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The High-Frequency Response of the Rand-Dollar Rate to Inflation Surprises

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Abstract

We examine the high-frequency response of the rand-dollar nominal rate within ten-minute intervals around (five minutes before, five minutes after) official inflation announcements, and show that the rand appreciates (resp., depreciates) on impact when inflation is higher (resp., lower) than expected – evidence that "bad" news about inflation is "good" news for the currency. The effect only applies after the adoption of inflation targeting. Our findings are rationalizable by the belief, among market participants, in a credible (though perhaps not particularly aggressive) inflation targeting policy in South Africa; and can be used to monitor changes in currency market perceptions about the monetary policy regime.

JEL classification: E31, E52, F30, F31.

Keywords: high-frequency exchange rates; inflation surprises; inflation targeting; credibility.

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1   Introduction

1.1   Intraday Reactions to Large Inflation Surprises

The median expectation for inflation in South Africa for the May 2002 to April 2003 period, amongst financial market analysts, was 10.4 percent in mid-May 2003.[1] When the data were released, on 30 May 2003 at 11:30am Johannesburg time (GMT + 2), they revealed an inflation rate of 8.5 per cent − an exceptionally large inflation surprise (and "good" news about inflation).[2] The currency market's response to the official announcement of an inflation rate two percentage points lower than expected, was a sharp and immediate depreciation of the currency − see Figure 1.[3]

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[1] Bloomberg conducted a market survey of expected inflation in mid-May (the last survey prior to the official release). The rates refer to South African year-on-year inflation for the consumer price index excluding mortgage costs for metropolitan and other urban areas (CPIX), the measure of inflation targeted by the central bank at the time.

[2] See Statistics South Africa (2003).

[3] The rand depreciated relative to the US dollar by approximately two percent in less than five minutes immediately after the announcement. Note that press reports in the weeks prior to the announcement (and an admission of an error in the computation of CPI-X by the Minister of Finance shortly before the announcement) suggest that at least some market participants already anticipated some degree of revision (and hence a "surprise"), but not its magnitude, nor with certainty.

Figure 1: Exchange Rate Behavior on 30 May 2003

1a: Five-Minute Rand-Dollar Rates Over 24 Hours
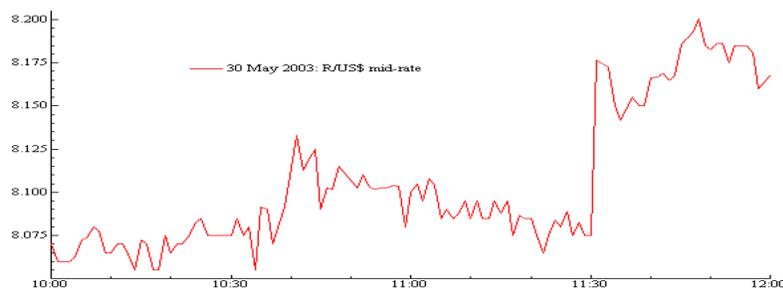
1b: Five-Minute Rand-Dollar Rates Around 11:30am

The direction of the currency's movement in response to this inflation surprise is inconsistent with textbook economics and conventional wisdom, but not uncommon. Anecdotal evidence frequently indicates that at least some currencies consistently appreciate in response to unexpectedly high inflation; and depreciate in response to unexpectedly low inflation.[4] The conventional wisdom is that inflation is "bad" for the exchange rate. If the domestic rate of inflation increases relative to foreign inflation, the domestic currency depreciates. Its rationale is provided by the classic Purchasing

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[4]For example, from the Financial Times, March 2011, one can read: "Sterling marched to a 14-month peak against the dollar after UK inflation jumped to its highest level in $2\frac{1}{2}$ years. (...) The data further fuelled speculation that the Bank's monetary policy committee may soon pave the way for a rise in interest rates (...)." (See "Inflation jump lifts sterling", Financial Times, March 22, 2011.) Similarly, from Bloomberg, July 2007: "Sweden's krona rose, snapping two days of declines, after a report showing inflation unexpectedly accelerated in June reinforced the central bank's argument last month for quickening the pace of interest-rate increases. (...) Elsewhere, Norway's krone fell the most in more than a week after Statistics Norway said inflation unexpectedly slowed to 1.3 percent in June from 1.4 percent. Economists surveyed expected inflation to accelerate to 1.5 percent." (See "Swedish Krona Gains as Inflation Unexpectedly Quickens in June," Bloomberg, July 10, 2007.)

Power Parity (PPP, henceforth) hypothesis. The empirical evidence is well-known, and it is largely supportive of PPP, but only as a measure of central tendency for the exchange rate − a long-run relationship with a half-life of deviations of about four years (Froot and Rogoff (1995), Taylor (1995)). [5] Price level or inflation differentials cannot explain short-term exchange rate movements.

Intuitively, if short-term movements in the exchange rate are unpredictable, the difference between domestic and foreign interest rates represents expected carry trade returns − the expected return from borrowing in the low-interest currency and investing in the high-interest currency (Meese and Rogoff (1983), Burnside, Eichenbaum and Rebelo, (2007), Backus, Gavazzoni, Telmer and Zin (2010), Hassan and Smith (2011), Burnside (2011)). Under a credible inflation-targeting regime, higher than expected domestic inflation is interpreted as a likely increase in domestic interest rates − and hence, in the expected return from holding the currency.

1.2 This Paper's Contribution

We perform a systematic analysis of the high-frequency reaction of the rand-dollar rate to inflation surprises, and address the natural questions: is there a negative correlation between inflation surprises and the nominal exchange rate in the very short term? Is it statistically significant? And is it different before and after the adoption of inflation targeting? [6]

Specifically, we construct time series for inflation surprises, measured as the difference between announced and expected inflation; and for the currency's movements within ten-minute intervals around (five minutes before, and five minutes after) each official inflation announcement. We find, using a standard regression approach, that the high-frequency response of the South African rand to inflation surprises is to appreciate on impact when inflation is higher than expected; and depreciate on impact when inflation is lower than expected − but only under inflation targeting. For the period before the adoption of inflation targeting, bad news about inflation are bad news for the currency − but the effect is statistically insignificant. We also find that the effect of inflation surprises on the exchange rate is larger when

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[5]It also holds in the short-run under hyper-inflation episodes − see Froot and Rogoff (1995).

[6]South Africa is an emerging market for which there is an explicit date for the official adoption of inflation targeting, and a heavily traded currency. To date, evidence comparing official periods before and after inflation targeting is only available for Norway and the United Kingdom - see Clarida and Waldman (2008).

inflation is lower than expected; and when it breaches the official target, under the inflation targeting regime.

The remainder of the paper proceeds as follows. Section two contains a discussion of related literature. Section three is the empirical analysis. We explain how we constructed the data series, describe the regression model, and present and discuss the results. Section four contains concluding remarks on the implications of our findings for the credibility of inflation-targeting in South Africa.

2   Related Literature

Clarida and Waldman (2008) examine how the nominal exchange rate responds to inflation announcements in a set of ten countries, over ten minute windows around these announcements. They find that for currencies of inflation targeting countries, where monetary policy can be compactly described by an interest rate rule, "bad news" about inflation (i.e. that it is higher than expected) cause the exchange rate to appreciate on impact. (See for example Svensson (2011) on inflation targeting.) This effect is however absent for the currencies of non-inflation-targeting economies. Interestingly, they also show that the effect changed in Norway and the United Kingdom after the adoption of inflation targeting: higher than expected inflation caused the Norwegian krona and British pound to depreciate before the official policy change, but to appreciate thereafter.

Related currency-specific studies include Karagedikli and Siklos (2008), showing that the response of the New Zealand dollar to inflation surprises is stronger than (but directionally consistent with) that reported in Clarida and Waldman (2008) for the same currency; and Conrad and Lamla (2010), who find that the euro appreciates (resp., depreciates) on impact, in response to European Central Bank statements about rising (resp., falling) inflation. Fedderke and Flamand (2005) examine the effect of news about a set of macro-economic variables on the rand-dollar daily rate. Their study precedes the literature on exchange rates under interest rate rules, but their findings are relevant. The group of macro-economic variables includes South African and United States inflation surprises over a four-year period under inflation-targeting. They find no statistically significant effects on the rand-dollar rate from surprises about South African inflation, but that bad news about United States inflation (that it is higher than expected) are bad news for the South African currency (it depreciates). This finding suggests that good news about South African inflation relative to United States inflation

(i.e. the inflation differential) is bad news for the rand. The lack of statistical significance for the effect of surprises about inflation in South Africa may be due to the use of daily data (an insufficiently fine time-partition to decipher currency market reactions to news), as well as the relatively short time period.

Theoretically, recent research shows that currency appreciation on impact in response to unexpectedly high inflation is rationalisable by exchange-rate models with an explicit treatment of inflation-targeting. This is done by Engel and West (2006) for the real exchange rate, and by Clarida and Waldman (2008) and Farrell, Hassan and Viegi (2011) for the nominal exchange rate. These models rationalise the intuitive argument that, if inflation-targeting is credible and short-term exchange rate movements are perceived as unpredictable, then the currency ought to appreciate (resp., depreciate) on impact when inflation is higher (resp., lower) than expected. Macroeconomic fundamentals may still anchor the currency's long-term direction, as predicted in standard models.

3 Empirical Analysis

3.1 Data

The data set consists of market data on South African inflation expectations; official data on inflation announcements; and high-frequency (five-minute intervals) exchange rate data.

3.1.1 Inflation Surprise Series

We construct a series for inflation surprises by computing the difference between the market expectation for CPI inflation announcements as surveyed by Bloomberg, and the actual values subsequently released by Statistics South Africa (Statistical release P0141.1). A positive surprise indicates higher-than-expected inflation (i.e., bad news). We use the median expectation of the Bloomberg survey, and the official inflation rate as announced on the release date.[7]

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[7]That is, we do not use the revised statistics, when such revisions are made, as was the case in April 2003, when Statistics South Africa had to revise CPI data backwards to January 2002 following an overestimation in the residential rent component in the CPI (Statistics South Africa, 2003). We are interested in measuring inflation surprises as perceived by the market at the time of each announcement, hence using revised statistics would be obviously incorrect.

We calculate both year-on-year and month-on-month surprises for the inflation rate targeted by policymakers, i.e. measured using the consumer price index excluding mortgage interest cost for metropolitan and other urban areas (CPIX) until the end of 2008, and the CPI for all urban areas thereafter. We also calculate these inflation surprises for the headline CPI series (the consumer price index for metropolitan areas until the end of 2008, and the CPI for all urban areas thereafter), and for the CPIX separately. Availability of Bloomberg survey data on inflation expectations determines the start dates of our samples. Figures 2 and A1 (in the appendix) show the evolution of expected inflation, actual (announced) inflation, and inflation surprises.

Figure 2: Inflation Surprises
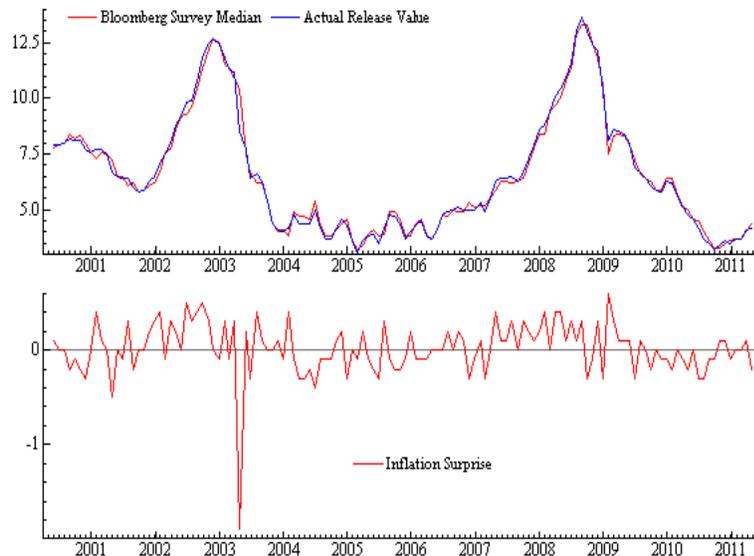
Notes: year-on-year (YoY) targeted inflation

The mean inflation surprise (for year-on-year targeted inflation) is 0.017, with a standard deviation of 0.284.

3.1.2 Exchange Rate Returns Series

The raw exchange rate data, obtained from Olsen and Associates, consists of last mid-rates (averages of bid and ask quotes) at 5-minute intervals for the rand against the US dollar (an increase is a depreciation). The data set

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runs from the beginning of 1997 (to coincide with availability of inflation expectations data) to the end of August 2010.[8] We convert these rates to returns by taking ten-minute changes (100 times the log differences), to capture exchange rate behavior over the period from five minutes before an inflation announcement to five minutes after the announcement. Figure 3 shows the ten-minute rand-dollar returns for 130 inflation announcement days. The mean return is minus 0.011, with a standard deviation of 0.157.

**Figure 3: High-Frequency Currency Movements
Around Announcements**
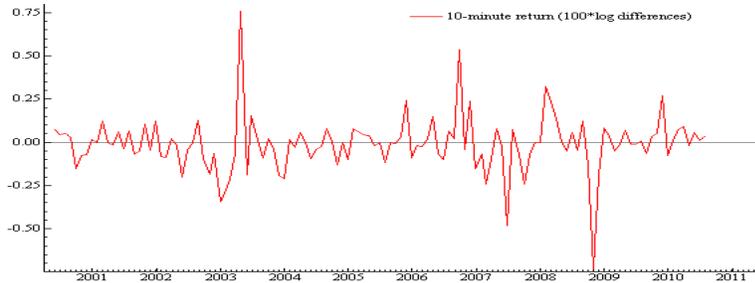
The exceptionally large inflation surprise in May 2003 (in Figure 2), accompanied by a sharp depreciation of the currency (in Figure 3), is the event discussed in the introduction.

3.2   Empirical Model

We follow the common approach in the macroeconomic announcements literature, and estimate the following regression equation (Gürkaynak, Sack and Swanson (2005), Bernanke and Kuttner (2005), Faust, Rogers, Wang and Wright (2007), Clarida and Waldman (2008), Karagedikli and Siklos (2008)):

$$R_t = \alpha + \beta U_t + \epsilon_t. \tag{1}$$

Here, R_t is the ten-minute return around the inflation announcement, U_t is the inflation surprise, and ϵ_t is the error term. A negative exchange rate return indicates an appreciation of the rand against the US dollar. The coefficient β represents the percentage change in the rand for a 1 percentage point surprise in targeted inflation. Table 1 reports the results.

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[8] The last CPI data release is therefore for July 2010, released on 25 August 2010.

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Table 1: Main Regression Results					
Inflation:	Targeted †	Targeted †	Targeted ‡	CPI †	CPI ‡
Sample begins	2000:5	2002:1	2001:5	1997:1	1999:6
Sample ends	2010:7	2010:7	2010:7	2010:7	2010:7
Coefficient (β)	-0.129	-0.156	-0.014	-0.064	0.005
T-statistic (β)	-2.64	-2.87	-0.186	-2.06	0.074
R-squared	0.054	0.075	0.0003	0.026	0.000
Observations	123	103	111	159	130
Notes: † is year-on-year; ‡ is month-on-month					

The reported negative coefficients for four of the five estimations, which are statistically significant when the explanatory variable is surprises to targeted year-on-year inflation, show that, for South Africa, bad news about inflation causes the currency to appreciate on impact. Conversely, when inflation is lower than expected (good news), the currency depreciates on impact. This finding is consistent with those of Clarida and Waldman (2008) for the currencies of inflation-targeting countries. It is also consistent with the theoretical predictions in Clarida and Waldman (2008) and Farrell, Hassan and Viegi (2011). Note that existing evidence indicates that the Taylor rule coefficient on inflation for South Africa, although above one, is relatively low (compared to other commonwealth countries).[9]

The size of the coefficients, as well as the R-squared statistics, indicate that the market reacts more strongly to information about targeted year-on-year inflation − as expected. The magnitudes of the same statistics are however quantitatively lower than the averages reported by Clarida and Waldman (2008) for inflation targeters. The β coefficient for South Africa after the official announcement of inflation targeting as policy (in February 2000), is minus 0.129, with an R-squared of 0.054 (see the first column of results in Table 1); for the period after the first target year (2002), the coefficient increases in absolute value to minus 0.156, with an R-squared of 0.075 (second column, Table 1). For comparison, Clarida and Waldman (2008) report a cross-section average coefficient of 0.2 (equivalent to minus 0.2 using our definitions), with an R-squared of 0.13, for headline inflation (see their Table 9.4, page 387). This is consistent with market perceptions of a relatively mild inflation-targeting stance by the South African Reserve

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[9]Ortiz and Sturzenegger (2007) estimate a coefficient of 1.11 for South Africa (with a 90 percent confidence interval between 0.89 and 1.33), compared to 1.41 for Australia, 1.3 for Canada, 1.69 for New Zealand, and 1.30 for the UK. Note however that the beginning of their sample period precedes the adoption of inflation targeting in South Africa.

Bank.[10]

3.3   Regime Change

South Africa officially adopted a policy of flexible inflation targeting in February 2000, with a target band of three to six percent, and 2002 as the first target year. We compute an inflation surprise series using CPI (year-on-year), and ten-minute rand-dollar returns around each announcement between January 1997 and February 2000, and estimate regression equation (1).

Table 2: Results for Pre-Inflation Targeting Period	
Inflation:	CPI †
Sample period	1997:01−2000:02
Coefficient (β)	0.036 (1.48)
R-squared	0.06
Observations	34
Notes: Regression results for period prior to inflation targeting	
† is year-on-year; t-statistics in parenthesis	

The positive coefficient reported in table 2 indicates a positive correlation between inflation surprises and immediate changes in the nominal exchange rate − higher than expected inflation caused the currency to depreciate on impact. So prior to inflation targeting, bad news about inflation tended to depreciate the currency on impact, but the effect is not statistically significant (which may be due to the small sample). Clarida and Waldman (2008) report the same findings for Norway and the United Kingdom.

As an alternative test, to deal with the small sample size for the pre-inflation targeting period, we run the regression model with a dummy variable (taking the value of one if the inflation surprise is prior to the adoption of inflation targeting and zero otherwise) in the set of regressors, using the entire sample period. The results are shown in Table 3.

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[10] Our β coefficient for South Africa is larger than Clarida and Waldman's (2008) for Canada, and marginally larger or approximately equal to Australia and Switzerland. It is smaller than those for New Zealand, Norway, Sweden and the United Kingdom. The same broad pattern applies to the R-squares.

Table 3: Regression Results with Regime Change Dummy Variable

	CPI †
Sample period	1997:1 − 2010:7
Coefficient (β)	-0.064 (-2.02)
Coefficient (Dummy)	0.004 (0.162)
Observations	159
R-squared	0.026
Notes: t-statistics in parenthesis	

The findings are consistent with the previous results. The β coefficient remains negative and statistically significant; the coefficient on the dummy variable is positive but close to zero and not statistically significant.

3.4 Sign Effects

We examine whether the exchange rate reaction differs depending on the sign of the inflation surprise. We divide the inflation surprise series into two: a series consisting only of positive inflation surprises (higher than expected inflation), and another consisting only of negative surprises (lower than expected inflation); and estimate equation (1) for both. (Cases where inflation was as expected are discarded.) We obtain negative coefficients in both cases, but the coefficient for positive surprises is not statistically significant − see Table 4.

Table 4: Sign Effects

	Targeted † ($U_t > 0$)	Targeted † ($U_t < 0$)
Sample period	2000:05 − 2010:7	2000:05 − 2010:7
Coefficient (β)	-0.011 (-0.16)	-0.216 (-2.94)
Observations	52	48
R-squared	0.001	0.155
Notes: † is year-on-year; t-statistics in parenthesis		
$U_t > 0$ (resp., $U_t < 0$) is the series for positive (resp., negative) surprises		

The correlation between inflation surprises and the exchange rate response is also of far larger magnitude for negative surprises (when inflation is lower than expected). That is, for inflation surprises of the same magnitude, currency depreciations following good news tend to be larger than the appreciations associated with bad news; and the statistical relationship is stronger. The same findings are reported by Clarida and Waldman (2008).

3.5 Reaction When Inflation is Outside the Target Band

Lastly, we use a dummy variable to test for an additional effect when inflation is outside the policy target band − which were all periods when inflation exceeded the target's upper bound. One expects that market participants will anticipate more aggressive changes in the policy interest rate in such periods, and therefore stronger reactions in the currency market to inflation surprises. Table 5 shows the results. The coefficient for the inflation surprise remains negative, and the coefficient for the dummy is also negative, indicating that the exchange rate response to an inflation surprise is quantitatively larger when the target is breached. The coefficient on the dummy variable is however not statistically significant.

Table 5: Reaction When Inflation Target is Breached	
	Targeted †
Sample period	2000:05 − 2010:7
Coefficient (β)	-0.123 (-2.43)
Dummy	-0.013 (-0.47)
Observations (total)	123
R-squared	0.056
Notes: † is year-on-year; t-statistics in parenthesis	

4 Concluding Remarks

An alternative take on the analysis conducted in this paper, as observed by Clarida and Waldman (2008) and Engel (2008), is to interpret the findings in terms of what they imply about the conduct of monetary policy. The channel through which the currency appreciates on impact when inflation is higher than expected, is the expectation that the central bank is likely to raise interest rates in response. Hence, evidence that the currency appreciates on impact in response to bad news about inflation, reflects credibility of the central bank's inflation targeting policy. This interpretation is clearly applicable for South Africa, since: 1) the exchange rate tended to depreciate on impact in response to higher than expected inflation before the adoption of inflation targeting (bad news about inflation was mildly bad news for the currency), but to appreciate thereafter; and 2) the exchange rate response is larger when inflation is outside the central bank's target range.

Our findings on the exchange rate's reaction to inflation surprises are therefore consistent with a credible (though perhaps not particularly aggressive) inflation targeting policy in South Africa. Importantly, they also

suggest that changes in the direction (and strength) of the currency's reaction to significant inflation surprises, may convey useful information, for the purposes of policy making, on the market's belief about the conduct of monetary policy by the South African Reserve Bank. For example, an increased focus on growth, and relatively less weight placed on inflation when setting interest rates, should reduce the magnitude of the currency's depreciation (resp., appreciation) in response to lower (resp., higher) than expected inflation − or, in the extreme case, reverse the direction of the currency's short-term response. It will also increase the strength of the currency's reaction to unanticipated announcements on indicators of economic output.

The finding of an asymmetric exchange rate response, depending on whether announced inflation is higher or lower than expected, is consistent with the evidence in Clarida and Waldman (2008), as well as Fedderke and Flamand (2005). This is a new empirical regularity for which we do not have a theoretic explanation.

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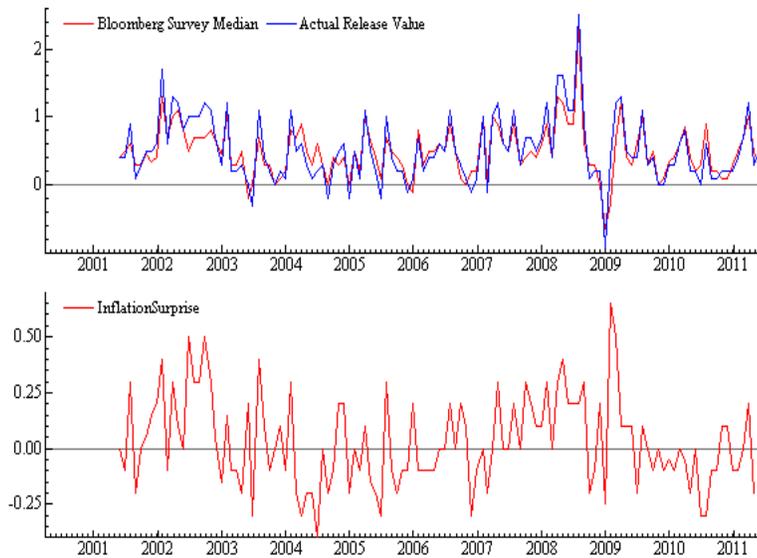
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6   Appendix

6.1   Inflation Surprises, Month on Month

Figure A1: Inflation Surprises

Notes: month-on-month (MoM) targeted inflation