

Assessing the impact of time-varying monetary policy credibility in affecting inflation expectations

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[Preliminary and incomplete. Please do not quote.]

Abstract

Standard New Keynesian rational expectations models assume that the monetary policy authority has perfect credibility in achieving its desired inflation target. Whilst limiting assumptions are quite common in this class of models, this particular assumption creates a challenge when attempting to simulate the disinflation that results from a lowering of a central bank's inflation target. Under the assumption of perfect credibility, inflation expectations adjust rapidly towards the newly announced target, raising real interest rates in the process. Under most conditions, the result is lower inflation without the need for nominal monetary policy tightening. Using a reduced-form New Keynesian general equilibrium model that is calibrated for the South African economy, this paper introduces a non-linear process where the policymaker's credibility in achieving its desired inflation target may vary over time, depending on his actual performance in controlling inflation. Within this framework, the speed at which inflation expectations adjust to a hypothetical change in the inflation target depends not only on the responsiveness of aggregate demand to real interest rates and the slope of the Phillips curve with respect to the output gap, but also the degree of credibility that the policy-maker possesses. This innovation permits a scenario where, if the policy maker has insufficient credibility, falling inflation expectations don't facilitate the necessary real interest rate increase when disinflating, forcing a nominal rate increase from the central bank.

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Contents

1	Introduction	3
2	Inflation target credibility	3
2.1	What is meant by inflation target credibility?	3
2.2	The role of target credibility in price stability	3
2.3	How is this credibility achieved?	5
2.4	How credible is the SARB in achieving its inflation target	5
2.4.1	Target point versus range	6
3	Modelling inflation target credibility in the literature	8
3.1	Gauging credibility	8
4	The model	8
4.1	The standard New Keynesian model	8
4.2	Non-linear extension to account for endogenous credibility	9
5	Disinflation from the upper end of the target band to the midpoint	11
5.1	Disinflation in a standard New Keynesian model	11
5.2	Disinflation when credibility is endogenous	12
6	Conclusion	15

List of Tables

1	Individual countries inflation targets	4
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List of Figures

1	MPC meetings at which the Repo rate was increased	6
2	Hard edge: inflation expectations have become anchored at the upper end of the target range	7
3	Long-term bond market inflation expectations confirm the hard edge	7
4	What if the 4.5 midpoint is announced as the explicit target?	11
5	In the standard New Keynesian model, expectations adjust automatically	12
6	The Bank is perceived to have full credibility in keeping inflation close to the upper end	13
7	Building credibility at the midpoint of the target band	14

1 Introduction

Central banks (CBs) are still largely about price stability, which is achieved through anchoring long-run inflation expectations to an announced target. To help anchor these long-run inflation expectations, the CB should be credible. The South African Reserve Bank (SARB) is seen as credible by the market, but this credibility is arguably in terms of inflation being anchored at the upper target level of six per cent.

This paper explains inflation targeting credibility in terms of: its role in price stability; how it is achieved; the merits of a target point versus a range; how credible the SARB is in achieving its desired target; and the modelling of credibility. We then turn to our own model (see De Jager (2007) and De Jager et al. (2015)), a reduced-form New Keynesian general equilibrium model that is calibrated for the South African economy, and introduce a non-linear credibility process that varies over time, depending on the central banks track record in achieving inflation outcomes that are in line with its desired target – as in Argov et al. (2007) and Alichu et al. (2009). In this model, the adjustment of inflation expectations to a changed inflation target also depends on the degree of target credibility that the policy-maker possesses.

2 Inflation target credibility

2.1 What is meant by inflation target credibility?

Inflation target credibility is the ability to achieve the desired inflation target. It can also be seen as the central bank's inflation track record – simply calculated as the average inflation outcome over the inflation targeting period relative to the central bank's desired target. Since the commencement of South Africa's inflation targeting regime in February 2000, inflation has averaged 6,1 per cent. Although it is slightly above the upper target level of 6 per cent, it remains broadly consistent with the SARB's mandate of keeping inflation between 3 and 6 per cent on average.

It is important to note that target credibility should not be confused with general credibility of a central bank, which in turn refers to the general trust in the organization. Although target credibility will add to overall credibility of the monetary authority, but is by no means the only measure of overall credibility.

2.2 The role of target credibility in price stability

Around a decade ago the standout goal of most CBs was price stability. The real economy was managed by limiting the cycles around trend potential output and getting long-run inflation expectations to target. And the outcomes were generally good. Inflation was well behaved and growth prospects sound. Then the 2008 financial crisis reverberated across the globe and the world's central banks faced a far more complicated economic environment. Financial stability became a new focus point. But, despite the changes, price stability continues to remain the cornerstone of monetary policy with credibility of achieving the desired target vital to maintaining price stability.

Table 1: Individual countries inflation targets

	Target set by	Measure	Target 2012	Target type	Target horizon
Armenia	G and CB	H CPI	4% ± 1.5 pp	P + T	Medium term
Australia	G and CB	H CPI	2%?3%	Range	Medium term
Brazil	G and CB	H CPI	4.5% ± 2 pp	P + T	Yearly target
Canada	G and CB	H CPI	2% ± 1pp	P + T	Six-eight quarters
Chile	CB	H CPI	3% ± 1 pp	P + T	Around two years
Colombia	CB	H CPI	2%?4%	Range	Medium term
Czech Republic	CB	H CPI	2% ± 1 pp	P + T	Medium term, 12-18 months
Ghana	G and CB	H CPI	8.7% ± 2 pp	P + T	18-24 months
Guatemala	CB	H CPI	4.5% ± 1 pp	P + T	End of year
Hungary	CB	H CPI	3%	Point	Medium term
Iceland	G and CB	H CPI	2.5%	Point	On average
Indonesia	G and CB	H CPI	4.5% ± 1 pp	P + T	Medium term
Israel	G and CB	H CPI	1%?3%	Range	Within two years
Mexico	CB	H CPI	3% ± 1 pp	P + T	Medium term
New Zealand	G and CB	H CPI	1%?3%	Range	Medium term
Norway	G	H CPI	2.5%	Point	Medium term
Peru	CB	H CPI	2% ± 1 pp	P + T	At all times
Philippines	G and CB	H CPI	4.0% ± 1 pp	P + T	Medium term
Poland	CB	H CPI	2.5% ± 1 pp	P + T	Medium term
Romania	G and CB	H CPI	3% ± 1 pp	P + T	Medium-term target from 2013
Serbia	G and CB	H CPI	4.0% ± 1.5 pp	P + T	Medium term
South Africa	G	H CPI	3%?6%	Range	On a continuous basis
South Korea	CB (with G)	H CPI	3% ± 1 pp	P + T	Three years
Sweden	CB	H CPI	2%	Point	Normally two years
Thailand	G and CB	H CPI	3.0% ± 1.5 pp(a)	P + T	Eight quarters
Turkey	G and CB	H CPI	5.0% ± 2 pp	P + T	Multi year (Three years)
United Kingdom	G	H CPI	2%	Point	At all times

Note: CB = Central bank; G = Government; H CPI = Headline CPI; P + T = Point with tolerance band; pp = percentage point(s).

Source: Hammond (2012)

Inflation expectations are influenced through credibility enhancing transparency and accountability, so that the inflation target is either continuously attained or attained over the medium term (see Table ?? for an international comparison). CBs have come to view transparency as vital to ensure accountability to the public. To achieve this, it is essential to clearly communicate why monetary policy decisions have been made. At the SARB, this process is on-going. The latest enhancement to transparency has seen the SARB release its key assumptions (that underlie its forecast) to the market in July 2015 (see SARB, 2015b).

The key assumptions feed into the SARB's main forecasting model and underpin the forecasts of inflation and real GDP. It was decided that publishing these assumptions (in combination with credible forecasts), would contribute to better anchoring inflation expectations by increasing the information base related to the baseline trajectory. Frequent publication of the assumptions would allow the financial sector to more clearly observe central bank responses to various internal and external developments. The more open the SARB becomes, the more predictable it's actions should be as the markets will be better informed. This should further enhance expectations about the future conduct of policy and contribute to greater accountability and ultimately inflation targeting credibility.

2.3 How is this credibility achieved?

Credible broadly means believable and so a policy lacks credibility if it cannot reasonably be believed.

Bennett T. McCallum, 1984

Credibility is achieved when markets believe in the CB's commitment to low inflation over the long term. Market decisions would then moderate inflationary pressures. This would occur if business and labour believe that short-run movements in prices are merely transitory and if they believe the CB will aim to return inflation to within the target range. Business will then limit passing on higher prices to consumers and labour will reduce their wage expectations. This in turn will allow the Bank to adjust the repo rate less and less over time, in order to maintain price stability, with the cost to output then being lower. Developing credibility is a continuous process whereby the Bank strives to achieve predictable policy decision making.

2.4 How credible is the SARB in achieving its inflation target

In Bernanke's (2007) words, inflation expectations are well anchored " ... if the public experiences a spell of inflation higher than their long-run expectation, but their long-run expectation of inflation changes little as a result .."

Against the background of Bernanke's anchored-expectations criteria, Reid (2009), analyses the sensitivity of South African inflation expectations to macroeconomic surprises, and compares her results with similar international studies. Reid finds that the SARB compares well with other key inflation targeters and that the Bank is credible as it "has encouraged inflation expectations to be relatively insensitive to macroeconomic surprises", and thereby anchoring inflation expectations despite these surprises. Moreover, Reid and Du Plessis (2010) find that the Bank has been highly successful in signalling its likely future policy decisions through its monetary policy committee statements (between 2000 and 2009) with a high degree of consistency. This consistent signalling identified by Reid and Du Plessis (2010) remains to this day, and the most recent MPC statement attests to it:

... as emphasised previously, we have to be mindful of the risk of second-round effects on inflation, and the committee is concerned that failure to act against these heightened pressures and risks will cause inflation expectations to become entrenched at higher levels.

Lesetja Kganyago (SARB, 2015b)

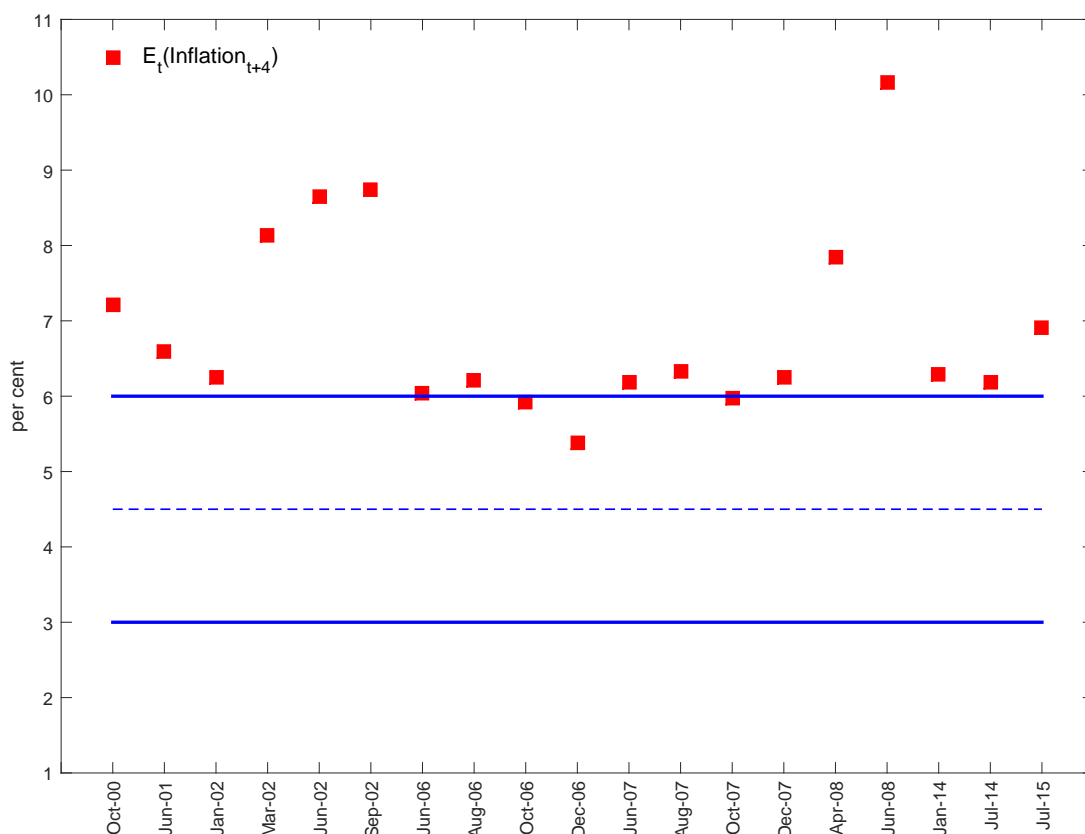
Nevertheless, the general public form inflation expectations through how the media translates the communication of the Bank and those of professional forecasters. This channel is indirect and relies on the ability of the media to adequately translate the message of the Bank. Kabundi et al. (2015) find that inflation expectations of analysts fall within the inflation target range and are more forward-looking, but that of business and labour is backward-looking and falls outside the target range. This raises concerns of how well the bank's communication is translated by the media, the main source of information to the broader public. Initial work by Reid and Du Plessis (2010) find that the media's translation of monetary policy lacks critical assessment and interpretation. However they do not directly analyse its impact on inflation expectations.

2.4.1 Target point versus range

The general consensus amongst official inflation targeting CBs is to have a point target with a tolerance band. Of the 27 official inflation targeting CBs, only five have target ranges as opposed to point targets, with the SARB being one of the five (see Hammond, 2012). A point target is more precise than a range. This precision clearly announces the CB's goal to the market, and should thereby enhance credibility. In South Africa, inflation expectations are relatively well-anchored, but they appear to have anchored themselves to the upper target level of 6 per cent, rather than the mid-point of the target. The SARB's Monetary Policy Review of June 2015 refers to this as follows: "inflation expectations remain uncomfortably close to the upper end of the target range over the longer term" (see SARB, 2015a).

In theory, a target range is essentially indistinguishable from a point target as long as the policy makers aim to get projected inflation to the centre of the target range over the forecast horizon and communicate this intention clearly. However, in practice the SARB has generally tended to increase the policy rate when inflation was expected to exceed the upper limit of the inflation 3 – 6 per cent target range, as can be seen in Figure 1:

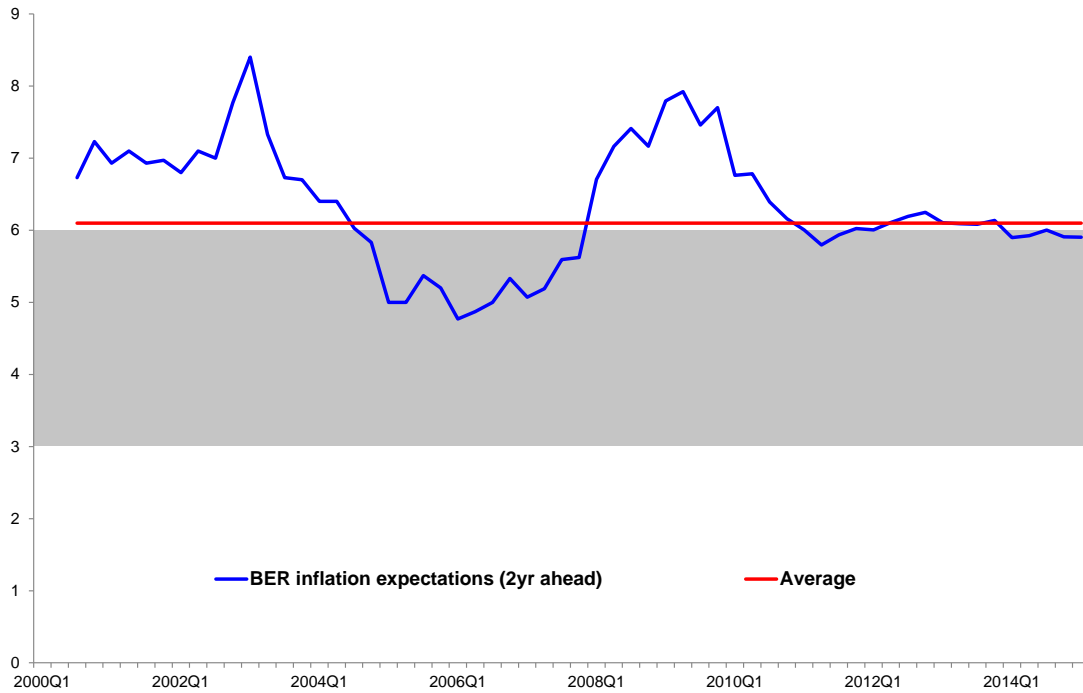
Figure 1: MPC meetings at which the Repo rate was increased



On average, inflation expectations have become anchored around the upper level of the target range (see Figure 2). Du Plessis (2003) warned about this being likely to happen. He highlighted the shortcoming of a target range over a point target, warning of the likelihood that inflation could "harden" at the edges of the target range, either above or below.

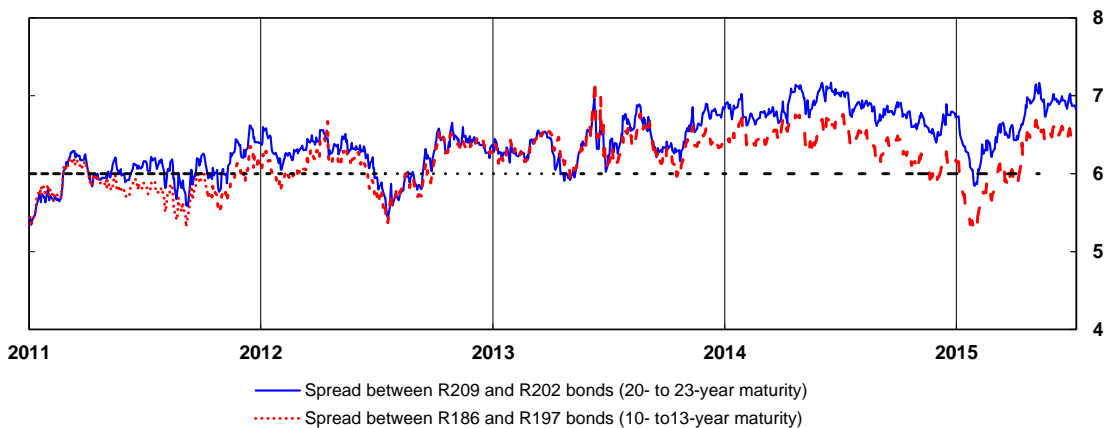
A hard edge is problematic as policy credibility could be affected in that monetary policy, being

Figure 2: Hard edge: inflation expectations have become anchored at the upper end of the target range



imprecise, results in a central bank being unable to influence inflation with the requisite accuracy that a hard edge requires. Lags in the monetary transmission mechanism are long and variable and together with the shocks that strike when least expected, inflation at the edge is easily pushed over the edge. It would not take much of a price shock to do so. A target range does have some advantages over a point target though. It more clearly shows the imprecise control that a CB has over the inflation target, which allows the CB to better stabilize output as it has more room to accommodate temporary shocks to prices.

Figure 3: Long-term bond market inflation expectations confirm the hard edge



3 Modelling inflation target credibility in the literature

Faust and Svensson (2001) test CB credibility in a model where the CB lacks transparency and the public does not have access to the inputs the CB uses to make decisions. This lack of transparency sees the markets deduce the goals of the CB from their own information and the CB's policy decision. They identify CB credibility as "negatively related to the distance between the private sector's inflation expectations and the bank's announced inflation target."

Faust and Svensson (2001) make the point that a general "wisdom" of credibility has developed over time in the literature. This wisdom claims a low credibility central bank: responds less flexibly to shocks; generally conducts policy in a more restrictive way; and as transparency improves so do the policy outcomes. As a result of this wisdom, inflation targeting has become the monetary policy regime of choice and with it, the rise of enhanced transparency in the form of regular forward looking statements and policy reports.

Contrary to general wisdom, Faust and Svensson (2001) find that a CB with low credibility will tend to be less tough on inflation and softer on the real economy, while the opposite is true for a high credibility bank. But simultaneously this CB will still lower inflation more than expected with the requisite positive spillovers. The second wisdom (that a low credibility CB responds less flexibly to shocks) cannot be proven due to the linear nature of the model. They do find though that the more transparent the CB becomes the closer market inflation expectations and ultimately the CB's reputation will be linked to its actions. This will happen as the markets will be more and more aware of why it is making the decisions it does and will increase the costs of the CB deviating from its announced inflation target. Full transparency is seen as socially beneficial, but may not necessarily be in the best interest of the CB. Then there is "extreme" transparency, a case where a CB's particular objectives are fully observed in real time and ends in the worst social and CB outcome.

3.1 Gauging credibility

Bordo and Siklos (2014), amongst others, define CB credibility as "a commitment to follow well-articulated and transparent rules and policy goals." They calculate a credibility indicator for emerging economies (EMs), defined by "the squared difference between observed and expected or targeted inflation." Their indicator shows that credibility for these EM countries has improved significantly for the period post 2005, coinciding with the rise of inflation targeting as the policy regime of choice.

4 The model

4.1 The standard New Keynesian model

The core structure of the model is broadly similar to the reduced-form New Keynesian models of De Jager (2007) and De Jager, Johnston, and Steinbach (2015). Essentially, real economic activity

\hat{y}_t is described by the following IS curve:

$$\hat{y}_t = \alpha_1 \hat{y}_{t+1} + \alpha_2 \hat{y}_{t-1} - \alpha_3 \hat{r}_t - \alpha_4 \hat{z}_t + \alpha_5 \hat{y}_t^f + \varepsilon_t^{\hat{y}}, \quad (1)$$

where \hat{r}_t , \hat{z}_t and \hat{y}_t^f are the gaps for the real interest rate, real exchange rate and foreign output, respectively.

Similarly, CPI inflation π_t is determined by the New Keynesian Phillips curve:

$$\pi_t = \beta_1 \pi_t^e + (1 - \beta_1 - \beta_2) \pi_{t-1} + \beta_2 \pi_t^m + \beta_3 rmc_t + \varepsilon_t^\pi, \quad (2)$$

where $\pi_t^e = E_t \pi_{t+4}$, π_t^m is imported inflation and rmc_t captures the real marginal costs of firms.

The exchange rate follows a modified UIP condition:

$$s_t = \theta_1 s_{t+1} + (1 - \theta_1) (s_{t-1} + 2/4(\bar{\pi} - \bar{\pi}^f + \Delta \bar{z}_t) + 1/4(-i_t + i_t^f + prem_t) + \varepsilon_t^s). \quad (3)$$

The model is closed by the central bank who sets the policy rate according to the following Taylor rule:

$$i_t = \phi_1 i_{t-1} + (1 - \phi_1) (i^n + \phi_2 (\pi_{t+4} - \bar{\pi}) + \phi_3 \hat{y}_t) + \varepsilon_t^i \quad (4)$$

The foreign economy f has a similar structure than the domestic economy, albeit modelled as a closed economy.

4.2 Non-linear extension to account for endogenous credibility

In the current inflation targeting regime, where an inflation band of 3 to 6 per cent is targeted, it is assumed that, similar to Argov et al. (2007), one of two possible inflation regimes will manifest over time: (i) a low inflation regime π_t^L , where inflation converges to the midpoint of the target band $\bar{\pi}^{\text{mid}}$; (ii) a high inflation regime π_t^H , where inflation converges to the upper end of the target band $\bar{\pi}^{\text{upper}}$.¹

$$\pi_t^L = \kappa_L \bar{\pi}^{\text{mid}} + (1 - \kappa_L) \pi_{t-1} + \varepsilon_t^{\pi^L} \quad (5)$$

$$\pi_t^H = \kappa_H \bar{\pi}^{\text{upper}} + (1 - \kappa_H) \pi_{t-1} + \varepsilon_t^{\pi^H} \quad (6)$$

The degree to which actual inflation outcomes compare to the *high* and *low* regimes enables the specification of a contemporaneous credibility coefficient φ_t :

$$\varphi_t = \frac{(\pi_t^H - \pi_t)^2}{(\pi_t^H - \pi_t)^2 + (\pi_t^L - \pi_t)^2} \quad (7)$$

According to Equation (7), if inflation were to converge to the *high* regime, such that $\pi_t^H = \pi_t$, the numerator becomes zero and so too does the credibility coefficient φ_t . Essentially, this coefficient

¹The implied one-year ahead inflation expectations of the high and low inflation regimes are as follows:

$$\pi_t^{e,H} = (1 - \kappa_H) \bar{\pi}^{\text{upper}} \sum_{i=0}^3 \kappa_H^i + \kappa_H^4 \pi_t \quad \text{and} \quad \pi_t^{e,L} = (1 - \kappa_L) \bar{\pi}^{\text{mid}} \sum_{i=0}^3 \kappa_L^i + \kappa_L^4 \pi_t$$

can vary between 0 and 1 and reflects the public's contemporaneous perception of the central bank's ability to achieve the *low* inflation regime around the midpoint of the target band. As such, full credibility is achieved if inflation were to converge to the *low* regime. When this occurs, the term $\pi_t^L - \pi_t$ in the denominator of Equation (7) becomes zero and $\varphi_t = 1$.

Moreover, the central bank then accumulates a credibility stock γ_t over time as a measure of its longer term performance in keeping inflation at the target midpoint $\bar{\pi}^{\text{mid}}$. This stock evolves according to the following process:

$$\gamma_t = \kappa_\gamma \varphi_{t-1} + (1 - \kappa_\gamma) \gamma_{t-1} + \varepsilon_t^\gamma, \quad (8)$$

where the credibility stock in period t is an autoregressive function of its existing credibility in $t - 1$ and its contemporaneous credibility coefficient φ_t , as well as a credibility shock ε_t^γ . If the central bank were to succeed in keeping inflation outcomes at the target midpoint $\bar{\pi}^{\text{mid}}$ over a period of time, it will achieve a succession of contemporaneous credibility coefficients φ_t that are each equal to 1. As a result, the credibility stock γ_t in Equation (8) will converge to 1 as well, thereby implying that the central bank has obtained full long-term credibility.

In turn, this time-varying credibility stock of the central bank affects the manner in which inflation expectations are formed. Firstly, it is possible to define an inflation expectations *bias*, as some weighted average of the *high* and *low* inflation regimes:

$$\text{bias}_t = \kappa_b \left\{ \left[\gamma_t \pi_t^{e,L} + (1 - \gamma_t) \pi_t^{e,H} \right] - \bar{\pi}^{\text{mid}} \right\}. \quad (9)$$

According to Equation (9), the expectations bias is zero if the central bank has full credibility (i.e., $\gamma_t = 1$ and $\pi_t^{e,L} = \bar{\pi}^{\text{mid}}$), while the bias would be some magnitude of the difference between the *high* inflation regime and the target midpoint if the central bank has a credibility stock of less than one (i.e., $\gamma_t < 1$).

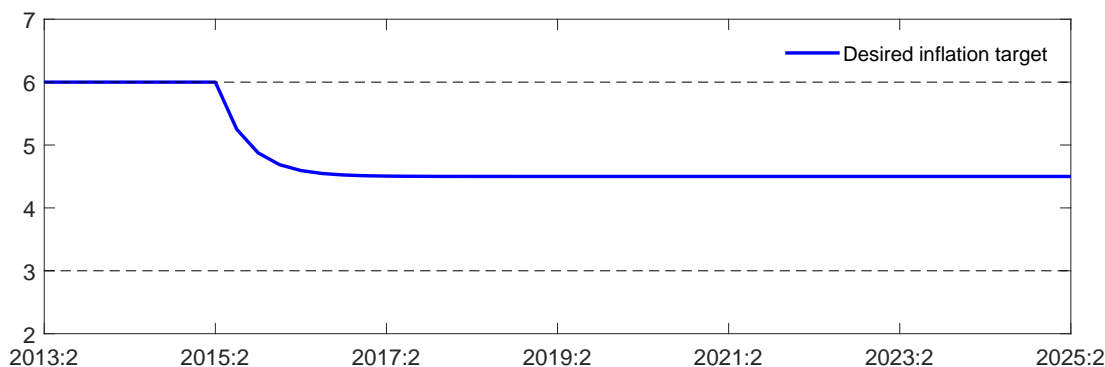
Finally, both this expectations *bias* and the credibility stock γ_t form part of the inflation expectations formation process π_t^e , as follows:

$$\pi_t^e = (\gamma_t) \pi_{t+4} + (1 - \gamma_t) \pi_{t-1} + \text{bias}_t + \varepsilon_t^{\pi^e} \quad (10)$$

Equation (10) shows that if the central bank has full credibility, inflation expectations are purely forward-looking. However, backward-looking persistence and a non-zero bias creep into the expectations formation process when the central bank's stock of credibility is less than one.

5 Disinflation from the upper end of the target band to the midpoint

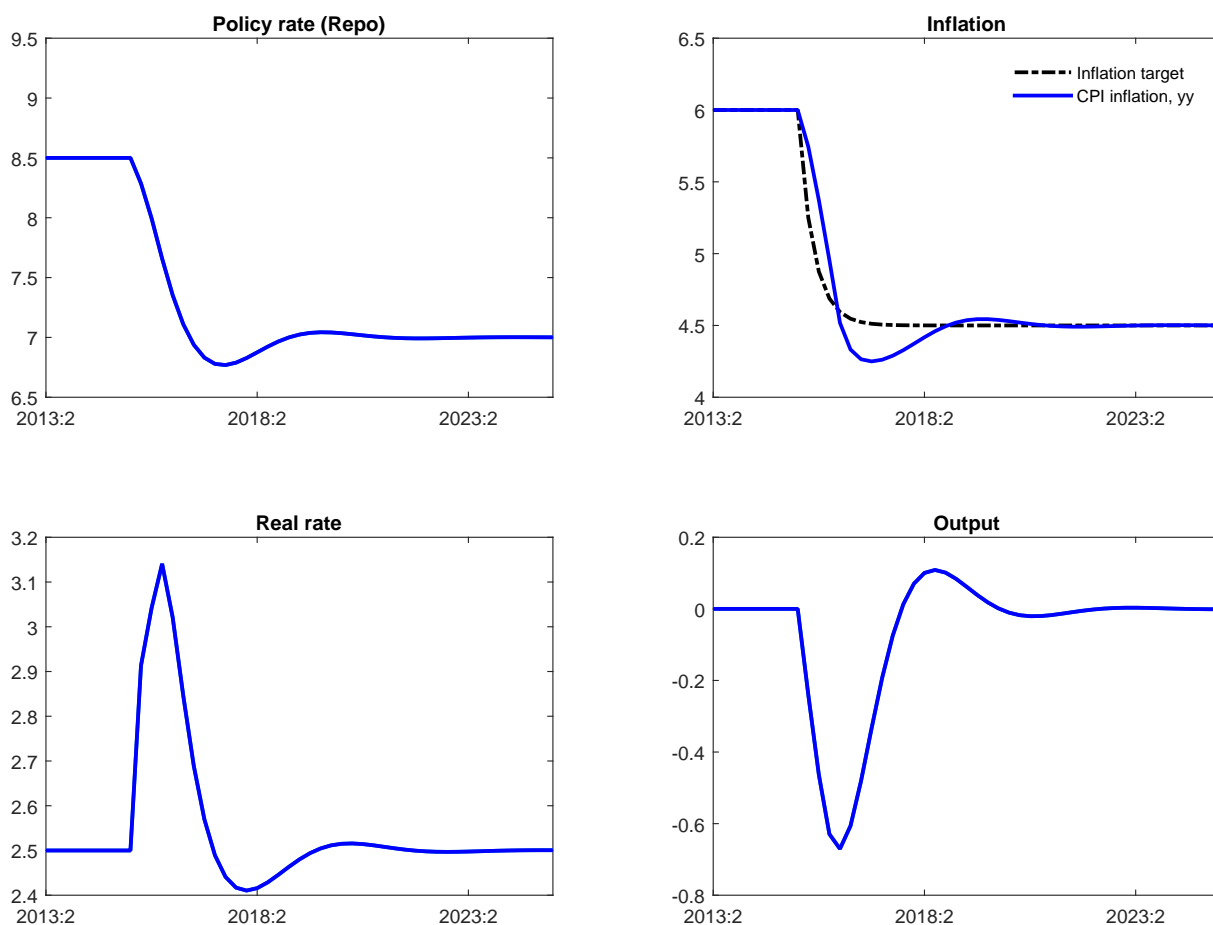
Figure 4: What if the 4.5 midpoint is announced as the explicit target?



5.1 Disinflation in a standard New Keynesian model

Within the standard New Keynesian model, the central bank's policy is always fully credible (De Grauwe, 2010). As a result, disinflation to a newly-announced lower inflation target essentially occurs by itself, as forward-looking agents – given the central bank's proven credibility – merely adjust their inflation expectations to the new target. The fall in inflation expectations raises the real interest rate. This raised real interest rate reduces demand in the economy which, in turn, further assists with the decline in inflation to the new target level.

Figure 5: In the standard New Keynesian model, expectations adjust automatically



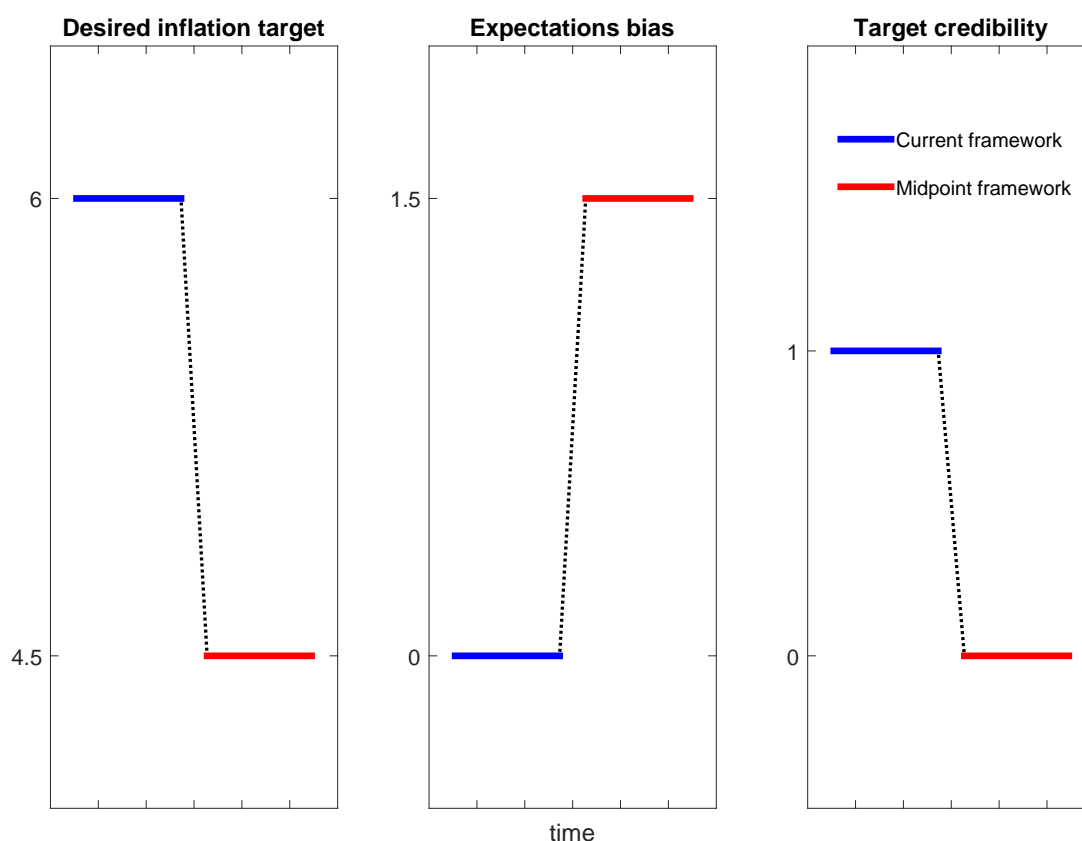
As can be seen in Figure 5, inflation falls immediately after the change in the inflation target to 4.5 per cent is announced. This happens without any nominal policy tightening by the central bank. In fact, the central bank loosens nominal policy. However, inflation falls faster than what the policy-maker can respond and, as a result, the real interest rate increases. This increase in the real interest rate causes output to fall, before recovering as the real interest rate normalises. Nevertheless, the cumulative output loss as a result of the disinflation from 6 to 4.5 per cent amounts to roughly 0.8 per cent.

5.2 Disinflation when credibility is endogenous

As discussed in Section 1, inflation expectations in South Africa have become anchored at the upper end of the official 3 – 6 per cent target band. This does not imply that the SARB is not credible in pursuing its inflation targeting mandate. On the contrary, what it does imply is that the Bank has full credibility in keeping inflation from exceeding 6 per cent (see the blue lines in Figure 6), but not necessarily in keeping inflation at the midpoint of the target band.

For the purposes of this analysis, it is therefore assumed that the Bank is in a position of enjoying full credibility in keeping inflation near 6 per cent. As a result, the inflation expectations *bias* is assumed to be zero within the current framework, since expectations are anchored at a level that still broadly fulfils the Bank’s inflation targeting mandate of keeping inflation within the 3 – 6 per

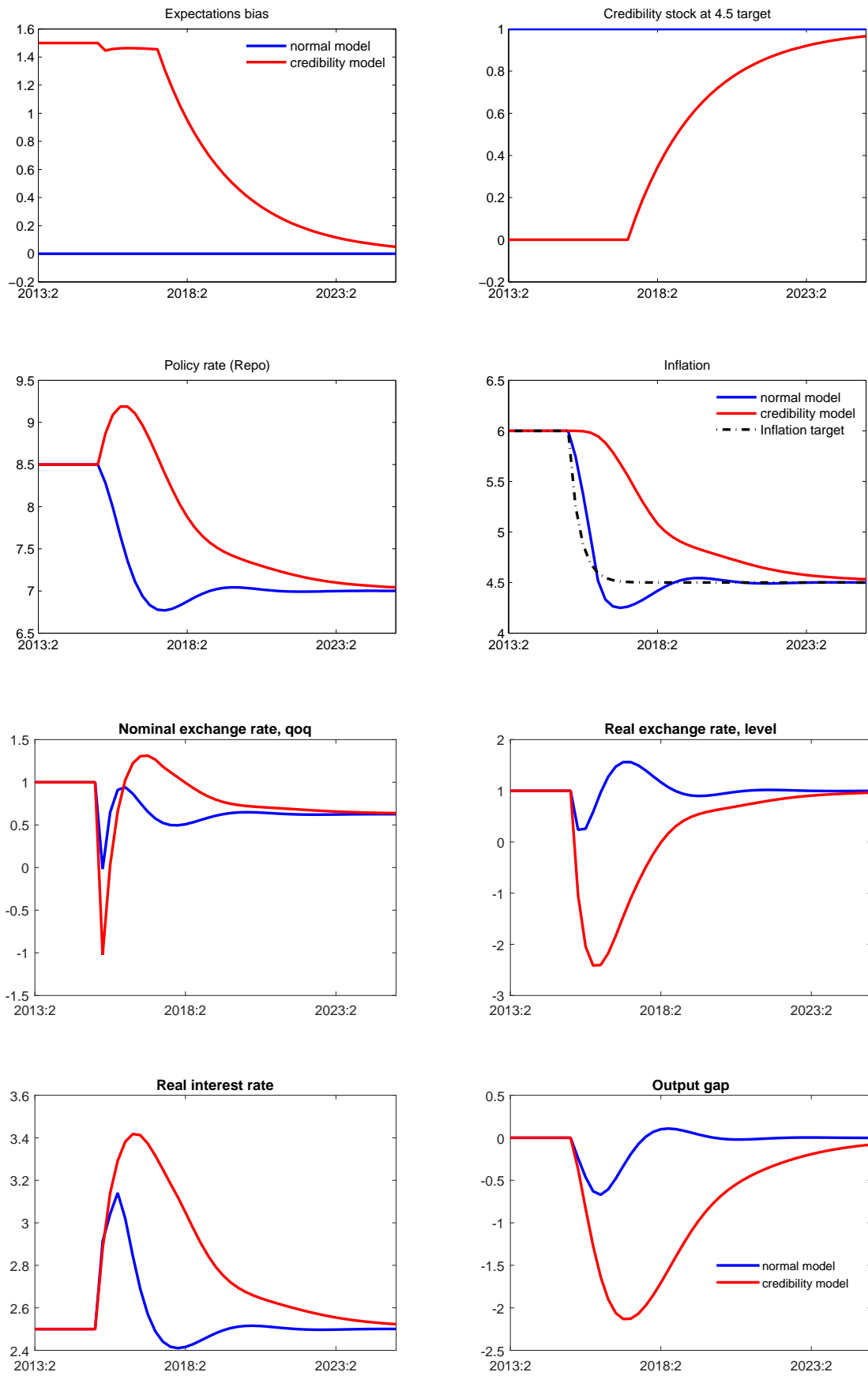
Figure 6: The Bank is perceived to have full credibility in keeping inflation close to the upper end



cent band. However, if the Bank were to announce a *new* regime in which the intended inflation target is at the 4.5 per cent midpoint of the current target band – a level for which it has no proven track record of having successfully kept inflation expectations anchored to – its credibility in terms of its track record within this new regime starts at zero (see the red lines in Figure 6). Similarly, the expectations bias – measured as the difference between the desired inflation target and the actual level of expectations – equals 1.5 per cent at the start of this new regime. Within the non-linear endogenous-credibility version of the model, disinflation is not that easily achieved by the central bank as in the standard New Keynesian model. Starting out from a position of zero credibility in terms of its track record in keeping inflation expectations anchored at 4.5 per cent, whilst intending to lower inflation expectations towards this new target, requires more than purely an announcement from the central bank. As can be seen in Figure 7, the central bank first make its intentions clear by raising the nominal interest rate in order to lower inflation towards the newly-announced target. The transmission mechanism at play here works as follows:

1. The central bank increases the policy rate.
2. Since credibility is linked to the difference between actual inflation outcomes and the desired target of the central bank through Equations (7) and (8), policy-induced lower inflation outcomes gradually start to increase the track-record credibility of the central bank.
3. In turn, the inflation expectations bias in Equation (9) is directly linked to the central bank’s credibility. Therefore, as the lower inflation outcomes gradually improve the central bank’s track record and credibility, the upward bias in inflation expectations begins to decline, which partially assists in lowering inflation expectations towards the newly-announced target

Figure 7: Building credibility at the midpoint of the target band



midpoint.

4. However, lowering the expectations bias is merely one avenue through which inflation outcomes converge to the lower target. The other important channel is the impact that improving credibility has on the inflation expectations formation process. Within Equation (10), credibility of the central bank informs the degree to which inflation expectations are backward or forward-looking. While backward-looking expectations are driven by past inflation outcomes, forward-looking expectations are closely tied to the central bank's desired inflation target. As such, raised credibility on behalf of the central bank enhances forward-looking expectations, which further assists in lowering inflation outcomes towards the new target.

6 Conclusion

South African inflation expectations have become anchored near the upper end of the 3 to 6 per cent target range. This paper analyses the likely policy response that would be required to shift inflation expectations towards the midpoint of the inflation target band. It does so by incorporating a non-linear credibility process into a standard New Keynesian general equilibrium model. According to this process, the central bank's credibility depends on its track record in achieving inflation outcomes that are in line with its desired inflation target. When comparing the disinflation processes between the standard New Keynesian model and the model with the endogenous credibility process, it is evident that disinflating to a newly announced target, at which the central bank has no proven track record, could be a significantly more costly and slower process.

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