for most bankers, analysts and portfolio managers. Considerable speculation and adjustments to debt and stock portfolios take place prior to regulators' scheduled meetings. In recent years, central banks have become more transparent in their announcements regarding rate changes, reducing the uncertainty of the future course of the economy. As a result, market participants are able to better anticipate the future changes in interest rates (Gravelle & Moessner, 2001).

This paper examines the impact of official interest rate (OIR) announcements of six Asia-Pacific countries, namely, Australia, China, India, South Korea, Philippines, and Taiwan. Two different impacts are examined. First, we determine whether OIR changes announced by central banks within a country triggers similar response at other central banks. This is important because if an OIR change by one central bank triggers an announcement at another central bank, market participants can anticipate rate changes not from their own central bank but from another central bank's announcement. Second, we study the impact of OIR announcements on market interest rates; an announcement of an OIR change should cause a parallel shift in the term structure of interest rates. We first look at the impact of OIR announcements only on domestic market interest rates. Next, we examine the impact of OIR announcements by other central banks on the market interest rates of a country. We believe this is the first paper to examine intra-country announcement effects of the six Asia-Pacific countries.

Using Granger causality tests, we find that a country's OIR changes affect OIR announcements in other countries. However, the Granger test is unable to identify one or more dominant countries that trigger announcements in the other countries. One explanation for multidimensional causation is the gradual integration of financial markets worldwide and the increased coordination between central banks in recent years. Although each central bank pursues its monetary policies based on domestic market conditions, the integration and interdependence of global banks and the resultant transmission of shocks have forced central banks to coordinate their monetary policies.

Event study tests show that OIR announcements by Taiwan, South Korea and Australia impacted only short-term rates in their own countries. India and China were exceptions and saw both their short- and long-term rates impacted by announcements of their central banks. Announcements by the central

bank of the Philippines had no effect on their market interest rates. All countries, except the Philippines, saw market rates adjust prior to announcements indicating that OIR changes were anticipated. This supports the efforts of central banks in recent years to increase transparency and reduce economic uncertainty for market participants, in contrast to OIR announcements of the past which were often shrouded in secrecy.

We next examine the impact of OIR announcements on the market interest rates of the other countries in the sample. The results show that OIR announcements by one country impacted the market interest rates of the remaining five countries in varying degrees. The two dominant countries were India and China whose OIR announcements affected the market rates of all the other countries. The OIR announcements by India affected short-term rates while OIR announcements by China affected long-term rates. One likely explanation for the difference is that the OIR changes in China were infrequent and could signal long-term policy changes and hence affect the long-term rates of other countries. China, in return, was also the only country to be affected by OIR announcements of all the five countries. We also tested the announcement effects of three other central banks, those of the United States (Fed), United Kingdom (BOE) and Europe (ECB). The results show that their announcements had a marginal impact, indicating that monetary policies among the Asia-Pacific countries are more interconnected than with those in the West.

Finally, we test for two other developments in the financial markets during the sample period. First, the gradual liberalisation of financial markets and advances in technology transformed market trading in many of these countries during the sample period. Second, the 2008 recession increased uncertainty in the markets and dampened bond market activity. The results of dummy variables in the regressions are mixed and we cannot conclusively state that market responses were impacted uniformly in all six countries. Additional tests will be required to separate the varying effects and should be a consideration for future research.

This paper provides preliminary evidence on the effectiveness of central banks in transmitting monetary policy in the six Asia-Pacific countries. Three of the countries, China, India and the Philippines, liberalised their financial markets later than the other countries. Restrictions on banking activities have only been lifted recently. The Reserve Bank of India, for example, allowed banks to set their own deposit rates on savings accounts only in 2011. The Peoples Bank of China removed the cap on loan rates in 2013 and deposit rates in 2015. Although the Philippines officially deregulated bank rates in 1983, there is a maximum markup of 5% between the deposit and interest rate. Our results can serve as benchmarks for future research incorporating recent data in a fully liberalised market.

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