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Some benefits of monetary policy transparency in New Zealand*

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Abstract

The Reserve Bank of New Zealand (RBNZ) is regarded as one of the most transparent central banks in the world. Recent research suggests that one benefit of such transparency is that financial markets better anticipate a central bank's reaction to incoming data, and in relation, do not over-react to macroeconomic data surprises. In this paper, we provide some institutional details of how the RBNZ communicates its monetary policy decisions to financial markets and conduct an events analysis to test whether there are any transparency benefits in the pricing of New Zealand's yield curve. In line with the recent empirical literature, our results suggest that short-term interest rates tend to react appropriately to the data flow, while longer term interest rates are not unduly influenced. We also show that market reactions tend to be in line with the RBNZ's inflation target objective.

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1 Introduction

Over the past two decades or so central banks have become considerably more transparent about the motivation and thinking behind monetary policy actions. The genesis of this shift was likely the opening up of capital accounts and associated movement away from highly managed exchange rate regimes, wherein central bank secrecy was the modus operandi, towards the increasing focus on a price stability objective (whether this objective is legislated or not). This shift was enforced by the fact that some central banks, such as the Reserve Bank of New Zealand (RBNZ) and Bank of England, have had parliamentary Acts passed that require the rationale for monetary policy decisions to be publicly disclosed. In general, however, central banks with these obligations both provide much more information and communicate much more regularly with the public than require by the statutory obligations. In addition, it is notable that central banks without such statutory obligations have also tended to increase the transparency surrounding their policy process (e.g. see Eijffinger and Geraats 2006).

Perhaps the main motivation driving the behavior of central banks themselves towards increased transparency is the belief that influencing agents' expectations in pursuit of price stability objectives might enhance the efficacy of monetary policy. Persuading price and wage setters that the central bank is committed to a "no surprises" pursuit of its objective might better stabilize inflation expectations and inflation itself. In a similar vein, communicating policy decisions to financial market participants might better align market pricing of longer-term interest rates (and possibly the exchange rate) with the central banks' policy interests.

The burgeoning theoretical literature on transparency suggests there may be some transparency benefits. In particular, benefits may include a lower output "sacrifice" in the transition path from a high to low inflationary environment; the ability to conduct policy more flexibly in the Svensson (1997) sense, implying a reduction in macroeconomic volatility; a reduction in private sector uncertainty; and closer alignment of monetary policy with a socially optimal approach. On the other hand, some literature stresses that there may be transparency limits and costs. In particular, given that in practice all central banks operate in an environment where there is considerable uncertainty surrounding the way the economy works, the current state and future shocks, the formulation of monetary policy is best described as "constrained discretion" (Bernanke 2003). Policy instruments are not set by simple rules or formulas and central banks often revise their outlook for the economy and the monetary policy stance along with it. As such, some have argued that providing markets with information such as "endogenous" policy interest rate paths may damage the credibility of the institution should it (inevitably) not follow through with the pre-announced path (e.g. Goodhart 2001, Morris and Shin, 2002, Mishkin 2004). In this respect, it is notable that the RBNZ, which has published forward interest rate paths since 1997, was the only central bank to do so until fairly recently.

The empirical literature on transparency generally falls into two strands. One strand codifies a central bank's transparency in some way and investigates whether greater transparency is associated with superior macroeconomic outcomes (e.g. see Chortareas, Stasave and Sterne 2002, Eijffinger and Geerats 2006, Dinçer and Eichengreen 2007). This literature tends to find that countries whose central banks are more transparent, such as the RBNZ, tend to have superior inflation outcomes, even controlling for macroeconomic and institutional characteristics such as a central bank's independence. There is also more tentative evidence that central bank transparency reduces output volatility (Dinçer and Eichengreen, 2007).

Another strand focuses more narrowly on how financial markets respond to monetary policy and macroeconomic data surprises (e.g. see Gürkaynak, Levin, Marder and Swanson 2006 and Gürkaynak, Levin and Swanson 2006). In this literature, greater transparency is associated with markets better anticipating central bank actions and not overreacting to macroeconomic data surprises. A finding of this literature is that countries with explicit inflation targets - a key measure of transparency - tend to have better anchored forward nominal rates and long-run inflation expectations (as measured by inflation indexed bonds). As discussed further below, our paper appeals to this strand of the literature in examining the impact of monetary policy transparency in New Zealand.

The RBNZ is regarded as one of the most open and transparent central banks in the world (Eijffinger and Geraats 2006, Dinçer and Eichengreen 2007). This assessment is partly based on the fact that policy decisions accompanied by a Monetary Policy Statement (MPS), which are published each quarter, include detailed macroeconomic forecasts upon which the monetary policy decisions are based. Forecasts include paths for output, inflation, interest rates and the exchange rate. In addition, the forecasts provide some identification and quantification (in the form of alternative scenario analysis) of what the RBNZ sees as the main risks and uncertainties around the central forecast. This provides market participants with an idea of how the RBNZ is likely to react should these risks unfold. Policy decisions not accompanied by an MPS, known as the intra-quarter reviews, are much briefer (typically a one-to two-page press release) and do not contain a numerical forecast. Nevertheless, they still outline how the RBNZ views the current state of inflation pressures and the broad outlook for the economy.

Aside from detailed macroeconomic forecasts, several other institutional aspects of the RBNZ's communication of monetary policy decisions to financial markets warrant further elaboration. First, key tools used to prepare the forecasts, including the RBNZ's main macroeconomic model, have been published (e.g. see Black et al. 1997, Conway and Hunt 1997, RBNZ 2004 and Giannone and Matheson 2006). In the model there is a Taylor-style forward-looking policy rule. Although the rule is by no means a literal interpretation of how the RBNZ will react to data, and the published model-based forecasts are always subject to considerable judgments, in principle this information still gives market participants an idea of how the RBNZ will react to "surprises" in the data flow and how it views the policy transmission mechanism.

Second, before publication of the decision (whether it is an MPS or intra-quarter review) there is a running dialogue between the RBNZ and market economists regarding how markets might interpret alternative phrasings of the upcoming policy announcement. These feed into the drafting of the releases in a conscious effort to align markets with the RBNZ's point of view. Third, before the general release of an MPS, a lock-up is held at the RBNZ for financial market analysts. Attending this lock-up are senior RBNZ economists who are available for questioning from the financial analysts. This gives the analysts time to digest the nuances of the MPS and the opportunity to check their understanding against RBNZ economists. Fourth, outside of these times, the RBNZ periodically holds sessions with financial market analysts to discuss in more detail technical aspects of the forecast. Finally, many financial market economists and analysts in New Zealand have worked at the RBNZ and thus have had a first-hand account of the tools used at the RBNZ and the policy-making process.

Given the empirical literature and the institutional aspects of New Zealand's policy transparency discussed above, it might be thought that New Zealand would experience monetary policy transparency benefits. Broad cross-country support of this is seen in Dinçer and Eichengreen 2007, whose results suggest that transparency has reduced output and inflation variability in New Zealand. More indirect evidence is seen in Schmidt-Hebbel 2006, who finds that New Zealand's historical monetary policy has operated closer to the so-called efficient policy frontier than a comparable group of small open-economy inflation targeters. In addition, as discussed further below, a recent study by Karagedikli and Siklos (forthcoming) suggests that the New Zealand dollar reacts to data surprises and monetary policy in a way consistent with a credible and transparent central bank. However, to date, there has been no analysis of the possible transparency benefits on New Zealand's yield curve. Partly, this reflects that until March 1999 New Zealand's monetary policy implementation was fairly unconventional and relied upon so-called "open-mouth operations" to influence market prices, rather than adjustment of a specific policy-controlled short-term rate (see Guthrie and Wright 2000). As such, it is only recently that there has been sufficient data to examine the impact of policy and data surprises on New Zealand's yield curve at frequencies that enable a robust interpretation of the results.

We construct a data set that includes intra-daily interest rates over the yield curve, data surprises for variables such as unemployment and inflation, and several measures of monetary policy surprises. We then conduct an "events analysis" similar to Kuttner (2001), Gürkaynak, Levin and Swanson (2006) and Gürkaynak, Levin, Marder and Swanson (2006) to estimate the impact of data and monetary policy surprises on New Zealand's yield curve. Our results suggest that in response to data surprises, short-term interest rates react in a direction that is helpful for monetary policy purposes, while long-term forward rates remain relatively well anchored. This result is firmly in line with the recent literature and can be interpreted as a transparency benefit.

In response to positive monetary policy surprises, both short- and longer-term forward rates tend to rise, although the impact at very long horizons is not robustly significant. Our interpretation of this result is that markets view the central bank's monetary policy stance as credible and lift rates over the curve accordingly. Rates are increased over the short to medium run as markets come into line with the RBNZ's view of inflationary pressure, but do not increase over the medium to longer run (i.e. from around seven years forward) on the expectation that the central bank will get on top of inflationary pressures. We also find that market reactions tend to be marginally larger at times when a decision is accompanied by the release of a full Monetary Policy Statement, indicating that the information provided in the statement influences the market over and above the much more limited information set provided in the intra-quarter reviews.

In the remainder of the paper, Section 2 reviews the literature on monetary policy and data surprises and motivates the empirical specifications used in this paper. Section 3 briefly describes the data used in this paper and how we construct surprises. In Section 4 the empirical results are presented, while Section 5 concludes this paper. An appendix provides some robustness testing of the empirical analysis.

2 Literature review

The early empirical literature on the effects of monetary policy on asset prices (and the economy more broadly) typically estimated the impact of changes in observed policy rates on variables of interest directly (Cook and Hahn 1989). However, to the extent that policy moves are anticipated by market participants, the estimated impacts will be biased downwards and monetary policy will look less effective than its true impact. In principle then, one needs to differentiate the anticipated and unanticipated components of any monetary policy actions.

Several approaches have been applied in the literature to better identify the impact of monetary policy on the economy. Perhaps the most popular is the vast vector autoregressions (VAR) literature (e.g. see Buckle et. al. 2002 and Smith and Haug 2007 for applications using New Zealand data). However, there is considerable debate over the robustness of VAR estimates of policy shocks (Rudebusch 1998 and Brunner 2000). In addition, as Kuttner (2001) notes, there is also the issue of whether estimates of monetary policy shocks derived from current data are robust to the real-time data measures policymakers and market participants had at the time of actual policy implementation. A growing literature suggests that data revisions have a significant impact on the econometric estimates (e.g. see Koenig and Kishor, 2005) and it is recognized that revisions are substantive in the New Zealand data (see Sleeman 2005).

A more recent strand of literature, which we follow in this paper, uses high frequency data to estimate the impact of monetary policy shocks on asset prices. In a seminal paper, Kuttner (2001) uses Federal Reserve fund futures to calculate the unanticipated component of monetary policy and estimates its impacts on a range of asset prices at daily frequencies. Bernanke and Kuttner (2005), Gürkaynak (2005), Gürkaynak, Sack and Swanson (2005a,b) and others use the same or similar measures of surprises. The regression used in this literature takes the following form:

$$\Delta A_t = \alpha_0 + \alpha_1 \Delta S_t + \varepsilon_t \tag{1}$$

where ΔA_t is the change in some asset price, while ΔS represents the surprise element from monetary policy.[1]

A motivation for this literature is that the endogeneity between policy and changes in asset prices is likely to be small using high frequency (daily or intra-daily) data. At these frequencies, it is possible to zero in on the minutes around an event that occurs exclusively due to a monetary policy action. In addition, the real-time data issues are immaterial as financial market prices are not subject to revision. However, the approach is not without its pitfalls and limitations. First, it is not always easy to isolate particular events. For example, as discussed in greater detail below, there can be several announcements that arrive within a very short time before and after the release of, say, a monetary policy report or the setting of the overnight cash rate.

Many researchers have found that news events dissipate within a matter of hours (Goodhart et. al. 1993, Andersen et. al. 2005). Therefore, using daily data may underestimate the short-run effects of unexpected events on asset prices whose impact may peak within minutes of the arrival of new information only to be reversed later the same day. On the other hand, Ehrmann and Fratzscher (2004a, 2004b) argue that intra-daily data contain over-reactions of the markets, and they defend the use of daily data. Not all market participants necessarily react within a few hours. For example, they may wait for a day or so to determine whether the surprise reflects a permanent or a transitory change in policies. There is also a presumption that markets react to the same news at the same time.[2] In this paper we

[1] More recently, the focus has shifted to asking how central bank generated surprises via the communications channel can influence asset prices.

[2] Additionally, there is the problem that intra-daily data appear not to be a martingale while difference stationarity characterizes data sampled at the daily frequency.

focus on intra-daily effects on the basis that estimates tend to be more significant at this horizon, but as shown in Section 4, our results are similar at daily frequencies.

Perhaps the most substantive limitation of the event study approach applied in this paper is that it is not possible to use it to directly examine the impact of monetary policy on the economy beyond asset prices as variables such as GDP, inflation and employment are not, of course, compiled by statistical agencies at frequencies shorter than a quarter or perhaps a month.[3] That said, in isolating the impact of policy shocks on the yield curve it is still possible to directly examine the impact of monetary policy on a crucial part of the transmission mechanism - the impact of policy rates on longer-term rates. If an inflation-indexed bond market exists, the approach may also be used to examine how inflation expectations adjust in response to monetary policy shocks, from which direct inferences on the central bank's credibility and transparency may be made.

In addition, the approach enables us to consider the impact of data surprises on asset prices by including in the regressions a measure of news, or data surprises. These are commonly measured as follows:

$$s_{i,t} = \frac{D_{i,t} - E[A_{i,t}]}{\sigma_{i,t}} \tag{2}$$

where $s_{i,t}$ is the surprise component of an announcement type i, at time t . It is defined the difference between the announced value of the economic indicator in question, D, and its median expected value based on forecast or survey data ($E[A]$) divided by the sample standard deviation, σ, which standardizes the surprise thereby permitting a comparison of regression coefficients across different kinds of announcements.

How the markets react to the data surprise may also contain information about the central bank's transparency and credibility. Gürkaynak, Levin, Marden and Swanson (2006), for example, argue that if a central bank's inflation target is credible, a surprise related to inflation should not have any effect on interest rates at very long horizons, as predicted by almost all macro models, including the Reserve Bank of

[3] It is possible, however, to indirectly study the broader impacts by treating the expected future path of interest rates resulting from the events analysis as information in a standard VAR model, see Faust et al. 2004.

New Zealand's main macroeconomic model. We examine whether this holds in the New Zealand data in Section 4.

How the exchange rate adjusts to data surprises may also have some bearing on the central bank's credibility and transparency. In particular, Clarida and Waldman (2006) find in an events study that a positive inflation data surprise only consistently appreciates nominal exchange rates in their sample of inflation-targeting countries (including New Zealand), as markets presume the central bank will react to the news by increasing real interest rates. In contrast, the price-level effect (i.e. depreciation) sometimes dominates in periods before the adoption of inflation-targeting frameworks, and in non-inflation targeting countries more broadly. These results suggests that in inflation-targeting countries a transparency and credibility benefit is that markets generally adjust exchange rates in a direction that is helpful for policy objectives.[4]

The exchange rate is of course a key part of the transmission mechanism in small open economies such as New Zealand. Although examining how the New Zealand dollar adjusts is outside the scope of this paper, a study by Karagedikli and Siklos (forthcoming) finds that the New Zealand-US dollar and the New Zealand--Australian dollar cross rates tend to appreciate in response to inflation data surprises in line with the Clarida and Waldman (2006) estimates. Moreover, Karagedikli and Siklos examine the impact of a broader range of data and monetary policy surprises on the New Zealand dollar. Stronger-than-expected activity measures tend to appreciate the exchange rate, and similarly, positive monetary policy shocks also cause the currency to appreciate. Overall, these results likely indicate a transparency and credibility benefit of New Zealand's inflation targeting regime.

[4] Note that the exchange rate adjustment likely reflects both transparency and credibility. A central bank with a transparent price stability framework that, nevertheless, did not adjust policy rates in response to persistent inflation surprises would likely soon lose credibility and hence the exchange rate might fall in response to further inflationary surprises. In a credible central bank without transparent objectives, markets might not always increase the exchange rate in response to inflationary surprises as it is not as obvious how the central bank will react to the news.

3 Data

In this section, we briefly describe the monetary policy and data surprise measures.

3.1 Monetary Policy Surprises

In the United States, a Federal Reserve fund-futures market exists from which a natural measure of monetary policy surprises may be constructed. In New Zealand, there is no direct futures market for the Bank's policy instrument, the Official Cash Rate (OCR); however, there are three reasonable proxy measures of monetary policy surprises one can construct from the available data: 90-day bank bill futures, Over-night Indexed Swaps (OIS) and a Reuters survey of market participants. We discuss these measures in turn.

The 90-day bank bill rate is determined in wholesale commercial bank markets and in practice is very highly correlated with the OCR, although term premia can weaken the relationship at times. The first, second, third and fourth contracts of the 90-day bank bill futures are quite liquid and can be used to calculate different components of the surprise in a similar fashion to Gürkaynak (2005). The available intra-daily data required to construct this measure of monetary policy surprises begins in August 2000.[5]

An interest rate swap is an agreement between two parties to exchange, or 'swap', for an agreed time period, a series of fixed interest rate payments for a series of variable interest rate payments (or vice versa). An Overnight Indexed Swap is a special type of interest rate swap in two respects. First, OIS contracts involve the exchange of obligations for relatively short periods. Second, the floating reference rate in the OIS is the overnight rate, whereas the floating rate for most interest rate swaps is generally set less frequently, with reference to a quarterly or semi-annual interest rate. OIS rates can then be regarded as providing the 'cleanest' market-based measure of OCR expectations because of the smaller term premium embedded in OIS yield (see Choy 2003 for details). Although this market is now very liquid in New Zealand (and in many other countries) the available data span

[5] One can also use the change in the 90-day bank bill rate that the RBNZ tries to influence at the time of the policy announcements. Surprises measured from the 90-day bank bill rates are almost identical to the bank bill futures contract and thus give very similar results.

is quite short as OIS contracts only began trading in New Zealand in February 2002.

Finally, the Reuters survey of market participants in New Zealand about the probability they attach to an upcoming policy shift is taken into account. From this, a median market expectation of the future OCR setting, and thus a monetary policy surprise, can be constructed. However, a limitation of this measure is that the gap between when market participants are surveyed and when the policy announcement is made can be as large as 25 days. As such, at times key pieces of data may arrive in the interim and change market participants' expectations of the upcoming policy announcement.[6]

Table 1 below summarises the measures of surprises we use:

Table 1 Surprise Measures

Measure	First observation	No of observations	Shorthand
Change in 1st contract of the Bank Bill Futures	16 Aug 2000	55	s1
Weighted Market Expectations by Reuters	14 November 2001	48	s2
Change in Overnight Indexed Swaps	20 March 2002	43	s3

Figure 1 below shows the actual OCR changes against three different measures of monetary policy surprises. One feature of figure 1 is that the surprises are a small proportion of total changes in OCR. In other words, monetary policy in New Zealand tends to be fairly predictable. Second, there can be surprises when there is no change in the OCR. Third, the three measures may differ from each other at times.

[6] See Gordon and Krippner 2001 for a discussion of different measures of OCR expectations.

Figure 1
Different measures of monetary surprises August 2000- July 2007

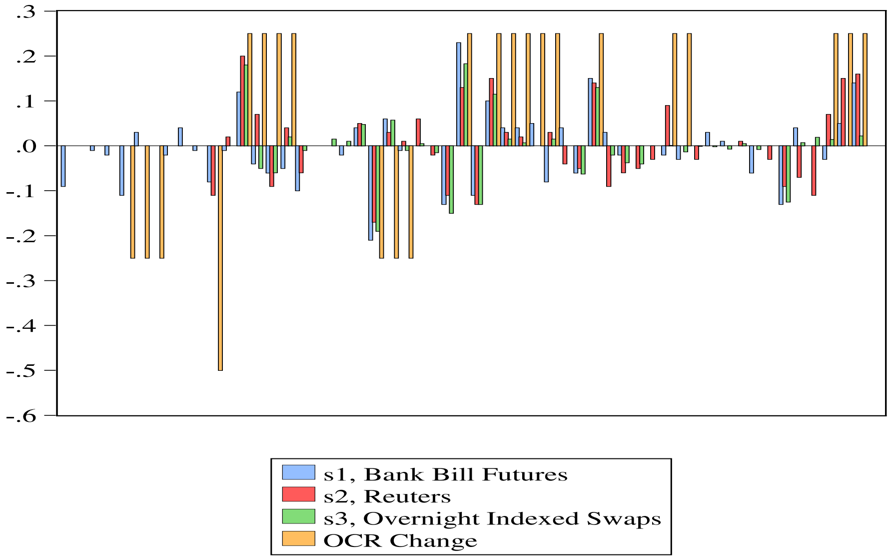

Table 2 below reports the descriptive statistics for the three different measures of monetary policy surprises. Their means are not statistically different than zero, while minimum and maximum variables match each others fairly closely. However, the standard deviations of the measures do differ and correlation coefficients between vary between 0.70 and 0.83, indicating that they are close but not perfect substitutes.

Table 2 Descriptives of Surprises

	Surprise 1	Surprise 2	Surprise 3
Mean	-0.005	0.003	-0.001
Absolute Mean	0.053	0.054	0.056
Maximum	0.23	0.20	0.19
Minimum	-0.21	-0.17	-0.19
Std Dev	0.073	0.083	0.072
Obs	55	48	43
	Pairwise	Correlation	
	Surprise 1	Surprise 2	Surprise 3
Surprise 1	1		
Surprise 2	0.72	1	
Surprise 3	0.87	0.78	1

In Table 2b below we divide our sample into decisions coinciding with the release of a full MPS, and the intra-quarter review decisions. Surprises are not significantly different between the two sub-samples, suggesting that the RBNZ does not use the opportunity of a full MPS to "surprise" the markets to a greater extent than what occurs in the intra-quarter reviews.

Table 2b Descriptives of for MPS and OCR Reviews

	Surprise 1	Surprise 2	Surprise 3
		MPS	
Mean	-0.001	0.001	0.004
Absolute Mean	0.054	0.053	0.032
St Dev	0.073	0.086	0.069
		Inter-quarter review	
Mean	-0.009	0.005	-0.008
Absolute Mean	0.044	0.047	0.032
St Dev	0.075	0.082	0.073

3.2 Data Surprises

To examine the impact of data surprises on New Zealand's yield curve, surprise measures for six major data announcements are constructed: Consumer Price Index (CPI), Current Account (CA), Gross Domestic Product (GDP), Retail Sales (RS), Trade Balance (TB) and the Unemployment Rate (U). This gives us a set of data surprises comparable to that seen in Gürkaynak et al. 2006 and others. Of course, the data the markets react to is not limited to these variables. However, these are the main variables for which Bloomberg have surveyed market participants for their expectations and thus does represent our feasible choice set.

In constructing data surprise measures we use the median market expectation for every variable concerned. It should be noted, however, that the number of participants surveyed varies between 9 and 15, with a mean of around 13. The survey nature of these variables and the small number of market participants actually surveyed implies that there is likely to be a measurement error in the data surprises. However, it is assumed that the variance in the measurement error is much smaller than the variance of the variable concerned and therefore the bias this poses is likely to be small.

Table 3 gives more information about the release time of the data, their frequency and date of the first observation for these variables in our data set. The number of observations we have for the quarterly data is very small, at only 22 for CA and 23 for GDP and CPI. However, the sample size is larger for the RS and TB series which are available monthly.

Table 3 Data Announcements

Variable	Frequency	Time of the day	First observation	No of observations
CPI	Quarterly	10.45 am	18 April 2001	23
GDP	Quarterly	10.45 am	29 June 2001	23
CA	Quarterly	10.45 am	26 June 2001	22
U	Quarterly	10.45 am	10 May 2001	23
RS	Monthly	10.45 am	6 April 2001	68
TB	Monthly	10.45 am	10 April 2001	65

4 Methodology and Results

4.1 Methodology

We follow the event analysis literature and estimate OLS regressions of the following form:

$$\Delta A_t = \alpha_0 + \alpha_1 \Delta S_t + \varepsilon_t \tag{3}$$

where ΔA_t is the change in the interest rate concerned, while ΔS_t represents the surprise element, which may be a monetary policy or data surprise. Standard errors for the coefficients are constructed using the Huber-White statistic.

Perhaps the main critique of this approach is that, when considering data surprises, the estimated slope coefficients may contain information about more than one state variable in the economy (Faust et. al. 2007). For example, consider a positive GDP surprise. The surprise may mainly reflect stronger-than-expected demand, perhaps implying the need for tighter monetary policy; it could be the result of stronger than expected productivity growth, which may imply a looser policy stance going forward; or, as is often the case in a fairly small economy like New Zealand, the surprise may be narrowly concentrated in one sector of the economy, with few policy implications. The estimated coefficient will then likely represent the “net" effect of the underlying reasons for the data surprises. If the underlying reasons balance out over the estimation sample, it is possible that the estimated coefficient will be insignificant even if markets react strongly to the data surprises. As such, ideally one would like to distinguish between the causes of the data surprises in order to cleanly identify the estimated coefficients. However, as our sample mainly covers a period of very robust growth and strong inflation pressure in New Zealand, it is plausible that surprises to activity and inflation measures mainly reflect a "demand side" interpretation.[7]

4.2 Responses of Implied 1 and 2 year swap rates

Does the yield curve respond to data surprises in a way that is consistent with a transparent and credible inflation-targeting central bank? In this section we investigate this by means of simple regressions of the standardized data surprise on the changes in implied one-year and two-year forward swap rates up to seven years ahead.[8] The lack of depth in instruments at all horizons makes it difficult to calculate the implied one and two year rates beyond the five and seven year horizons. Table 4 shows the responses of the one-year nominal swap rates ending in one, two, three and five years within windows of 30 minutes and 60 minutes after the surprise. Table 5 shows responses of the two-year nominal yields ending in two, three, five and seven years.

The monetary policy surprises ($s1$ to $s3$) are in basis points. This implies that we can multiply the size of any monetary policy surprise by the estimated coefficients to infer the impact on forward rates. For example, in the top-left cell of Table 4 a surprise of 100 basis points suggests one year nominal rates increase by 92 basis points. Moving further along the yield curve, the impact of monetary policy shocks diminish but still remain significant on the s1 surprise measure. For example, the response of implied one-year rates ending in five years is still around 25 basis points for our hypothetical surprise of 100 basis points and the response of two-year rates ending in seven years is around 11 basis points. Responses to monetary policy surprises are very similar for the surprise measures of $s1$ and $s3$,

[7] Over the sample, growth in New Zealand was the strongest it has been in the post-War period and the unemployment rate fell to multi-decade lows. The RBNZ estimates that the output gap has been positive throughout this period. See RBNZ (2007) for an in depth discussion of the New Zealand economy since around the start of this decade.

[8] We use the pure expectations model of the term structure of interest rates to calculate the implied forward interest rates. For example, two-year interest rate beginning in 5 years and ending in 7 years would can be calculated as the solution to $[1+i(0,7)]^7 = [1+i(0,5)]^5[1+i(5,7)]^2$, where $i(j,t)$ is the interest rates starting at period j and ending in period t. Also note that there are severe liquidity issues in the government bond and bank bill markets in New Zealand, hence the use of the swap yields to measure the yield curve.

although at the longest horizon for which we can construct data, monetary policy shocks are not significant using the *s*3 measure. The responses are significantly lower, however, for the *s*2 measure. This is likely due to a very large “measurement error" in the Reuters surveys arising from the small sample and significant time delays in survey collections, as discussed above. Hence one would expect a downward bias in the estimated coefficients.[9]

Overall, monetary policy shocks have a large and significant impact on implied forward rates at short horizons and a diminishing impact on forward rates at longer horizons. These results can be interpreted as a transparency and credibility benefit of the operation of monetary policy in New Zealand. The result that shocks to monetary policy have a large impact on forward short-term interest rates suggests that markets believe, in general, that the RBNZ will indeed follow through with a tighter (looser) policy stance for some time. But the fact that the estimated impact diminishes at longer horizons suggests that market participants also expect that the RBNZ will get on top of inflationary pressure over the longer run.

Data surprises are standardized by the standard deviations of the actual data. Therefore the coefficients reported in Tables 4 and 5 imply the responses of a one standard deviation surprise in basis points (multiplied by 100). For example, it is estimated that a one-standard deviation CPI surprise increases the one-year swap rate by four basis points. This effect diminishes as we go further out on the yield curve. This effect goes down to one basis point in the one-year swap rate ending in five years. Statistical significance disappears in the 60 minute window for the response of the one- year rate ending in five years.

[9] Karagedikli and Siklos (forthcoming) analytically show this measurement error introduces an even larger bias in the OLS estimates than classical measurement error.

Table 4 Responses of 1 year rates

	1y1		1y2		1y3		1y5	
	30 Min	60 Min	30 Min	60 Min	30 Min	60 Min	30 Min	60 Min
s1	0.927***	1.017***	0.434***	0.498***	0.362***	0.334***	0.289***	0.255***
se	(0.060)	(0.076)	(0.095)	(0.083)	(0.057)	(0.068)	(0.055)	(0.053)
R sq	0.87	0.82	0.34	0.30	0.46	0.33	0.21	0.19
Obs	55	55	55	55	55	55	55	55
s2	0.598***	0.638***	0.224**	0.248**	0.221***	0.170**	0.190**	0.135**
se	(0.109)	(0.125)	(0.100)	(0.097)	(0.069)	(0.065)	(0.071)	(0.065)
R sq	0.42	0.39	0.11	0.09	0.20	0.10	0.22	0.10
Obs	45	45	45	45	45	45	45	45
s3	0.881***	0.964***	0.396***	0.475***	0.300***	0.309***	0.251***	0.231***
se	(0.060)	(0.058)	(0.109)	(0.090)	(0.076)	(0.069)	(0.084)	(0.076)
R sq	0.64	0.62	0.27	0.28	0.28	0.22	0.28	0.20
Obs	43	43	43	43	43	43	43	43
CPI	0.040***	0.039***	0.028**	0.038***	0.020***	0.020***	0.014**	0.006
se	(0.007)	(0.007)	(0.014)	(0.012)	(0.006)	(0.008)	(0.005)	(0.008)
R sq	0.67	0.59	0.31	0.43	0.37	0.19	0.27	0.05
Obs	23	23	23	23	23	23	23	23
GDP	0.038***	0.038***	0.054***	0.067***	0.017***	0.025***	0.010	0.020
se	(0.008)	(0.007)	(0.016)	(0.015)	(0.006)	(0.008)	(0.011)	(0.012)
R sq	0.56	0.55	0.41	0.44	0.17	0.28	0.06	0.15
Obs	23	23	23	23	23	23	23	23
CA	-0.001	-0.006	-0.016	0.002	-0.006	-0.016**	0.009	-0.002
se	(0.004)	(0.009)	(0.011)	(0.017)	(0.004)	(0.007)	(0.010)	(0.012)
R sq	0.00	0.03	0.09	0.00	0.10	0.11	0.02	0.00
Obs	22	22	22	22	22	22	22	22
RS	0.013***	0.012***	0.009**	0.011**	0.006***	0.007**	0.004*	0.007**
se	(0.002)	(0.002)	(0.004)	(0.005)	(0.002)	(0.003)	(0.003)	(0.003)
R sq	0.41	0.34	0.10	0.12	0.10	0.09	0.04	0.07
Obs	68	68	68	68	68	68	68	68
TB	-0.002	-0.002	0.002	-0.239	-0.001	-0.255	-0.003	-0.265
se	(0.001)	(0.002)	(0.002)	(0.239)	(0.002)	(0.249)	(0.002)	(0.261)
R sq	0.05	0.02	0.01	0.04	0.00	0.04	0.02	0.04
Obs	65	65	65	65	65	65	65	65
U	-0.066***	-0.076***	-0.029	-0.057***	-0.033***	-0.049***	-0.045***	-0.044**
se	(0.012)	(0.015)	(0.018)	(0.015)	(0.011)	(0.013)	(0.013)	(0.016)
R sq	0.64	0.60	0.13	0.38	0.29	0.42	0.43	0.34
Obs	23	23	23	23	23	23	23	23

Table 5 Responses of 2 year rates

		2y2		2y3		2y5		2y7
	30 Min	60 Min	30 Min	60 Min	30 Min	60 Min	30 Min	60 Min
s1	0.693***	0.780***	0.399***	0.417***	0.323***	0.295***	0.171**	0.118**
se	(0.071)	(0.078)	(0.071)	(0.072)	(0.048)	(0.049)	(0.070)	(0.051
R sq	0.73	0.69	0.43	0.34	0.32	0.29	0.040	0.022
Obs	55	55	55	55	55	55	55	55
s2	0.415***	0.447***	0.223***	0.210**	0.197***	0.156**	0.094	0.049
se	(0.097)	(0.109)	(0.081)	(0.079)	(0.066)	(0.062)	(0.081)	(0.051)
R sq	0.31	0.28	0.16	0.10	0.22	0.12	0.057	0.019
Obs	45	45	45	45	45	45	45	45
s3	0.645***	0.728***	0.349***	0.393***	0.278***	0.280***	0.118	0.063
se	(0.076)	(0.069)	(0.085)	(0.075)	(0.073)	(0.067)	(0.091)	(0.057)
R sq	0.54	0.51	0.30	0.27	0.32	0.28	0.062	0.022
Obs	43	43	43	43	43	43	43	43
CPI	0.035***	0.038***	0.024***	0.029***	0.015***	0.012*	0.005	0.001
se	(0.004)	(0.005)	(0.009)	(0.009)	(0.005)	(0.006)	(0.004)	(0.007)
R sq	0.80	0.73	0.41	0.41	0.34	0.18	0.051	0.000
Obs	23	23	23	23	23	23	23	23
GDP	0.046***	0.052***	0.035***	0.046***	0.014	0.021**	0.008	0.028*
se	(0.012)	(0.010)	(0.009)	(0.010)	(0.010)	(0.010)	(0.008)	(0.010)
R sq	0.49	0.50	0.38	0.42	0.16	0.23	0.039	0.306
Obs	23	23	23	23	23	23	23	23
CA	-0.008*	-0.001	-0.011	-0.007	0.008	0.001	-0.001	0.001
se	(0.004)	(0.009)	(0.007)	(0.009)	(0.006)	(0.008)	(0.008)	(0.009)
R sq	0.14	0.00	0.11	0.03	0.08	0.00	0.001	0.000
Obs	22	22	22	22	22	22	22	22
RS	0.011***	0.012***	0.007***	0.009**	0.006***	0.006**	0.004**	0.008*
se	(0.002)	(0.003)	(0.003)	(0.004)	(0.002)	(0.003)	(0.002)	(0.003)
R sq	0.33	0.25	0.13	0.13	0.14	0.08	0.080	0.146
Obs	68	68	68	68	68	68	68	68
TB	0.000	0.000	0.001	-0.247	-0.001	-0.259	-0.001	-0.268
se	(0.002)	(0.002)	(0.002)	(0.244)	(0.002)	(0.257)	(0.002)	(0.262)
R sq	0.00	0.00	0.00	0.04	0.00	0.04	0.004	0.040
Obs	65	65	65	65	65	65	65	65
U	-0.048***	-0.066***	-0.031**	-0.053***	-0.037***	-0.038***	-0.020**	-0.018*
se	(0.012)	(0.014)	(0.013)	(0.013)	(0.011)	(0.013)	(0.009)	(0.010)
R sq	0.52	0.59	0.30	0.47	0.41	0.32	0.117	0.114
Obs	23	23	23	23	23	23	23	23

In general, the impact of data surprises on forward rates is in line with our expectations. In response to positive shocks to GDP, inflation and retail sales interest rates initially increase. In response to a positive shock to the unemployment rate, forward rates fall. In theory, how monetary policy should respond to shocks to the current account and trade balance is ambiguous (e.g. a positive shock to the trade balance might imply stronger than expected commodity prices and export volumes; alternatively it could result from weaker-than-expected domestic demand). In line with this ambiguity, the effects of trade balance and current account shocks are insignificant.[10]

Also in line with our expectations is that the estimated impact of data surprises die out at long horizons. The exception to this finding is surprises related to the unemployment rate, which still show significant effects on the two-year forward rate at seven years, the maximum horizon permitted in our regressions. That said, the decay rate on the unemployment impact moving along the yield curve is large, and as such it is plausible that at the ten-year horizon, the “benchmark" in the literature, its impact would not be significant.

To see these results in a broader context, Table 6 reports some of the previous results along with the relevant international findings, whose sample includes a selection of inflation-targeting countries and the United States. Initial responses to data and monetary surprises tend to be significant across all countries, while long-term rates tend not to be affected across any countries except the United States. Again, this result can be interpreted as a transparency benefit of the inflation-targeting regimes.[11]

[10] In contrast, Karagedikli and Siklos (forthcoming) show that these shocks do significantly impact spot exchange rates in a “buffering manner”, as might be expected in a small open economy with a freely floating exchange rate regime.

[11] In line with this interpretation, Gürkaynak et al. 2006 find that surprises significantly moved long-term rates in the United Kingdom before the Bank of England was made independent and had its inflation-target objective legislated. In the post-independence sample reported in Table 6, effects on long-term rates are mainly insignificant.

Table 6 International Comparison

		NZ			US			UK	
	1yr1	1yr5	2yr7	1yr	1yr5	1yr10	1yr	1yr5	1yr10
Mon+	0.88***	0.25***	0.11	0.47***	-0.04	-0.16**	0.72**		-0.12
CPI++	4***	1.4**	0.5	1.67***	1.81***	1.09*	2.28**	0.07	-0.43
GDP	3.8***	1	0.8	4.39***	4.12*	3.76**	2.05***	0.26	-1.08
U	-6.6***	-4.5**	-2*	-1.76 ***	-0.77	0.14			
RS	1.3***	0.7**	0.4*	2.97***	2.62**	1.93**	1.58**		-1.08*
		Chile			Canada			Sweden	
	1yr1	1yr5	1yr10	1yr	1yr5	1yr10	1yr	1yr5	1yr10
Mon	0.15***	NA	0.22	0.81***	NA	-0.28	0.72**	NA	0.25
CPI	0.4	NA	1.86	1.49*	NA	-0.27	1.94*	NA	1.01
GDP	0.25	NA	1.1	-1.01	NA	-2.35	0.79	NA	0.72
U		NA		0.31	NA	-0.29	-0.26	NA	-0.42
RS		NA		1.48**	NA	-0.29	-0.49	NA	0.26

++ Basis point responses per standard deviation of the data. Monetary responses are to a 1 basis point surprise. US figures are from Gürkaynak, Sack and Swanson (2005a); UK results are from Gürkaynak, Levin and Swanson (2006) and the 2003 Working Paper version of Gürkaynak et al (2005a); Canada results are from Gürkaynak, Levin, Marden and Swanson (2006), New Zealand results are the 30 minute window responses with the s3 monetary policy surprise measure.

+ Retail Price Index(Core) for the UK.

4.3 Robustness Testing

As discussed above, a key motivation of the events study literature is that the endogeneity between policy and changes in longer-term interest rates is likely to be very small at very high data frequencies. In New Zealand, the problem is likely to be small even at daily frequencies as RBNZ policy announcements are timed to coincide with days when there are no major domestic data releases. That said, there may be international data releases and monetary policy surprises on the day of an RBNZ policy announcement and for this reason it might be expected that the estimated effects are smaller at daily frequencies than at intra-daily frequencies. To test this and the general robustness of the results we re-estimated the regressions at daily frequencies. The results are shown in Annex Table A1. In general, the estimated coefficients are in line with the intra-daily estimates and are still quite significant for shorter-term interest rates, although the fit of the equations tends to be lower at daily frequencies.

As noted above, our sample contains two kinds of monetary policy decisions.

Decisions accompanied by the release of a detailed Monetary Policy Statement (which includes a forecast for inflation, GDP, interest rates and other variables) and the intra-quarter reviews, which only gives a very brief non-numerical update on the outlook. Given the large difference in the information provided between the MPS and the intra-quarter reviews, it is natural to ask whether surprises arising from a MPS have a larger effect on the yield curve. To test this, we re-estimate the regressions above with an additional dummy variable, which takes the value of 1 if the announcement was an MPS and 0 for the intra-quarter reviews. This dummy permits an intercept effect at points on the yield curve. We also include an interaction term to permit a change in the estimated slope.

Key results of these regressions are in Annex Tables A2 and A3. Although the slope coefficients (not reported) are not significantly different from those of the original regressions, the dummy terms at times are significant, albeit modest. Moreover, the coefficients on the dummy terms tend to be slightly larger and more significant when the equations are estimated at daily frequencies. These results suggest that decisions accompanied by publication of a MPS have a stronger impact on market interest rates, but markets take some time to digest the information provided in the lengthy statements.

Finally, for completeness in Annex Table A4 we report the impact of the surprises on longer-term swap interest rate *levels* at frequencies from 30-minutes to daily. As would be expected, the estimated impacts on longer-term interest rate levels are larger and more significant than the impacts on longer-term forward rates. For example, under the $s1$ and $s3$ measures 5-year swap rates are estimated to increase around 50 basis points in response to the 100 basis points monetary policy surprise. This suggests that monetary policy can significantly affect longer run wholesale interest rate levels, notwithstanding the fact that at times offshore interest rate developments may push rates against domestic policy interests (RBNZ 2007).

5 Conclusions

In this paper we estimated the impact of monetary and data surprises on New Zealand's yield curve. We argue that the pattern observed reflects the credibility and transparency of New Zealand's inflation targeting regime. In line with what has been found in several other inflation-targeting countries, data surprises die out at long horizons. At shorter horizons, interest rates generally move in a direction consistent with policy objectives. For example, our estimates show that when there is a positive inflation or GDP surprise, forward rates increase in anticipation of the central bank's reaction. These results are likely a function of both the transparent approach to policy making at the RBNZ and the credibility of the regime.

It is evident that central banks take communication with markets very seriously and some, such as the RBNZ, expend considerable resources communicating policy decisions to financial markets and the economy more broadly. It has been argued that such transparent communication risks credibility as, given the uncertainties in policy making, commitments cannot always be followed through. Our findings provide some evidence that this concern is misplaced.

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Annex

Table A1 Daily responses

	1y1	1y2	1y3	1y5	2y2	2y3	2y5	2y7
s1	1.040***	0.725***	0.472***	0.265***	0.913***	0.601***	0.337***	0.218***
se	(0.099)	(0.148)	(0.105)	(0.067)	(0.115)	(0.118)	(0.072)	(0.077)
R sq	0.75	0.30	0.33	0.14	0.58	0.34	0.22	0.06
Obs	55	55	55	55	55	55	55	55
s2	0.640***	0.276*	0.213**	0.089	0.463***	0.246***	0.127	0.137*
se	(0.142)	(0.153)	(0.105)	(0.094)	(0.138)	(0.122)	(0.097)	(0.073)
R sq	0.37	0.06	0.10	0.03	0.21	0.09	0.05	0.07
Obs	45	45	45	45	45	45	45	45
s3	1.026***	0.529***	0.442***	0.200*	0.788***	0.487***	0.288	0.151*
se	(0.070)	(0.146)	(0.088)	(0.104)	(0.097)	(0.110)	(0.103)	(0.087)
R sq	0.66	0.18	0.31	0.12	0.44	0.26	0.20	0.06
Obs	43	43	43	43	43	43	43	43
CPI	0.061***	0.071***	0.039***	0.051**	0.067***	0.055***	0.043***	0.013
se	(0.012)	(0.024)	(0.018)	(0.023)	(0.016)	(0.017)	(0.015)	(0.018)
R sq	0.63	0.37	0.23	0.30	0.61	0.46	0.33	0.03
Obs	23	23	23	23	23	23	23	23
GDP	0.041***	0.067***	0.040***	0.019	0.054***	0.053***	0.022	0.029*
se	(0.011)	(0.020)	(0.014)	(0.023)	(0.015)	(0.014)	(0.016)	(0.016)
R sq	0.40	0.30	0.34	0.05	0.35	0.35	0.08	0.13
Obs	23	23	23	23	23	23	23	23
CA	-0.019	-0.019	-0.006	0.001	-0.019	-0.013	-0.008	0.032
se	(0.014)	(0.030)	(0.022)	(0.026)	(0.020)	(0.022)	(0.028)	(0.025)
R sq	0.11	0.03	0.00	0.00	0.08	0.02	0.01	0.05
Obs	22	22	22	22	22	22	22	22
RS	0.014***	0.015***	0.011***	0.005	0.014***	0.013***	0.008	0.013**
se	(0.004)	(0.007)	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)
R sq	0.21	0.07	0.07	0.01	0.14	0.08	0.04	0.11
Obs	68	68	68	68	68	68	68	68
TB	-0.002	0.019	-0.002	-0.006	-0.003	0.008	0.002	-0.011
se	(0.003)	(0.023)	(0.019)	(0.017)	(0.004)	(0.020)	(0.016)	(0.016)
R sq	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.01
Obs	65	65	65	65	65	65	65	65
U	-0.065***	-0.062***	-0.042	-0.034*	-0.064***	-0.052***	-0.029*	-0.011
se	(0.016)	(0.019)	(0.024)	(0.017)	(0.015)	(0.019)	(0.017)	(0.022)
R sq	0.44	0.27	0.11	0.10	0.43	0.21	0.09	0.01
Obs	23	23	23	23	23	23	23	23

Table A2 Effects of MPS dummy in 30 minute windows

	1y1 30 Min	1y2 30 Min	1y3 30 Min	1y5 30 Min	2y2 30 Min	2y3 30 Min	2y5 30 Min	2y7 30 Min
				Surprise 1				
MPS	0.013*	0.015	0.015**	0.003	0.014	0.015	0.005	0.002
se	(0.007)	(0.012)	(0.008)	(0.007)	(0.008)	(0.009)	(0.006)	(0.009)
R sq	0.88	0.36	0.51	0.41	0.74	0.46	0.51	0.14
Obs	55	55	55	55	55	55	55	55
				Surprise 2				
MPS	0.030	0.030*	0.020*	0.012	0.030*	0.025*	0.013	0.007
se	(0.018)	(0.016)	(0.011)	(0.009)	(0.016)	(0.013)	(0.009)	(0.009)
R sq	0.46	0.19	0.26	0.28	0.37	0.23	0.27	0.14
Obs	45	45	45	45	45	45	45	45
				Surprise 3				
MPS	0.023	0.032**	0.021**	0.011	0.027**	0.027**	0.012	0.005
se	(0.014)	(0.014)	(0.010)	(0.008)	(0.012)	(0.011)	(0.008)	(0.009)
R sq	0.66	0.37	0.39	0.40	0.60	0.41	0.41	0.19
Obs	43	43	43	43	43	43	43	43

Table A3 Effects of MPS dummy in daily window for 1 and 2 year rates

	1yr1 1 Day	1yr2 1 Day	1yr3 1 Day	1yr5 1 Day	2yr2 1 Day	2yr3 1 Day	2yr5 1 Day	2yr7 1 Day
					Surprise 1			
MPS	0.026**	0.047**	0.020	0.003	0.035**	0.033**	0.006	0.017
se	(0.012)	(0.021)	(0.014)	(0.010)	(0.015)	(0.016)	(0.011)	(0.012)
R sq	0.77	0.38	0.36	0.20	0.63	0.41	0.29	0.18
Obs	55	55	55	55	55	55	55	55
					Surprise 2			
MPS	0.041*	0.061**	0.029	0.006	0.051**	0.045**	0.011	0.014
se	(0.021)	(0.025)	(0.016)	(0.013)	(0.022)	(0.019)	(0.014)	(0.013)
R sq	0.43	0.20	0.17	0.04	0.32	0.21	0.07	0.13
Obs	45	45	45	45	45	45	45	45
					Surprise 3			
MPS	0.034**	0.070***	0.029*	0.011	0.052**	0.049***	0.013	0.015
se	(0.016)	(0.022)	(0.014)	(0.011)	(0.018)	(0.017)	(0.013)	(0.013)
R sq	0.69	0.35	0.38	0.18	0.54	0.40	0.24	0.17
Obs	43	43	43	43	43	43	43	43

Table A4 Effects of Surprises on the current 5, 7 and 10 year swap rates

	5-year 30 Min	5-year 60 Min	5-year 1 Day	7-year 30 Min	7-year 60 Min	7-year 1 Day	10-year 30 Min	10-year 60 Min	10-year 1 Day
s1	0.484***	0.510***	0.607***	0.388***	0.382***	0.478***	0.341***	0.317***	0.413***
se	0.050	0.055	0.081	0.047	0.045	0.069	0.045	0.046	0.073
R sq	0.71	0.64	0.54	0.65	0.56	0.48	0.61	0.47	0.42
Obs	55	55	55	55	55	55	55	55	55
s2	0.294***	0.281***	0.285**	0.240***	0.217***	0.246***	0.199***	0.156**	0.204**
se	0.073	0.075	0.105	0.067	0.062	0.087	0.062	0.056	0.080
R sq	0.29	0.22	0.16	0.27	0.19	0.16	0.24	0.13	0.14
Obs	45	45	45	45	45	45	45	45	45
s3	0.436***	0.472***	0.527***	0.348***	0.358***	0.424***	0.286***	0.278***	0.338***
se	0.067	0.055	0.082	0.069	0.051	0.074	0.068	0.055	0.083
R sq	0.47	0.44	0.40	0.41	0.37	0.36	0.35	0.29	0.29
Obs	43	43	43	43	43	43	43	43	43
CPI	0.024***	0.024***	0.052***	0.019***	0.018***	0.041***	0.016***	0.017***	0.040***
se	0.004	0.004	0.013	0.003	0.004	0.014	0.003	0.004	0.013
R sq	0.72	0.57	0.55	0.65	0.43	0.45	0.51	0.34	0.42
Obs	23	23	23	23	23	23	23	23	23
GDP	0.028***	0.035***	0.039***	0.022***	0.033***	0.036***	0.020***	0.034***	0.035***
se	0.007	0.008	0.012	0.006	0.007	0.012	0.005	0.008	0.010
R sq	0.42	0.44	0.28	0.37	0.46	0.31	0.33	0.47	0.34
Obs	23	23	23	23	23	23	23	23	23
CA	-0.001	-0.003	-0.012	-0.001	-0.003	0.000	-0.002	-0.003	0.003
se	0.004	0.005	0.021	0.004	0.005	0.019	0.005	0.006	0.022
R sq	0.00	0.01	0.03	0.00	0.01	0.00	0.00	0.01	0.00
Obs	22	22	22	22	22	22	22	22	22
RS	0.008***	0.009***	0.011***	0.007***	0.008***	0.012***	0.007***	0.008***	0.012***
se	0.002	0.003	0.004	0.002	0.002	0.004	0.002	0.002	0.004
R sq	0.27	0.19	0.10	0.26	0.21	0.12	0.26	0.21	0.12
Obs	68	68	68	68	68	68	68	68	68
TB	-0.001	0.000	-0.006	-0.001	0.000	-0.005	-0.001	-0.001	-0.006
se	0.002	0.002	0.003	0.002	0.002	0.004	0.002	0.002	0.004
R sq	0.01	0.00	0.03	0.00	0.00	0.03	0.00	0.00	0.03
Obs	65	65	65	65	65	65	65	65	65
U	-0.041***	-0.052***	-0.046***	-0.035***	-0.043***	-0.036**	-0.033***	-0.039***	-0.026*
se	0.011	0.012	0.015	0.010	0.011	0.015	0.009	0.010	0.015
R sq	0.53	0.54	0.27	0.45	0.46	0.17	0.44	0.44	0.09
Obs	23	23	23	23	23	23	23	23	23