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Can monetary policy surprise the market?

Edda Claus, Department of Economics, Wilfrid Laurier University
and the Centre for Applied Macroeconomic Analysis, ANU
Mardi Dungey, School of Economics and Finance, University of Tasmania,
the Centre for Applied Macroeconomic Analysis, ANU
and the Centre for Financial Analysis and Policy, University of Cambridge

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Edda Claus[‡]*and Mardi Dungey[°]
[‡] Wilfrid Laurier University and CAMA
[°] The University of Tasmania, CAMA and CFAP

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Abstract

This paper extracts measures of monetary policy surprises for Australia, Canada and the United States using a latent factor framework. We distinguish monetary policy surprises which occur when central banks report new assessments of the economy (or do not reinforce changes expected by market assessments) from those when policy makers appear to change their preferences. Changing policy preferences are evident in all jurisdictions, particularly during periods of stress. No-change policy announcements have distinctly differing impacts across the three countries; in Canada these have the same impact as policy changes, in Australia they are not discernibly different to a normal trading day and the US market lies between these scenarios. The revealed differences in size and type of the policy surprise outcomes for these operationally similar central banks suggests that the role of transparency policy is more subtle than previously appreciated.

Key Words: monetary policy, central banks, latent factor model.
JEL Classifications: E43, E52, C38.

*Corresponding author. Edda Claus, School of Business and Economics, Wilfrid Laurier University, 75 University Avenue West, Waterloo, ON, N2L 3C5, Canada. Email: eclaus@eddaclaus.com.

"If market agents can broadly anticipate policy responses, this allows a rapid implementation of changes in monetary policy into financial variables...accelerate any necessary economic adjustments... and potentially enhance the effectiveness of monetary policy." (ECB)[1]

1 Motivation

Our current understanding of monetary policy transmission places emphasis on transparency as a means of improving monetary policy efficacy. The clear communication of central bankers' view of the economic environment, and an understanding of how they may be expected to react to economic developments promotes certainty and thus an easier economic environment for investment and consumption decisions – a theme that echoes through academic and central bank writings for decades; e.g. Miles (2015), Crowe and Meade (2008), Santomero (2002), Friedman (1968).

Clear communication ought to result in relatively few monetary policy surprises to financial markets. Surprises should occur only when the central bank has new information on the state of the economy which is not widely available, or where the central bank has a differing interpretation of the existing information from the rest of the economy, or finally where the central bank changes its preferences for reacting to economic information. The theoretical model of Ellingsen and Söderström (2001) does precisely this, producing a yield curve shift in response to new economic data, or a yield curve rotation when confronted with a change in preferences; see also Gürkaynak (2014). Empirical evidence is growing supporting these theoretical predictions; see, for example, Winkelmann *et al.* (2015), Claus and Dungey (2012), Rudebusch and Wu (2008) and Peersman (2002).

This paper examines monetary policy surprises for Australia, Canada and the United States. The results show that, although monetary policy in all three countries is operationally similar, there are important differences in the types and sizes of policy shocks. Evidence for yield curve rotations, consistent with changing central bank preferences are evident in all three countries, most clearly during periods of economic turmoil. Reactions to economic data are more complex. Monetary policy surprises associated with announced changes in interest rates result in identifiable effects for each country. However, the

[1] Transparency at: http://www.ecb.eduropa.edu/ecb/orga/transparency/html/index.en.html, accessed January 26, 2015.

reactions to monetary policy announcement days which contain no change to the policy rate, the effects of surprises differ. In Australia, no-change policy days are not statistically different to days without monetary policy news. In Canada, no-change policy days have similar effects to days where policy changes are announced and in the US the reaction to no-change surprises is present, but differs to the effects on days policy changes are announced.

The three monetary policy making bodies are achieving differing results by the way in which markets are surprised by their actions. Overall, policy shocks tend to be largest in Canada. Many cases of no-change in monetary policy are unexpected and the Bank of Canada (BoC) is perceived as changing preferences more frequently than the two other central banks in the sample. These findings are perhaps surprising given the BoC typically outperforms both the Reserve Bank of Australia (RBA) and the US Federal Reserve (Fed) in measures of degree of transparency; see Dincer and Eichengreen (2007, 2010) and Eijffinger and Geraats (2006). A possible explanation for this finding is that measures of transparency often rely on inputs, such as the type and frequency of central bank publications and legal and institutional frameworks,[2] rather than outcomes: 'Do financial markets understand what the central bank is doing?' When outcomes are considered, the focus tends to be on inflation and output rather than financial variables and consequently with relatively infrequently updated data; see, for example, Crowe and Meade (2008), Demertzis and Hallett (2007) both of whom use annual data while Geraats (2002) ties a theoretical model to the extensive literature on monetary policy announcement effects but does not provide an empirical implementation.

The paper provides the first estimates of the size of monetary policy shocks for the Australian and Canadian markets, and identifies an additional 6 years of shocks from 2008 onwards for the US from that published in Claus and Dungey (2012) which augments those provided in Romer and Romer (2004). The approach is similar in spirit to the method proposed by Thornton (2014), but allows for two different types of policy shocks and while we provide analysis of the differences in our results over a limited subsample a full comparison of these approaches is a subject for future research.

The remainder of this paper is organized as follows. Section 2 sketches the empirical model and shows how monetary policy shocks can be extracted using the entire maturity structure of the yield curve. Section 3 discusses the data

[2] Central bank transparency is generally studied across five aspects: political, economic, procedural, policy and operational transparency (Geraats, 2002).

and Section 4 gives the estimation results. Section 5 discusses the extracted monetary policy shocks and the final Section 6 offers some concluding remarks.

2 Empirical framework

We implement a latent factor model framework which endogenously distinguishes two types of monetary policy actions. This framework has the advantage of being easy to implement, requiring only daily returns data and a chronology of monetary policy actions, and the clear benefit of extracting a measure of the monetary policy shocks from data that does not require an *ex ante* capturing of market expectations.

2.1 The model and identification

Consider a latent factor representation of demeaned change in the interest rate for a zero-coupon bond at maturity j at time t as follows:

$$r_{j,t} = \alpha_j m_t + \beta_j n_t + \gamma_j a_t + \kappa_j I_\kappa b_t + \tau_j I_\tau c_t + \delta_j d_{j,t}. \qquad (1)$$

The last four terms of the expression consist of a common shock, a_t, and b_t and c_t represents curvature effects – b_t captures changes at the short end of the curvature, with $I_\kappa = 1$ for $j < j^*$ and 0 otherwise and c_t captures changes at the long end $I_\tau = 1$ for $j \geqslant j^*$ and 0 otherwise – and $d_{j,t}$ represents idiosyncratic shocks to $r_{j,t}$; see Cox, Ingersoll and Ross (1985). The first two terms in the expression, m_t and n_t, represent the two potential monetary policy shocks that apply only on days where a monetary policy action is due and are hence zero on all other days. We allow for two types of shock to accommodate both the theoretical model of Ellingsen and Söderström (2001) and the empirical evidence in Claus and Dungey (2012) and Winkelmann *et al.* (2015). Thus, m_t represents a monetary policy shock that causes a shift in the yield curve while n_t potentially causes a rotation in the yield curve. All Greek letters represent factor loadings and by assumption all factors are independent and identically distributed with zero means and unit variances; see Claus and Dungey (2012). Identification relies on heteroskedasticity observed via the differing outcomes on policy and non-policy days as in Rigobon and Sack (2004) and Craine and Martin (2008).

Rewriting equation 1 in matrix form gives the following form for non monetary policy days (OTH)

$$R_t = \Psi H_t \text{ for } t \in T^{OTH} \tag{2}$$

and on monetary policy days (MPM and MPN)

$$R_t = \Psi H_t + \Phi m_t \text{ for } t \in T^{MPM} \tag{3}$$

$$R_t = \Psi H_t + \Pi n_t \text{ for } t \in T^{MPN} \tag{4}$$

where R_t is an $(N \times 1)$ vector of $r_{j,t}$. H_t is an $((N+1) \times 1)$ vector of shocks where the common shock a_t is in the first row and the idiosyncratic shocks are in the remaining N rows. The matrices Ψ, Φ and Π contain the factor loadings and Ψ is $(N \times (N+1))$ and Φ and Π are $(N \times 1)$. As the factors are assumed independent, the variance-covariance matrix for R_t, where Ω^i with $i = OTH, MPM, MPN$, can be expressed as follows;

$$\Omega^{OTH} = \Psi\Psi' \tag{5}$$

$$\Omega^{MPM} = \Psi\Psi' + \Phi\Phi' \tag{6}$$

$$\Omega^{MPN} = \Psi\Psi' + \Pi\Pi' \tag{7}$$

The expression in equation (6) applies on the monetary policy days with policy shock type 1 and equation (7) applies on monetary policy days with policy shock type 2. Equation (5) applies on all other days. Importantly, the model does not require *a priori* classification of policy days into shift and rotation policy shocks, rather, the empirical model is left to determine endogenously the presence of two types of policy shocks.

An additional identifying restriction is imposed on the model to empirically separate the two monetary policy shocks. Interest rate responses to both types of monetary policy shocks are set equal at the shortest maturity. It is reasonable to assume that each type of monetary policy shock causes a similar response of the 90 day rate as in the application for Australia and Canada but we recognize that the assumption is less reasonable for the US application where the shortest yield is one year.

2.2 Extracting monetary policy shocks

We extract the policy shocks over the sample period using simulation. Solving for each monetary policy shock in equations (3) and (4) and recognizing that only one type of policy shock can occur on any particular monetary policy day gives

$$\begin{aligned} m_t &= \Psi^{-1} R_t - \Psi^{-1} \Phi H_t \\ n_t &= \Pi^{-1} R_t - \Pi^{-1} \Phi H_t \end{aligned}$$

Using the estimated factor loadings for Ψ, Π and Φ and given R_t, 5000 estimates of $\widehat{m}_t$ and $\widehat{n}_t$ are simulated by drawing H_t from the random N(0,1) distribution. Estimates of the true monetary policy shocks, $\widetilde{m}_t$ and $\widetilde{n}_t$ are the median of those obtained by minimizing the squared errors $\left(\widetilde{m}_t - \widehat{m}_{j,t}\right)^2$ and $\left(\widetilde{n}_t - \widehat{n}_{j,t}\right)^2$. An additional penalty condition restricts the estimates from becoming inconsistent with the original estimates of Π, and Ψ by minimizing the squared distance between these and those generated using the estimated true monetary policy shocks, denoted $\widehat{\Pi}$ and $\widehat{\Psi}$ as follows: $R_t = \widehat{\Psi}\widetilde{m}_t + \varepsilon_{1t}$ and $R_t = \widehat{\Pi}\widetilde{n}_t + \varepsilon_{2t}$; this process is similar to that implemented in Claus and Dungey (2012).

3 Data

The latent factor model is applied to the demeaned first difference of daily interest rate data for Australia, Canada and the United States. The daily interest rates are the 90 day and 180 day T-bills and the 2 year, 5 year and 10 year bond yields for Australia and Canada. For the United States, the model is applied to the 1 year, 2 year, 3 year, 5 year and 10 year demeaned bond yields.

Australia and Canada are a natural choice for this analysis as both are early adopters of inflation targeting and have had a stable goal for monetary policy over a relatively long span, that is a particular inflation rate that can be checked against a firmly established target and good histories of monetary policy announcements. The Unites States is included as the benchmark market, with particular relevance during the difficult period of the 2008-09 financial crisis and subsequent recovery. The impact of the financial crisis and its aftermath was relatively muted for both Australia and Canada; although both were affected by the global credit crunch, their financial systems withstood the crisis. In addition, while Canada entered a relatively short and shallow recession, growth in gross domestic product (GDP) in Australia never dipped below zero.

The sample periods for each country differ slightly due to data availability. Each sample includes three sets of days, two sets of monetary policy days and all other days. As all three central banks make policy announcements on pre-determined days for at least part of the sample, there are two sets of monetary policy days. The first set of policy days includes all pre-determined announcement days when monetary policy actually changed. A second set of policy days also includes those pre-determined announcement days when monetary policy remained unchanged. It is not clear, *a priori*, how the latter set of policy days should be classified; unchanged policy could be unanticipated and hence be classified as a policy shock, or be fully anticipated and thus be like all other days. This paper finds evidence in the Canadian data that no-change days are like policy days, whereas in the Australian data no-change days are like all other days.

3.1 Australia

The sample period for Australia is 3 January 1993 to 28 November 2014. Policy changes are from the Reserve Bank of Australia (RBA) press releases. Between July 1997 and December 2007, the RBA announced changes to the target cash rate (TCR) on the day following its 11 monthly Board meetings - on the first Tuesday of each month except January.[3] In December 2007, the RBA announced that, amongst other changes in communication, starting from February 2008, monetary policy announcements in Australia would occur on the Tuesday afternoon of the Board meetings and policy would be implemented the following day. Thus from February 2008 monetary policy days are coded to the day of the Board meeting.[4]

Table 1 gives the sample standard deviations of demeaned bond returns for Australia. The table shows the statistics for monetary policy change days compared to all other days and monetary policy announcement days (change and no-change announcement days) and all other days. Between 3 January 1993 and 28 November 2014, there are 55 days on which monetary policy changed and 146 pre-determined announcement days when policy did not change (note: $55 + 146 = 201$).

[3] All changes between July 1997 and December 2008 occurred on the Wednesday mornings following the first Tuesday of the month.

[4] Careful inspection of policy changes since February 2008 suggests that markets react to the policy announcements rather than their implementation the following day.

The table points to strong heteroskedasticity between monetary policy change days and all other days and weaker heteroskedasticity between all policy announcement days and all other days. For both sets of policy days, the standard deviation declines with maturities of 180 days and up but rises with maturities for all other days.

Table 1: Standard deviations, monetary policy change days *versus* all monetary policy announcement days Sample: 3 January 1993 to 28 November 2014;

	Mon. pol change days		Mon. pol announcement days	
	Policy days	All other days	Policy days	All other days
90 day	17.284	3.465	9.816	3.443
180 day	18.722	4.195	10.815	4.172
2 year	16.131	6.801	10.291	6.801
5 year	11.947	7.473	8.450	7.496
10 year	9.220	7.067	7.141	7.094
No. days	55	5659	201	5513

3.2 Canada

The sample period for Canada is 22 February 1996 to 28 November 2014[5] and policy changes are identified by changes in the target for the overnight rate. Two changes in the bank rate are excluded as the target for the overnight rate did not change on those dates. These are 22 February 1996 and 16 October 1996 when the bank rate increased 9 and decreased 25 basis points while the target rate remained unchanged at 5.19 and 3.75 percent.

In November 2000, the BoC introduced eight fixed announcement days per year on which it communicates whether the target for the overnight rate is adjusted or remains unchanged. The target rate may however change in addition to these fixed dates. Two unscheduled monetary policy changes occurred (i) on 17 September 2001 when the target rate was decreased 50 basis points from 4.0 to 3.5 per cent in the aftermath of the September 11, 2001 terrorist attacks in

[5] Although the BoC website provides a chronology of changes in the bank rate since the founding of the BoC in 1935, Canada's central bank rate and its operation have experienced a number of changes over the past 70 years. The sample here covers the most recent means of operation since February 1996. The 22 February starting point is in line with the starting point of the current key interest rate period determined by the BoC; see *A history of the key interest rate* (http://www.bankofcanada.ca/en/policy/bankrate_history.html, accessed January 26, 2015).

the United States and (ii) during the height of the 2008-09 financial crisis, on 8 October 2008 when the target rate was decreased 50 basis points from 3.0 to 2.5 per cent.

Table 2 gives the sample standard deviations of demeaned bond returns for Canada between 22 February 1996 and 28 November 2014. Over that 18 year period, monetary policy changed 66 times and remained unchanged 71 times on policy announcement days. The table shows that standard deviations decline with maturity for both sets of monetary policy days and declines for maturities 2 years and up for all other days. In addition, the table shows heteroskedasticity between policy and non policy days, and, unlike Australia, the two sets of policy days display similar standard deviations.

Table 2: Standard deviations, monetary policy change days *versus* all monetary policy announcement days Sample: 22 February 1996 to 28 November 2014;

	Mon. pol change days		Mon. pol announcement days	
	Policy days	All other days	Policy days	All other days
90 day	15.794	3.771	11.355	3.766
180 day	12.636	3.847	9.708	3.810
2 year	10.530	5.652	8.781	5.634
5 year	8.432	5.414	7.227	5.407
10 year	5.759	4.939	5.090	4.947
No. days	66	4831	137	4760

3.3 United States

The sample period for the United States is 4 January 1994 to 28 November 2014 and hence includes the period of unconventional monetary policy. The US Federal Reserve responded to the 2008-09 financial crisis with aggressive easing in monetary policy which led to a rapid decline of short term interest rates to virtually zero. As a consequence, the zero lower bound on short term interest rates has subsequently supported the use of unconventional monetary policy tools, including large scale purchases of securities and forward guidance where the Federal Reserve has made explicit statements on the path of monetary policy (for more details, see Claus *et al.*, 2014 *op cit.* and Cukierman, 2013).

Prior to December 2008, policy changes are identified by changes in the federal funds rate while post December 2008, changes are identified through

Federal Reserve press releases.[6] Since February 1994 policy actions have been announced on the day of the FOMC meeting. The FOMC meets on eight scheduled days during the year and holds other meetings as needed such as those on 13 and 17 September 2001. In the 24 year sample the Federal Reserve adjusted policy 72 times and left policy unchanged on 121 days, giving a total of 193 monetary policy announcement days. Policy announcement days include meeting days of the Federal Open Market Committee (FOMC) as well as hearings before the Committee on Banking and Financial Services, or Humphrey-Hawkins testimony days; see Rigobon and Sack (2004).

Table 3 gives the sample standard deviations of demeaned bond returns for the US between 4 January 1994 and 28 November 2014. Unlike returns for Australia and Canada, the US data are for bonds at medium to longer term maturities reflecting the binding zero constraint on short term interest rates over the second half of the sample.

Table 3: Standard deviations, monetary policy change days *versus* all monetary policy announcement days Sample: 4 January 1994 to 28 November 2014;

	Mon. pol change days		Mon. pol announcement days	
	Policy days	All other days	Policy days	All other days
1 year	8.313	4.412	7.267	4.346
2 year	9.453	5.579	8.850	5.490
3 year	9.573	5.920	9.132	5.832
5 year	9.849	6.235	9.387	6.151
10 year	8.426	5.938	8.388	5.870
No. days	72	5382	193	5261

Table 3 demonstrates heteroskedasticity on policy compared to non policy days with fairly constant standard deviation across the maturities and between the two sets of policy days. The similarity of the standard deviations on both sets of policy days suggests a considerable number of no-change policy surprises and is in line with Gürkaynak *et al.* (2005) who find that FOMC statements affect asset prices and in particular longer-term Treasury yields; see also Blinder

[6] Thornton (2006) shows that the FOMC has been effectively targeting the federal funds rates since 1982. There is some controversy whether all changes in the federal funds rate represent changes in monetary policy. Romer and Romer (2004) show that the federal funds rate may vary for reasons other than changes in monetary policy. We acknowledge this but assume that these instances are few and should hence not bias the empirical results.

et al. (2008) which includes a survey of central bank communications on asset prices.

4 Estimation results

Table 4 presents the estimation results from applying equations (5)-(7) to demeaned daily bond returns. Factor loadings are estimated by applying general method of moments (GMM), matching the theoretical second moments with those of the data. As the model is over-identified, moment conditions are weighted by the inverse of model variance/covariance matrix as in Hansen (1982).

Two sets of estimation results are presented for each country. In the first set of results, the monetary policy change days represent only those days where policy actually changed. In the second set of results, monetary policy days also includes all announcement days, including those where policy remained unchanged. The tables gives the factor loadings of interest with standard deviations in brackets below the estimates. One and two stars (* and **) indicate significance at the 10 and 5 per cent level. Table 4 juxtaposes the monetary policy factor loadings for both representations of monetary policy days for each country. The full estimation results are in Appendix A.

4.1 Australia

The upper left panels of Table 4 refer to the Australian estimation results. The first two columns of results are the estimated parameters on the two policy factors, m_t and n_t, when the monetary policy days contain only those on which monetary policy changes occurred. The second two columns are loadings on m_t and n_t when the monetary policy days sample also contains the no-change policy days.

The first two columns, containing only monetary policy change days, indicates the presence of two types of monetary policy shock. A shift in the yield curve is indicated by positive coefficients across all maturities for the m_t factor, $\alpha_i > 0\ \forall i$, and a rotation for the n_t factor with $\beta_i > 0$ for $i = 90\ day, ...5\ year$ and $\beta_i < 0$ for $i = 10\ year$. Two types of shocks are not present when all announcement days are included in the sample of monetary policy days shown in the second panel of Australian results where the coefficients are positive for both factors across all maturities, $\alpha_i, \beta_i > 0\ \forall i$. The factor loadings are relatively similar at each maturity for both m_t and n_t in this case.

The differing results for the two alternative samples are perhaps not surprising given the standard deviations presented in Table 1. The results suggest that there are not many no-change announcement days that have surprised the Australian fixed income securities market. No-change policy days seem to be more similar to all other days than to monetary policy change days. This suggests that the RBA might be relatively transparent in its view on the macroeconomy and give clear signals in advance when policy is to remain unchanged.

4.2 Canada

The right hand panels of Table 4 give the estimation results for Canada. The fifth and sixth columns of the table show the factor loadings for those days when policy changed and the seventh and eight the loadings when the policy announcement days also include no-change days. The results are similar for both samples. A shift in the yield curve is evident for the first factor in both cases with positive loadings across all maturities, $\alpha_i > 0\ \forall i$ while the second factor identifies a rotation with $\beta_i > 0$ for $i = 90\ day, ...2\ year$ and $\beta_i < 0$ for $i = 5$ *year* and 10 *year*. The factor loadings for the two samples are similar, in line with statistics presented in Table 2 that showed similar standard deviations on policy change days and on all policy announcement days. Both panels suggest that there are a considerable number of no-change policy days that surprise Canadian fixed-income securities traders.

A possible explanation is that markets do not have a clear understanding of the BoC's view on the Canadian economy. Even if a central bank does not explicitly signal upcoming changes in monetary in advance of the change, markets are not likely to be surprised by a no-change policy announcement if they clearly understand the underlying economic framework used to make decisions.

4.3 United States

Finally the bottom panel of Table 4 gives the estimation results for the United States. The first and second columns in this panel present the factor loadings on m_t and n_t resulting from the sample where only policy change days are included. The third and fourth columns contain the factor loadings where both policy change and no-change days are included in the sample. The empirical application identifies a shift and a rotation for both sets of days but the results differ.[7] In the first sample, where only policy change days are included, the sign on the 10 year rate is opposite to all other policy factor loadings, that is a rotation is indicated at the long end. When no-change policy announcement days are included in the sample the loadings on factor n_t for maturities of 2 years and longer are of opposite sign to the extreme short end, indicating a rotation from all but the short-end. A word of caution is warranted here, as the factor loadings are insignificant for all α_i and for β_i when $i \neq 2$, that is only the loading on the 2 year bond is significant (at the 10% level).[8]

The findings for the US are consistent with the evidence in Gürkaynak *et al.* (2005) of a distinct Fed announcement factor – when change announcements are included we find statistically significant coefficients and evidence of both shift and rotation monetary policy factors. The inclusion of the no-change announcements leads to statistically insignificant results, providing evidence that the monetary policy change sample is separable from the no-change results.

To summarize, the empirical results suggest not only similarities but also important differences in the effects of monetary policy shocks. The empirical application isolated two types of monetary policy shock on policy change days with one type of policy shock causing a shift and the other causing a rotation in the yield curve. An important difference in policy shocks across the economies is that no-change policy seems to rarely surprise Australian markets but more frequently to be consistent with policy surprise in Canada. In the United States the evidence for the effect of no-change days is that they are distinctly different to days of change announcement. If the ECB view at the beginning of this paper is taken as a benchmark, the empirical results indicate that the RBA is the most transparent central bank in the sample where transparent means that financial markets understand how the RBA forms its views on the Australian economy and how the RBA is likely to react to updated views on the economy.

Although no-change policy events seem to surprise markets in Canada and the United States, the surprises are different in both countries. While no-change policy surprises are similar to policy surprises in Canada this does not apply to the United States. Adding no-change and policy change days leads to similar results in Canada but to statistically insignificant results for the United States.

[7] This presence of yield curve shifts and rotations may partly explain the empirical failure of the expectations hypothesis of the term structure of interest rates reported for US bond yields; see Sarno *et al.* (2007).

[8] It is possible that these results may reflect the identifying restriction $\alpha_1 = \beta_1$.

Table 4: Estimation results from applying equation 5 to Australian, Canadian and U.S. T-bills and bond yields; Sample Australia: 3 January 1993 to 28 November 2014; Sample Canada: 22 February 1996 to 28 November 2014; Sample United States: 4 January 1994 to 28 November 2014;

	Australia				Canada			
	Change days		Announce. days		Change days		Announce. days	
	Mon. pol. Type 1 (m_t)	Mon. pol. Type 2 (n_t)	Mon. pol. Type 1 (m_t)	Mon. pol. Type 2 (n_t)	Mon. pol. Type 1 (m_t)	Mon. pol. Type 2 (n_t)	Mon. pol. Type 1 (m_t)	Mon. pol. Type 2 (n_t)
	α_i	β_i	α_i	β_i	α_i	β_i	α_i	β_i
90 day	9.568 **	9.568 **	6.524 **	6.524 **	3.665 **	3.665 **	3.778 **	3.778 **
	(1.936)	(1.936)	(0.989)	(0.989)	(1.600)	(1.600)	(1.239)	(1.239)
180 day	13.154 **	6.289 **	6.558 **	7.496 **	3.557 **	3.971 **	3.992 **	3.990 **
	(2.782)	(2.448)	(1.016)	(1.412)	(1.230)	(1.203)	(1.128)	(1.103)
2 year	10.293 **	2.844 *	6.148 **	5.228 **	4.210 **	1.633 **	4.691 **	2.055 **
	(1.811)	(2.077)	(0.807)	(0.774)	(0.946)	(0.760)	(0.000)	(0.875)
5 year	7.477 **	0.961	5.184 **	3.135 **	4.470 **	-3.002 **	4.624 **	-1.357 *
	(1.149)	(1.664)	(0.637)	(0.480)	(1.236)	(1.124)	(0.924)	(0.980)
10 year	6.436 **	-0.630	2.517 **	2.938 **	0.102	-1.415 **	1.226 **	-0.350
	(0.921)	(1.498)	(0.553)	(0.434)	(0.607)	(0.639)	(0.696)	(0.673)
	United States							
	Change days		Announce. days					
	Mon. pol. Type 1 (m_t)	Mon. pol. Type 2 (n_t)	Mon. pol. Type 1 (m_t)	Mon. pol. Type 2 (n_t)				
	α_i	β_i	α_i	β_i				
1 year	0.930 **	0.930 **	0.303	0.303				
	(0.403)	(0.403)	(0.720)	(0.720)				
2 year	3.126 **	0.906	0.975	-1.988 *				
	(0.681)	(1.612)	(6.365)	(1.407)				
3 year	3.842 **	2.031	2.118	-1.717				
	(0.995)	(2.057)	(5.546)	(4.726)				
5 year	3.207 **	2.534 *	2.751	-1.392				
	(1.328)	(1.816)	(4.563)	(6.943)				
10 year	1.522 *	-0.238	1.254	-0.950				
	(0.909)	(1.167)	(3.179)	(2.991)				

level of significance: ** 5 per cent, * 10 per cent

5 Extracting monetary policy shocks

Using simulation methods, the monetary policy shocks for each economy are extracted from the bond returns using the model parameters estimated in the previous section. As a first step, policy days were divided into shift and rotation days and fully anticipated monetary policy days based on the observed behavior of the yield curve on policy days. Shift days are those days where the product of the shortest and longest maturity return was positive and rotation days are those days where the product was negative. Fully anticipated monetary policy days are those days when changes at the shortest maturity were zero and the change at the long end was 2 basis points or less. Table 5 gives the classification of policy shocks for both samples for each country.

Table 5: Classification of monetary policy shocks

	Australia	Canada	United States
		Monetary policy change days	
Shift	40	42	47
Rotation	15	23	23
No change	0	1	2
		Monetary policy announcement days	
Shift	130	82	123
Rotation	65	47	59
No change	6	9	11

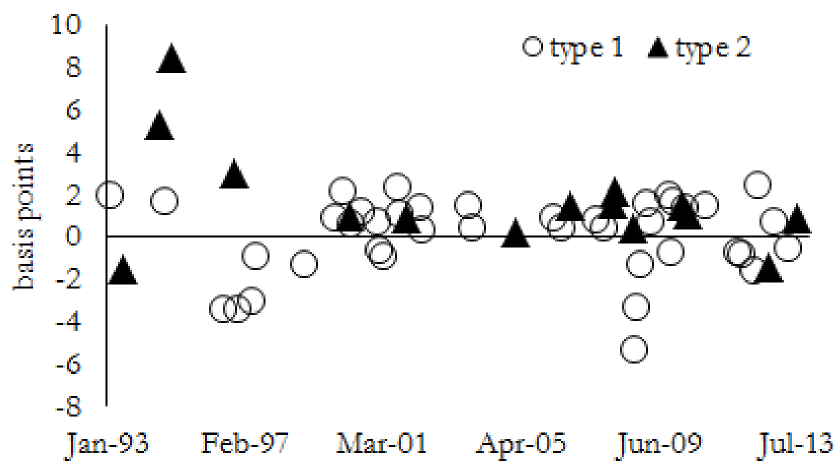
Sample Australia: 3 January 1993 to 28 November 2014;
Sample Canada: 22 February 1996 to 28 November 2014;
Sample United States: 4 January 1994 to 28 November 2014.

This classification led to 40 shifts, 15 rotations and no fully anticipated monetary policy change for Australia, 42 shifts, 23 rotations and 1 fully anticipated policy change for Canada and 47 shifts, 23 rotations and 2 fully anticipated changes in monetary policy for the United States. Canada has the largest proportion of rotations *versus* shifts (8 shifts : 4.4 rotations), Australia has the lowest proportion (8 shifts : 3 rotations) and the United States is in the middle (8 shifts : 3.9 rotations). For all announcement days, where no-change announcements are included, the proportions are similar; Australia and the United States have about the same proportion of shifts and rotations and Canada has, again, the largest number of rotations *versus* shifts.

The monetary policy shocks extracted from the model are given in Figures

1 to 3 where shift shocks are marked with a clear circle and rotation shocks are marked with a black triangle. The shocks were extracted from the sample containing monetary policy change days only. The shocks are not a continuous series but relate to the days of monetary policy action. Positive shocks represent tighter than expected policy and negative shocks represent looser than expected policy. A positive shock when policy was loosened means here that the policy easing was less than anticipated. This can be observed in particular in Australia during the financial crisis when some considered the RBA's initial policy actions to be too slow and too timid, thus the estimated shock on September 2, 2008 is for 0.412 a positive number during a period of dramatic easing. Appendix B includes tables with all the dates and shocks.

Figure 1: Australia: Two types of monetary policy shocks



The three figures point to important differences in policy shocks for the three countries. Policy shocks are largest in magnitude for Canada and smallest for Australia. This is perhaps surprising given that the central banks of all three countries typically change policy in steps of 25 basis points. Although larger changes are possible they tend to be rare and tend to be implemented during extraordinary events such as during the 2008-09 financial crisis.

Rotation shocks are more prevalent in Canada than the other two countries (as indicated by Table 5), and display less of the clustering around extraordinary events evident in the US and Australian outcomes. In particular, rotation shocks

Figure 2: Canada: Two types of monetary policy shocks

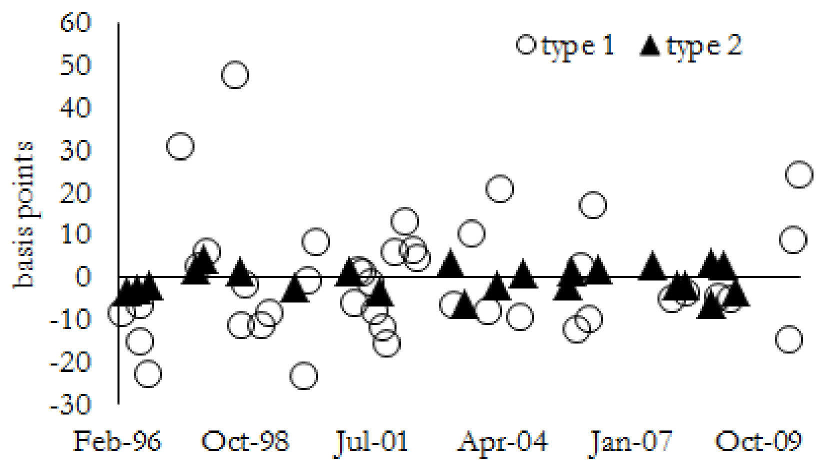
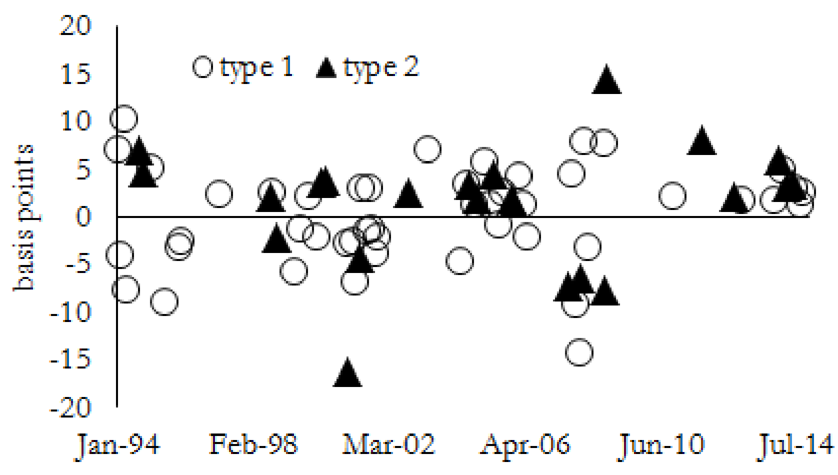


Figure 3: United States: Two types of monetary policy shocks



in the US occur in the aftermath of the 1997 Asian crisis, the dot-com bubble burst in 2000-01, following hurricane Katrina that devastated parts of Southern United States in August 2005, during the 2008-09 financial crisis and the zero-lower bound period thereafter. The occurrence in the 2008-09 crisis is consistent with the changes in wording of the FOMC statements issued during this period, to begin to include emphasis on employment; see Thornton (2011).

Thornton (2014) derives measures of the US monetary policy shocks for the period 2000-2006, and remarks both that the sizes of these shocks are relatively small, and that they reduce further in the post-2004 period where many zero surprises are recorded. Our results are not dissimilar in recording relatively small monetary policy surprises, of the order usually of only a few basis points, and we also find larger surprises on the inter-meeting target change days of January 3 and April 18, 2001 although slightly less evidence of a large change with the inter-meeting change days of September 7, 2001 and November 6, 2002. Indeed, we find that two of these inter-meeting dates, January 3, 2001 and November 6, 2002 are associated with surprises around changing central bank preferences rather than new economic news. We also find that rather than the frequent zero Kuttner shocks reported post-2004 in Table 5 of Thornton (2014), almost half of these dates are associated with rotations in our results, suggesting gradual learning about changes in the central bank preferences revealed by actions during this tightening phase of the cycle.

Our US results show that surprises were moderate during the period in the lead-up to the events of the financial crisis of 2008, when surprises in both information and revealed changes in central bank preferences are clearly evident in the results. In Australia, the greatest concentration of rotation shocks is during the financial crisis, which although small, add additional support to the hypothesis that actual or perceived changes in central bank preferences are often in times of instability and uncertainty.

6 Conclusion

This paper investigated whether monetary policy can surprise financial markets, where transparency arguments suggest that greater transparency will result in fewer surprises creating stability for the economy. However, central banks also respond to rapidly developing threats to the economy, which suggest that policy surprises may legitimately occur during rapidly emerging conditions such as the 2008 financial crisis. Markets respond to information from the central bank about its assessment of the state of the economy, and to evidence of changes in the preferences of the central bank. This paper uses a latent factor model specification to implement the theoretical framework of Ellingsen and Söderström (2001) and provide evidence of these phenomena for Australia, Canada and the US. In particular, the BoC and the RBA have a long history of inflation targeting and implementing monetary policy by targeting a specific level of the overnight rate.

All three central banks exhibit a number of instances of changing preferences across the sample, evidenced by the presence of yield curve rotations following monetary policy shocks. In the United States and Australia, these perceived changes in preferences tend to occur in times of increased economic uncertainty while they seem to occur more regularly in Canada.

All three central banks implement policy changes on pre-determined monetary policy announcement days. This means that there are two types of announcement days, those where monetary policy was changed and those announcement days where policy remained unchanged. The results suggest unchanged policy was mainly anticipated in Australia but was generally unanticipated in Canada. In Canada the no-change policy shocks produced similar market effects to shocks from policy changes. In the United States, no-change policy announcements also seem to surprise markets but the effect of these announcements provide different, and insignificant, loadings on the policy factors across the yield curve.

Overall, the findings support that the RBA has a policy agenda that is most anticipated (or best understood) by market participants, whilst the BoC was the least anticipated of the three with the Federal Reserve somewhere in the middle. This is a somewhat unexpected result given the similarities not only in the operational framework of monetary policy in Canada and Australia but also given the general similarities between these two small open economies and the findings in the transparency literature; Demertzis and Hallett (2007) rank the Bank of Canada as more transparent than the Reserve Bank of Australia but note that this is not true for all components of the transparency index. Our findings imply there are further complications to understanding either the composition of transparency indicators or important intangible aspects in the conduct of monetary policy that remain to be explored.

References

[1] Blinder, A.S., M. Ehrmann, M. Fratzscher, J. De Haan and F.-J. Jansen (2008), "Central bank communication and monetary policy: A survey of theory and evidence." *NBER Working Paper Series* 13932.

[2] Claus, E., Claus, I. and L. Krippner (2014), "Asset markets and monetary policy shocks at the zero lower bound" *Reserve Bank of New Zealand Discussion Paper DP2014/03* and *CAMA Working Paper 42/2014*.

[3] Claus, E. and M. Dungey (2012), "US monetary policy surprises: Identification with shifts and rotations in the term structure." *Journal of Money, Credit and Banking* 44(7), 1547–1557.

[4] Cox, J., J. Ingersoll and S. Ross (1985), "A theory of the term structure of interest rates." *Econometrica* 53(2), 385-408.

[5] Craine, R. and V. L. Martin. (2008), "International monetary policy surprise spillovers." *Journal of International Economics* 75(1), 180–196.

[6] Crowe, C. and E.E. Meade (2008), "Central bank independence and transparency: Evolution and effectiveness." *European Journal of Political Economy*, 24(4), 763-777.

[7] Cukierman, A. (2013), "Monetary policy and institutions before, during and after the global financial crisis." *Journal of Financial Stability* 9(3), 373-384.

[8] Demertzis, M. and A.H. Hallett (2007), "Central bank transparency in theory and practice." *Journal of Macroeconomics*, 29(4), 760-789.

[9] Dincer, N.N. and B. Eichengreen (2010), "Central bank transparency: Causes, consequences and updates." *Theoretical Inquiries in Law*, 11(1), 75-123.

[10] Dincer, N.N. and B. Eichengreen (2007), "Central bank transparency: Where, why, and with what effects?" *NBER Working Paper Series* 13003.

[11] Eijffinger, S.C.W. and P.M. Geraats (2006), "How transparent are central banks?." *European Journal of Political Economy*, 22(1), 1-21.

[12] Ellingsen, T. and U. Söderström (2001), "Monetary policy and market interest rates", *The American Economic Review*, 91(5), 1594-1607.

[13] Friedman, M. (1968) "The role of monetary policy." *American Economic Review*, 58(1), 1-17.

[14] Geraats, P.M. (2002), "Central bank transparency." *The Economic Journal*, 112(483), F532-F565.

[15] Gürkaynak, R.S. (2014), "Discussion of "Are long-term inflation expectations well anchored in Brazil, Chile, and Mexico."", *International Journal of Central Banking*, 10(2), 401-403.

[16] Gürkaynak, R.S., B. Sack and E.T. Swanson (2005), "Do actions speak louder than words? The response of asset prices to monetary policy actions and statements" *International Journal of Central Banking*, 1(1), 55-93.

[17] Hansen, L.P. (1982), "Large sample properties of generalized method of moments estimators." *Econometrica*, 50(4), 1029-1054.

[18] Miles, D. (2015), "What can monetary policy do?" speech given by David Miles, Monetary Policy Committee, Bank of England, University of Edinburgh Business School, January 22, 2015.

[19] Peersman, G. (2002), "Monetary policy and long term interest rates in Germany." *Economics Letters*, 77(2), 271-277.

[20] Rigobon, R. and B. Sack (2004), "The impact of monetary policy on asset prices." *Journal of Monetary Economics*, 51(8), 1553–1575.

[21] Romer, C.D. and H. Romer (2004), "A new measure of monetary shocks: Derivation and implications." *American Economic Review*, 94(4), 1055-1084.

[22] Rudebusch, G.D. and T. Wu (2008), "A macro-finance model of the term structure, monetary policy and the economy." *The Economic Journal*, 118(530), 906-926.

[23] Sarno, L., D.L. Thornton and G. Valente (2007), "The empirical failure of the expectations hypothesis of the term structure of bond yields." *Journal of Financial and Quantitative Analysis*, 42(1), 81-100.

[24] Santomero, A.M. (2002), "What monetary policy can and cannot do." *Philidelphia Federal Reserve Business Review*, Q1, 1-4.

[25] Thornton, D.L. (2014), "The identification of the response of interest rates to monetary policy actions using market based measures of monetary policy shocks." *Oxford Economic Papers,* 66(1), 67-87.

[26] Thornton, D.L. (2011), "What does the change in the FOMC's statement of objectives mean?" *Federal Reserve Bank of St Louis Economic Synopses,* 2011(1), 1-2.

[27] Thornton, D.L. (2006), "When did the FOMC begin targeting the federal funds rate? What the verbatim transcripts tell us" *Journal of Money, Credit and Banking,* 38, 2039-71.

[28] Winkelmann, L., M. Bibinger and T. Linzert (2015), "ECB monetary policy surprises: Identification through cojumps in interest rates." *Journal of Applied Econometrics*, forthcoming.

A Full estimation results

A.1 Australia

Table 6: Estimation results from applying Equation **??** to Australian T-bills and bond yields; Sample: 3 January 1993 to 28 November 2014; **Using only days when monetary policy changed.**

	Mon. pol. Type 1 (m_t) α_i	Mon. pol. Type 2 (n_t) β_i	Common (a_t) γ_i	Curvature (c_t) κ_i	Idiosyn. ($d_{i,t}$) δ_i
90 day	9.568 **	9.568 **	1.819 **	2.781 **	0
	(1.936)	(1.936)	(0.094)	(0.089)	
180 day	13.154 **	6.289 **	2.766 **	2.271 **	-1.964 **
	(2.782)	(2.448)	(0.111)	(0.101)	(0.045)
2 year	10.293 **	2.844 *	6.610 **	1.392 **	0
	(1.811)	(2.077)	(0.125)	(0.183)	
5 year	7.477 **	0.961	6.258 **	2.908 **	1.190 **
	(1.149)	(1.664)	(0.133)	(0.179)	(0.129)
10 year	6.436 **	-0.630	5.227 **	4.719 **	0
	(0.921)	(1.498)	(0.168)	(0.161)	

level of significance: ** 5 per cent, * 10 per cent

Table 7: Estimation results from applying Equation **??** to Australian T-bills and bond yields; Sample: 3 January 1993 to 28 November 2014; **Using all monetary policy announcement days.**

	Mon. pol. Type 1 (m_t) α_i	Mon. pol. Type 2 (n_t) β_i	Common (a_t) γ_i	Curvature (c_t) κ_i	Idiosyn. ($d_{i,t}$) δ_i
90 day	6.524 **	6.524 **	1.755 **	2.728 **	0
	(0.989)	(0.989)	(0.097)	(0.091)	
180 day	6.558 **	7.496 **	2.707 **	2.194 **	-1.949 **
	(1.016)	(1.412)	(0.114)	(0.101)	(0.044)
2 year	6.148 **	5.228 **	6.514 **	1.277 **	0
	(0.807)	(0.774)	(0.122)	(0.184)	
5 year	5.184 **	3.135 **	6.189 **	2.776 **	0
	(0.637)	(0.480)	(0.134)	(0.185)	
10 year	2.517 **	2.938 **	5.215 **	4.583 **	0
	(0.553)	(0.434)	(0.169)	(0.167)	

level of significance: ** 5 per cent, * 10 per cent

A.2 Canada

Table 8: Estimation results from applying Equation 5 to Canadian T-bills and bond yields; Sample: 22 February 1996 to 28 November 2014; **Using only days when monetary policy changed.**

	Mon. pol. Type 1 (m_t) α_i	Mon. pol. Type 2 (n_t) β_i	Common (a_t) γ_i	Curvature (c_t) κ_i	Idiosyn. ($d_{i,t}$) δ_i
90 day	3.665 **	3.665 **	1.684 **	1.684 **	2.318 **
	(1.600)	(1.600)	(0.128)	(0.250)	(0.214)
180 day	3.557 **	3.971 **	2.708 **	2.593 **	0
	(1.230)	(1.203)	(0.136)	(0.125)	
2 year	4.210 **	1.633 **	5.072 **	1.584 **	-1.863 **
	(0.946)	(0.760)	(0.178)	(0.260)	(0.210)
5 year	4.470 **	-3.002 **	4.330 **	3.239 **	0
	(1.236)	(1.124)	(0.167)	(0.186)	
10 year	0.102	-1.415 **	3.278 **	3.222 **	1.829 **
	(0.607)	(0.639)	(0.148)	(0.121)	(0.180)

level of significance: ** 5 per cent, * 10 per cent

Table 9: Estimation results from applying Equation 5 to Canadian T-bills and bond yields; Sample: 22 February 1996 to 28 November 2014; **Using all monetary policy announcement days.**

	Mon. pol. Type 1 (m_t)	Mon. pol. Type 2 (n_t)	Common (a_t)	Curvature (c_t)	Idiosyn. $(d_{i,t})$
	α_i	β_i	γ_i	κ_i	δ_i
90 day	3.778 **	3.778 **	1.626 **	1.703 **	2.275 **
	(1.239)	(1.239)	(0.126)	(0.252)	(0.213)
180 day	3.992 **	3.990 **	2.633 **	2.530 **	0
	(1.128)	(1.103)	(0.131)	(0.124)	
2 year	4.691 **	2.055 **	5.020 **	1.475 **	-1.651 **
	(0.954)	(0.875)	(0.178)	(0.263)	(0.214)
5 year	4.624 **	-1.357 *	4.338 **	3.162 **	0
	(0.924)	(0.980)	(0.168)	(0.189)	
10 year	1.226 **	-0.350	3.312 **	3.169 **	1.803 **
	(0.696)	(0.673)	(0.150)	(0.126)	(0.177)

level of significance: ** 5 per cent, * 10 per cent

A.3 United States

Table 10: Estimation results from applying Equation 5 to US bond yields; Sample: 4 January 1994 to 28 November 2014; **Using only days when monetary policy changed.**

	Mon. pol. Type 1 (m_t)	Mon. pol. Type 2 (n_t)	Common (a_t)	Curvature (c_t)	Idiosyn. $(d_{i,t})$
	α_i	β_i	γ_i	κ_i	δ_i
1 year	0.930 **	0.930 **	3.456 **	0.542 **	2.121 **
	(0.403)	(0.403)	(0.121)	(0.133)	(0.076)
2 year	3.126 **	0.906	5.402 **	0.746 **	0
	(0.681)	(1.612)	(0.123)	(0.170)	
3 year	3.842 **	2.031	5.594 **	1.026 **	1.161 **
	(0.995)	(2.057)	(0.120)	(0.089)	(0.051)
5 year	3.207 **	2.534 *	5.576 **	2.533 **	0
	(1.328)	(1.816)	(0.107)	(0.072)	
10 year	1.522 *	-0.238	4.754 **	2.867 **	-1.855 **
	(0.909)	(1.167)	(0.096)	(0.079)	0.038

level of significance: ** 5 per cent, * 10 per cent

Table 11: Estimation results from applying Equation 5 to US bond yields; Sample: 4 January 1994 to 28 November 2014; **Using all monetary policy announcement days.**

	Mon. pol. Type 1 (m_t) α_i	Mon. pol. Type 2 (n_t) β_i	Common (a_t) γ_i	Curvature (c_t) κ_i	Idiosyn. ($d_{i,t}$) δ_i
1 year	0.303	0.303	3.508 **	2.137 **	0
	(0.720)	(0.720)	(0.112)	(0.077)	
2 year	0.975	-1.988 *	5.443 **	0.029	0
	(6.365)	(1.407)	(0.108)	(0.037)	
3 year	2.118	-1.717	5.522 **	1.186 **	1.244 **
	(5.546)	(4.726)	(0.108)	(0.031)	(0.025)
5 year	2.751	-1.392	5.509 **	2.613 **	0
	(4.563)	(6.943)	(0.099)	(0.044)	
10 year	1.254	-0.950	4.702 **	2.892 **	-1.861 **
	(3.179)	(2.991)	(0.089)	(0.065)	(0.038)

level of significance: ** 5 per cent, * 10 per cent

B Monetary policy shocks

B.1 Australia

Table 12: Measures of policy shocks in basis points: grey indicates the shock is a rotation, 0.000 represents no surprise; Sample: 3 January 1993 to 28 November 2014

23/3/1993	1.923	3/5/2000	0.589	2/8/2006	0.372	1/12/2009	1.668
30/7/1993	-1.569	2/8/2000	1.155	8/11/2006	1.451	2/3/2010	1.437
17/8/1994	5.308	7/2/2001	0.710	8/8/2007	0.763	6/4/2010	1.405
24/10/1994	1.620	7/3/2001	-0.650	7/11/2007	0.385	4/5/2010	1.038
14/12/1994	8.512	4/4/2001	-0.939	5/2/2008	1.539	2/11/2010	1.501
31/7/1996	-3.455	5/9/2001	2.292	4/3/2008	2.098	1/11/2011	-0.753
6/11/1996	2.967	3/10/2001	1.061	2/9/2008	0.412	6/12/2011	-0.809
11/12/1996	-3.438	5/12/2001	0.910	7/10/2008	-5.350	1/5/2012	-1.601
23/5/1997	-3.056	8/5/2002	1.363	4/11/2008	-3.335	5/6/2012	2.385
30/7/1997	-0.960	5/6/2002	0.261	2/12/2008	-1.366	2/10/2012	-1.455
2/12/1998	-1.338	5/11/2003	1.438	3/2/2009	1.580	4/12/2012	0.685
3/11/1999	0.885	3/12/2003	0.406	7/4/2009	0.672	7/5/2013	-0.546
2/2/2000	2.144	2/3/2005	0.210	6/10/2009	1.907	6/8/2013	0.888
5/4/2000	0.997	3/5/2006	0.923	3/11/2009	-0.741		

B.2 Canada

Table 13: Measures of policy shocks in basis points: grey indicates the shock is a rotation, 0.000 represents no surprise; Sample: 22 February 1996 to 28 November 2014

21/3/1996	-8.838	31/3/1999	-11.672	4/6/2002	5.990	24/5/2006	1.679
18/4/1996	-3.268	4/5/1999	-8.446	16/7/2002	4.461	10/7/2007	3.015
19/7/1996	-2.897	17/11/1999	-2.317	4/3/2003	3.322	4/12/2007	-5.480
9/8/1996	-15.258	3/2/2000	-23.395	15/4/2003	-6.853	22/1/2008	-1.893
22/08/1996	-6.621	22/3/2000	-0.995	15/7/2003	-6.366	4/3/2008	-1.857
2/10/1996	-23.125	17/5/2000	8.217	3/9/2003	10.301	22/4/2008	-3.809
28/10/1996	-1.998	23/1/2001	1.548	20/1/2004	-8.419	8/10/2008	-6.282
8/11/1996	0.000	6/3/2001	-6.060	2/3/2004	-1.853	21/10/2008	3.126
26/6/1997	30.702	17/4/2001	1.384	13/4/2004	20.544	9/12/2008	-5.050
1/10/1997	2.133	29/5/2001	0.905	8/9/2004	-9.752	20/1/2009	2.793
25/11/1997	2.393	17/7/2001	-1.378	19/10/2004	1.009	3/3/2009	-5.321
12/12/1997	4.466	28/8/2001	-8.394	7/9/2005	-2.006	21/4/2009	-3.162
30/1/1998	5.684	17/9/2001	-3.355	18/10/2005	1.304	1/6/2010	-14.987
27/8/1998	47.625	23/10/2001	-12.093	6/12/2005	-12.332	20/7/2010	8.550
29/9/1998	1.637	27/11/2001	-15.907	24/1/2006	2.514	8/9/2010	23.916
16/10/1998	-11.713	15/1/2002	5.515	7/3/2006	-10.319		
18/11/1998	-1.914	16/4/2002	13.022	25/4/2006	16.572		

B.3 United States

Table 14: Measures of policy shocks in basis points: grey indicates the shock is a rotation, 0.000 represents no surprise; Sample: 4 January 1994 to 28 November 2014

4/2/1994	7.021	21/3/2000	3.656	10/11/2004	1.285	30/1/2008	-6.368
22/3/1994	-4.179	16/5/2000	3.708	14/12/2004	1.955	18/3/2008	7.804
18/4/1994	10.129	3/1/2001	-16.321	2/02/2005	0.000	30/4/2008	-3.263
17/5/1994	-7.738	31/1/2001	-2.826	22/3/2005	5.628	8/10/2008	7.550
16/8/1994	6.984	20/3/2001	-2.515	3/5/2005	1.196	29/10/2008	-7.696
15/11/1994	4.558	18/4/2001	-6.857	30/6/2005	4.418	25/11/2008	14.451
1/2/1995	5.046	15/5/2001	-4.236	9/8/2005	-0.823	3/11/2010	2.023
6/7/1995	-8.928	27/6/2001	2.921	20/9/2005	2.553	21/9/2011	8.094
19/12/1995	-3.229	21/8/2001	-1.615	1/11/2005	0.000	13/9/2012	2.129
31/1/1996	-2.625	17/9/2001	2.975	13/12/2005	1.809	12/12/2012	1.612
25/3/1997	2.228	2/10/2001	-1.237	31/1/2006	1.393	18/12/2013	1.694
29/9/1998	2.170	6/11/2001	-3.901	28/3/2006	4.237	29/1/2014	5.837
15/10/1998	2.458	11/12/2001	-2.272	10/5/2006	1.167	19/3/2014	4.881
17/11/1998	-2.147	6/11/2002	2.496	29/6/2006	-2.101	30/4/2014	3.127
30/6/1999	-5.926	25/6/2003	7.049	18/9/2007	-7.252	18/6/2014	3.441
24/8/1999	-1.424	30/6/2004	-4.808	31/10/2007	4.468	30/7/2014	2.888
16/11/1999	2.160	10/8/2004	3.276	11/12/2007	-9.254	17/9/2014	1.265
2/2/2000	-2.216	21/9/2004	3.398	22/1/2008	-14.389	29/10/2014	2.413