Minimal conditions for bad news about inflation to cause currency appreciation on impact, and evidence from South Africa *

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Abstract

This paper shows that if central banks follow interest rate rules and there are no arbitrage opportunities between the fixed income and currency forward/futures markets, bad (resp., good) news about inflation will appreciate (resp., depreciate) the currency on impact. No other significant assumptions are required. We examine the high-frequency response of the rand-dollar nominal rate within ten-minute intervals around inflation announcements, and show that the rand appreciates (resp., depreciates) on impact when inflation is higher (resp., lower) than expected. The effect is absent prior to inflation targeting. Our findings are consistent with a credible inflation targeting policy in South Africa.

Keywords: exchange rates; inflation surprises; high frequency data; Taylor rules; inflation targeting.

JEL Classification: E31, E52, F30, F31

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1 Introduction

1.1 Motivation

In standard exchange rate models inflation is bad for the exchange rate. If the domestic rate of inflation increases relative to foreign inflation, the domestic currency depreciates. Yet, 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.[1]

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 (five minutes before, and five minutes after) 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. 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.

In one of the earliest contributions to the modelling of exchange rate behavior under Taylor rules, Engel and West (2006) show that a transitory increase in inflation causes the real exchange rate to appreciate. Clarida and Waldman (2008) develop a theoretical model which is consistent with the empirical findings on the nominal exchange rate, by predicting a positive relationship between unexpectedly high inflation, and currency appreciation, in the short run. The theoretical analysis in Clarida and Waldman (2008) builds on a simplified version of Svensson (2000) and assumes (as do Engel and West (2006)), in addition to the interest rate rules and standard macro-economic relationships, that uncovered interest rate parity (UIP, henceforth) holds.

[1] 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.)

In practice, and under a credible inflation-targeting regime, a "positive" inflation surprise leads to the expectation that the central bank will respond by increasing the benchmark interest rate. Such a belief can only be consistent with appreciation of the currency if an increase in the interest differential (or a wider forward discount) is not seen as necessitating the opposite adjustment in the value of the currency - a belief which would be consistent with the extensive evidence showing that currencies at a forward discount (or offering a favorable interest differential) tend to appreciate; and the recent evidence documenting the persistent returns to currency carry trade strategies. (Burnside, Eichenbaum and Rebelo (2007), Backus, Gavazzoni, Telmer and Zin (2010), Burnside (2011).)

In short, it is difficult to rationalize the finding that currencies of inflation-targeting countries (but not those of non-targeters) appreciate after news that inflation is higher than previously expected, if uncovered interest parity holds - unless, of course, all the appreciation were instantaneous and the currency subsequently depreciated to restore UIP, *a la* Dornbusch (1976), which there is little evidence for, at horizons below two years. (There is much and well-known evidence to the contrary - Meese and Rogoff (1983), Frankel and Rose (1995), Obstfeld and Rogoff (1996).)

1.2 This paper's contribution

Our contribution is twofold. First, on the theoretical front, we show that inflation targeting is sufficient to explain short-term currency appreciation in response to bad news about inflation, if there are no arbitrage opportunities between the fixed income and currency forward markets (i.e. covered interest parity holds). We obtain a positive theoretical relationship between higher-than expected inflation announcements, and the immediate value of the currency (of an inflation-targeting country), relying only on assumptions which are consistent with well-documented facts. Moreover, the result holds even if the central bank's interest rate response does not conform to the Taylor principle.

Second, we add to the empirical evidence by examining an emerging market for which there is an explicit date for the official adoption of inflation targeting, and a heavily traded currency - South Africa.[2] Specifically, we examine the currency's movement within ten-minute intervals around inflation announcements, and find that the high-frequency response of the South African rand to inflation surprises is to appreciate (resp., depreciate) on impact when inflation is higher (resp., lower) than expected − but only under inflation targeting. For the recent period before the implementation of inflation targeting, bad news about inflation are bad news for the currency.

[2] 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).

2 A simple model

2.1 Assumptions

2.1.1 Assumption 1: no arbitrage

Let $i_{t,t+1}$ denote the interest rate at time t on a fixed-interest domestic security maturing at time $t+1$, and $i^*_{t,t+1}$ is the analogous rate for the foreign security. The spot exchange rate, in units of domestic currency per unit of foreign currency is S_t, and $F_{t,t+1}$ denotes the forward exchange rate at t, for delivery at $t+1$. A portfolio h with market value $h \cdot q_t$, where q is the price vector, and time $t+1$ payoff $h \cdot x_{t+1}$, where x is the payoff vector, is an arbitrage if $h \cdot q_t \leq 0$ and $h \cdot x_{t+1} > 0$, or $h \cdot q_t = 0$ and $h \cdot x_{t+1} \geq 0$. (Harrison and Kreps (1979), Duffie (2001).) Note that violations of *uncovered* interest parity do not, according to this definition, represent arbitrage opportunities. In our setting, a trading strategy or portfolio consisting of the domestic and foreign securities, and a forward exchange rate contract, is an arbitrage opportunity if

$$\frac{1}{S_t}\left(1+i^*_{t,t+1}\right)F_{t,t+1} \neq \left(1+i_{t,t+1}\right). \tag{1}$$

We assume the market is free of arbitrage opportunities, so *covered* interest parity must hold:

$$\frac{1}{S_t}\left(1+i^*_{t,t+1}\right)F_{t,t+1} = \left(1+i_{t,t+1}\right). \tag{2}$$

Re-arranging and taking logs, equation 2 becomes,

$$f_{t,t+1} - s_t = i_{t,t+1} - i^*_{t,t+1}, \tag{3}$$

where $f_{t,t+1} := \ln\left(F_{t,t+1}\right)$ and $s_t := \ln\left(S_t\right)$.

2.1.2 Assumption 2: interest rate rules

Consistent with modern monetary economics and much of current monetary policy practice, we represent monetary policy through interest rate rules, by assuming that the domestic and foreign central banks set the short term interest rate according to expected future inflation, and the observed deviation of current inflation from an inflation target, given by:

$$i_t = aE_t\pi_{t+1} + b\left(\pi_t - \overline{\pi}\right), \tag{4}$$

where E is the expectation operator, π is the log inflation rate, $\overline{\pi}$ is the domestic inflation target, and $a, b > 0$, are parameters which reflect, respectively, how aggressively the central bank responds to expected inflation and deviations from the target. The analogous rule for the foreign economy is given by

$$i^*_t = aE_t\pi^*_{t+1} + b\left(\pi^*_t - \overline{\pi}^*\right), \tag{5}$$

where again the superscript $*$ identifies the corresponding foreign quantity.

2.1.3 Assumption 3: inflation process

Lastly, we assume the following process for the inflation rate (Nelson and Plosser (1982), Cecchetti, Hooper, Kasman, Schoenholtz and Watson (2007)):

$$\pi_t = \pi_{t-1} + u_t, \tag{6}$$

where, technically, u is an independently distributed stochastic term with mean zero. Analogously, the inflation process for the foreign economy is given by:

$$\pi_t^* = \pi_{t-1}^* + u_t^*. \tag{7}$$

To see that u_t represents the inflation surprise in period t, note that $E_{t-1}\pi_t = \pi_{t-1}$, hence $u_t = \pi_t - E_{t-1}\pi_t$, i.e. the value of u in period t is the difference between announced or realized inflation for that period, and the inflation rate that had been anticipated for the same period.

Note that the assumptions are consistent with (and justified by) the empirical evidence, and recent facts about the conduct of monetary policy - see for example Branson (1969) and Taylor (1987, 1989, 1995) on the validity of covered interest parity; Taylor and Williams (2011) and Svensson (2011) for extensive reviews on the representation of monetary policy through interest rate rules, and the adoption of inflation targeting internationally; and Nelson and Plosser (1982), Fuhrer and Moore (1995), Batini (2002), Pivetta and Reis (2007), and Rangasamy (2009), on persistence (high serial correlation or large autoregressive coefficients) in the time series behavior of inflation processes internationally.

2.2 Result

The difference between domestic and foreign short-term interest rates, using Taylor rules (4) and (5), is

$$i_{t,t+1} - i_{t,t+1}^* = aE_t\left(\pi_{t+1} - \pi_{t+1}^*\right) + b\left(\pi_t - \pi_t^*\right) - b\left(\overline{\pi} - \overline{\pi}^*\right). \tag{8}$$

Using the assumed inflation processes, linearity of the expectations operator and elementary results of conditional expectations, we have,

$$\begin{aligned} E_t\left(\pi_{t+1} - \pi_{t+1}^*\right) &= E_t\left(\pi_t + u_{t+1}\right) + E_t\left(\pi_t^* + u_{t+1}^*\right) \\ &= \left(\pi_{t-1} - \pi_{t-1}^*\right) + \left(u_t - u_t^*\right). \end{aligned} \tag{9}$$

Also, $\pi_t - \pi_t^* = \left(\pi_{t-1} - \pi_{t-1}^*\right) + \left(u_t - u_t^*\right)$. Substituting these results into the expression for the interest differential and re-arranging gives,

$$i_{t,t+1} - i_{t,t+1}^* = (a+b)\left[\left(\pi_{t-1} - \pi_{t-1}^*\right) + \left(u_t - u_t^*\right)\right] - b\left(\overline{\pi} - \overline{\pi}^*\right). \tag{10}$$

No arbitrage in turn implies the following equation for the log forward premium (from equation (3)),

$$f_{t,t+1} - s_t = (a+b)\left[\left(\pi_{t-1} - \pi_{t-1}^*\right) + \left(u_t - u_t^*\right)\right] - b\left(\overline{\pi} - \overline{\pi}^*\right). \tag{11}$$

Re-arranging equation (11) gives the log spot exchange rate as

$$s_t = f_{t,t+1} - (a+b)\left[\left(\pi_{t-1} - \pi^*_{t-1}\right) + \left(u_t - u^*_t\right)\right] + b\left(\overline{\pi} - \overline{\pi}^*\right). \qquad (12)$$

It is immediately clear that unanticipatedly bad news about inflation (that it is higher than expected) causes the nominal exchange rate to appreciate on impact. We collect the preceding analysis in the following result.

Proposition 1 *For any a, b, such that $(a+b) > 0$, $\frac{\partial s}{\partial u} < 0$. That is, as long as the central bank responds to an increase in inflation by raising interest rates, the nominal exchange rate appreciates in response to higher than expected inflation.*

2.3 Discussion

All that is needed for the currency to appreciate is that the central bank follows an interest rate rule, and responds to the positive inflation surprise by increasing interest rates. The aggressiveness of its response (i.e. the magnitude of parameters a, b) will affect the magnitude of the exchange rate reaction; but not its direction. Hence the result holds even if or when the central bank does not obey the Taylor principle.[3] Equivalently, it is not necessary for the interest rate response to bad news on inflation to be such that the real interest rate increases. This may seem surprising, but it shouldn't. Purchasing power parity does not hold in the short run. (Taylor (1995), Obstfeld and Rogoff (1996).) Currency traders with short-term horizons will not expect the higher inflation to cause the currency to depreciate within the term of their speculative positions. Hence domestic inflation (and the domestic real interest rate) does not affect the trader's returns expressed in terms of the funding (foreign) currency.

Example 2 *Suppose that at the initial period inflation is on target, i.e. $\pi_1 = \overline{\pi}$, so the bank sets $i_1 = aE_1\pi_2$. Then there is an inflation surprise in period two, say it is higher than expected, $u_2 > 0$. Now $\pi_2 > \pi_1 = \overline{\pi}$, inflation is above target, so the central bank raises the interest rate. Holding the forward rate for delivery at the end of period 2 or beyond unchanged, absence of arbitrage requires the spot exchange rate to appreciate.*[4]

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] According to the Taylor principle, the nominal interest rate should respond more than one for one to current inflation, to stabilize the economy.

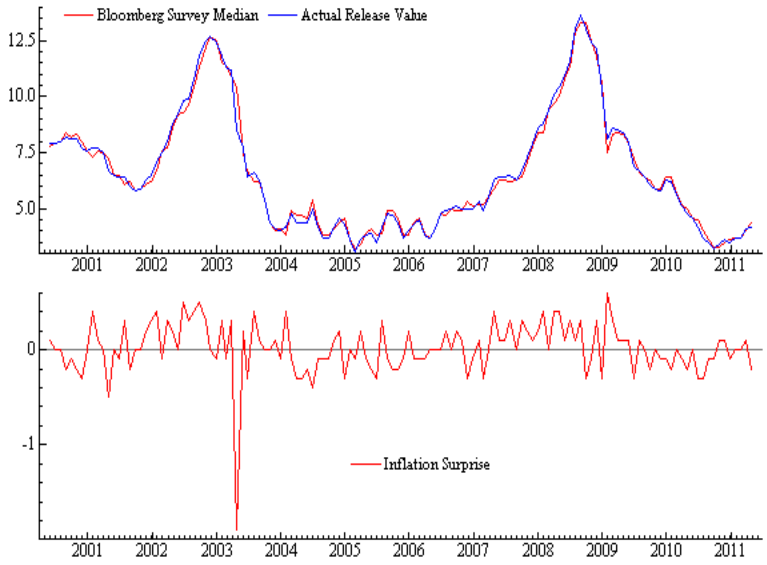
[4] As an alternative interpretation, if market participants see the short-term exchange rate process as a martingale, the currency becomes attractive as a carry trade target, and it appreciates.

3.1.1 Inflation surprises

Inflation surprises are calculated as 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 announced value of the inflation rate. The latter is important over this sample period since Statistics South Africa were forced in April 2003 to revise CPI data backwards to January 2002 following an overestimation in the residential rent component in the CPI (Statistics South Africa, 2003).[5]

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 1 and A1 (in the appendix) show the evolution of expected inflation, actual (announced) inflation, and inflation surprises.

Figure 1: Inflation surprises



Notes: year-on-year (YoY) targeted inflation

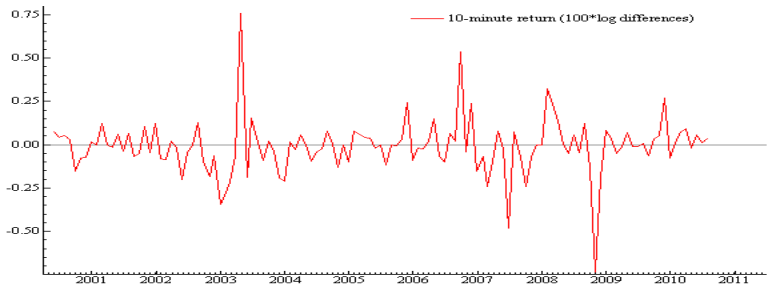
[5] This resulted in the spike in April 2003 in Figure 1(a), where the median expectation for year-on-year CPIX inflation was 10,4 per cent against an outcome of 8,5 per cent (the data were released on 30 May 2003.

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 data

The raw exchange rate data, obtained from Olsen and Associates, consists of last mid-rates (averages of bid and ask quotes) of 5-minute intervals for the rand against the US dollar (an increase is a depreciation). The data set runs from the beginning of 1995 to the end of August 2010.[6] 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 2 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 2: high-frequency rand-dollar returns around inflation announcements



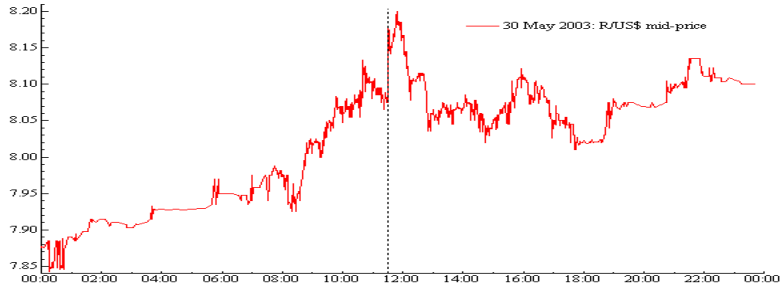
A cursory look at figure 1 reveals a particularly large inflation surprise in May 2003. Figure 2 shows that this is accompanied by a sharp appreciation of the currency. We look at this specific event, for illustration, before a more systematic empirical analysis.

3.2 Intraday reaction to a large inflation surprise

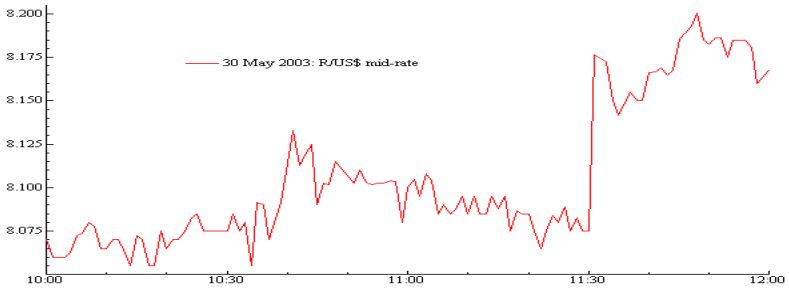
Inflation expectations rose sharply between 2002 and mid 2003, as shown in Figure 1. In mid-May 2003, the last Bloomberg market survey prior to the 30 May CPI release, indicates a median expectation for year-on-year CPIX inflation for South Africa (for the May 2002 to April 2003 period) of 10,4 per cent. When the data were released, at 11:30am Johannesburg time (GMT + 2) on 30 May 2003, it revealed an inflation rate of 8,5 per cent − a very large negative surprise (good news about inflation).[7] As shown in figure 3, the exchange rate response to the announcement of an inflation rate two percentage points lower than expected, was a sharp and immediate depreciation of the currency.

[6] The last CPI data release is therefore for July 2010, released on 25 August 2010.
[7] See Statistics South Africa (2003).

Figure 3: Exchange rate behavior on 30 May 2003



3a: Five-minute rand-dollar rates over 24 hours



3b: Five-minute rand-dollar rates around 11:30am

The behavior of the rand on the 30th May 2003, when there was a very significant inflation surprise, is completely consistent with our theoretic prediction. We now turn to a more systematic investigation 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 changes in the nominal exchange rate in the very short term? Is it statistically significant? Is it different before and after the adoption of inflation targeting? And is it different depending on whether inflation surprises are positive or negative?

3.3 Empirical model

We follow the common approach in the macroeconomic announcements literature, and estimate the following regression equation:[8]

$$R_t = \alpha + \beta U_t + \epsilon_t. \tag{13}$$

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.

[8] See Gürkaynak, Sack and Swanson (2005), Bernanke and Kuttner (2005), Faust, Rogers, Wang and Wright (2007), Clarida and Waldman (2008), Karagedikli and Siklos (2008).

Table 1: 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 very 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 their theoretical prediction, and ours. 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 0.13, 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).[10]

3.4 Regime change

South Africa formally adopted a policy of flexible inflation targeting in February 2000, with a target band of three to six percent (originally set at three to five percent). If the theoretic analysis is correct, we should only find a negative β coefficient for the subsequent period. We compute an inflation suprise series

[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.

[10] Our β coefficient for South Africa is larger than Clarida and Waldman's (2007) 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.

using CPI (year on year), and ten-minute rand-dollar returns around each of the announcements, from January 1997 to February 2000, and estimate the regression equation (13).

Table 2: Regression Results

Inflation:	CPI †
Sample begins	1997:01
Sample ends	2000:2
Coefficient (β)	0.036
T-statistic (β)	1.48
R-squared	0.06
Observations	34

Notes: Results for pre-inflation targeting period
† is year-on-year

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). Exactly the same findings are reported for the UK and Norway in Clarida and Waldman (2008).

3.5 Sign effects and currency reaction when inflation exceeds target

We examine whether the exchange rate reaction differs depending on the sign of the inflation surprise. We use a series consisting only of positive inflation surprises (higher than expected), and another consisting only of negative surprises (lower than expected). We obtain negative coefficients in both cases, but the coefficient for positive surprises is not statistically significant. The correlation between inflation surprises and the exchange rate response is also of larger magnitude for negative surprises. The same findings are reported by Clarida and Waldman (2008).

Lastly, we use a dummy variable to test for an additional effect when inflation exceeds the target band. The coefficient for the dummy is negative, indicating that the exchange rate response to an inflation surprise is larger when the target is breached, but the coefficient (on the dummy variable) is not statistically significant.

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.

Our 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). This is a new empirical regularity for which we do not have a theoretic explanation.

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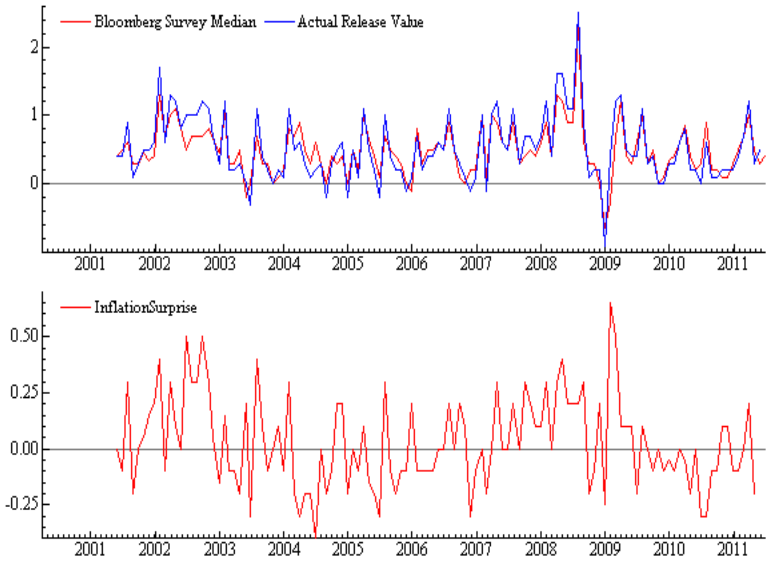
6 Appendix

6.1 Inflation surpises, month on month

Figure A1: Inflation surprises



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

6.2 Regime change

As an alternative test of the regime change, 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. The results are shown in Table A2.

Table A2: Regression Results for Regime Change

	CPI †
Sample period	1997:1 - 2010:7
Coefficient (β)	-0.064 (-2.02)
Coefficient (Dummy)	0.004 (0.162)
No. Observations	159
R-squared	0.026

Notes: t-statistics in parenthesis

The findings are consistent with the main regression results. The β coefficient remains negative and statistically significant; the coefficient on the dummy variable is positive but close to zero and insignificant.