

NOMINAL GDP TARGETING AND CENTRAL BANK CONSERVATIVENESS

Yuwen Dai and Bin Xu

Shanghai International Studies University (SISU); China Europe International Business School (CEIBS)

ABSTRACT

In the literature on monetary economics, there is the ‘inflationary bias’ result which predicts that the rate of inflation will be biased towards a higher level under discretionary monetary policy than under a rule-based policy regime. It is established that a credible nominal target can eliminate this ‘inflationary bias’. In this paper, we examine the case of nominal GDP targeting, which is a rule-based monetary regime. Depending on the degree of conservativeness by the central bank, we show in a stylized model the choice of different combination of inflation and real GDP targets can still result in an ‘inflationary bias’, and there also exists the possibility of a ‘dis-inflationary bias’.

Keywords: monetary policy, nominal GDP targeting, central bank, conservatism, inflationary bias

JEL codes: E52, E58

I. INTRODUCTION

In the literature on monetary economics, there is the ‘inflationary bias’ result, with the influential papers by Kydland and Prescott (1977), and Barro and Gordon (1983a) predicting that the rate of inflation will be biased towards a higher level under discretionary monetary policy than under a rule-based monetary policy regime. The reason for this counter-intuitive ‘inflationary bias’ result is due to the time-inconsistency problem, in which a central bank with discretion will have the incentive to raise the inflation rate *ex post*, and the public knows this *ex ante*.

To reduce the magnitude of this ‘inflationary bias’, researchers have proposed several methods, including reputation (Barro and Gordon, 1983b), delegation (Rogoff, 1985), and adoption of binding rules. But to eliminate this ‘inflationary bias’, it is well established that a credible commitment to a nominal targeting rule is required in a rule-based monetary policy regime.

In a rule-based monetary policy setting, it has become a common practice for central banks in many countries (including both developed and developing countries) around the world to gravitate towards an approach that is focused on the commitment to a binding rule for a ‘nominal anchor’. The reasons, for having a simple and publicly announced nominal variable as the monetary target, are transparency and the anchoring of expectation. To the extent that the public can observe and understand this target, it is established as the ‘nominal anchor’,

based upon which household and business will form their expectation and make their economic decision accordingly.

1.1 Background

In a rule-based monetary policy regime, the choice of a nominal anchor for the conduct of monetary policy is like a ‘fashion business’. From a historical point of view, the adoption of money supply targeting as the main policy regime was ended due to the velocity shocks in the 1980s. The monetarism school of economic thought maintains that the total amount of money in an economy, that is, the money supply, is the major determinant of GDP in the short run and the price level over the long run. Monetarists believe that the objective of monetary policy (of achieving low and stable inflation) is best met by targeting the growth rate of money supply. Gained prominence in the 1970s, money supply targeting was adopted by major advanced economies, and monetarism was successful in bringing down inflation in the USA and UK.

This is followed by the exchange-rate targeting regime, the vulnerability of which was exposed during the currency crises in the 1990s. Whist advanced countries adopted money supply targeting, the exchange rate was the favoured nominal anchor adopted by many developing countries to stabilize inflation in the late 1980s and early 1990s. Under an exchange rate targeting regime, the central bank targets the level of the exchange rate of an ‘anchor’ currency, with low and stable inflation.

Then there comes the inflation-targeting regime, which has been adopted by a lot of monetary authorities around the world, either explicitly or implicitly, in both advanced countries and developing countries. After the currency crises of 1994–2001, inflation targeting has become the preferred monetary policy regime, in place of exchange rate targeting. The inflation-targeting regime has functioned well in many ways, in terms of anchoring expectation and achieving low and stable inflation.

But in the aftermath of the 2007/08 Global Financial Crisis (GFC), we have witnessed a tepid economic recovery in the United States, and diminished prospects for a quick recovery in the euro zone. Unconventional monetary policy and unprecedented actions of many kinds, undertaken by central banks in advanced countries, have not been strong enough to restore output back to potential, to bring unemployment down rapidly enough, and to lift the world economy out of the so-called ‘secular stagnation’. The development since the GFC over the last several years have obviously cast considerable doubt on the adequacy of the previous consensus monetary framework, in particular, inflation targeting, especially given that it is constrained by the zero lower bound (ZLB) of the policy rate. This calls for the need to rethink about the choice of the monetary policy regime, and the possibility of a new nominal anchor in conducting monetary policy.

Given the limitation of inflation targeting as seen during the post-GFC period, one alternative nominal anchor is to target the nominal GDP (NGDP) level. Originally proposed in Meade (1978) and Tobin (1980), the idea of directing monetary policy towards targeting the nominal GDP attracted interest in the 1980s and the 1990s. See, for example, Bean (1983), West (1986), Frankel (1990), Feldstein and Stock (1994), Hall and Mankiw (1994), among others. In the wake of the GFC, there has been a revival of proposals that central banks should consider targeting the nominal GDP level, including Sumner (2012, 2014), Woodford (2012), Frankel (2013, 2014); and more recently, Armenter (2017), Bai, Kirsanova, and Leith (2017), Bhandari and Frankel (2017), Billi (2017), Murphy and Chen (2017), Waters (2017), and Chen (2018).

Among recent studies, Bhandari and Frankel (2017) argue that NGDP targeting has the merit of absorbing macroeconomic shocks in both price and output adjustments. This is in contrast to inflation targeting, which places the entire burden on output adjustment. Billi (2017) adapts

a New Keynesian model to compare NGDP targeting and inflation targeting, subject to the zero lower bound (ZLB) of the policy rate. Armenter (2017) investigates NGDP targeting rule constrained by the zero lower bound of the policy rate. Waters (2017) simulates a calibrated model to examine NGDP growth targeting under learning. Murphy and Chen (2017) conduct an empirical investigation into the optimal size of the NGDP target and level targeting. Bai *et al.* (2017) study NGDP targeting in an economy with government debt. Chen (2018) analyzes the impact of NGDP targeting on the labour market.

One important aspect of a NGDP targeting rule is that the central bank has the discretion of choosing its preferred price and output levels to achieve the NGDP target. To illustrate, the NGDP is a composite variable of price level and real GDP level. Expressed in growth terms, NGDP growth rate equals inflation rate plus real GDP growth rate. Hence, a NGDP growth target may be achieved with different combination of inflation and real GDP goals. In countries averse to inflation, a NGDP target can be achieved with a relatively larger weight on the real GDP target; whereas in countries averse to deflation, a NGDP target can be achieved with a relatively larger weight on the inflation goal.

1.2 Roadmap

If NGDP targeting rule is a possible alternative candidate to inflation targeting, and given that NGDP targeting is a rule-based monetary policy setting, will there still exist ‘inflationary bias’ or will the bias be eliminated as claimed in the existing literature? Will there be any other bias associated with NGDP targeting? This is the research question that we would like to investigate in this research paper.

The rest of this paper is structured as follows. In Section II, we introduce our analytical framework to examine the case of a NGDP targeting rule, which is a rule-based monetary policy regime. In Section III, we present and discuss our model results. Section IV concludes and indicates policy implication.

II. THE MODEL

In this section, we develop a one-period model in which the central bank sets its policy objective to minimize a loss function:

$$L = (p - p^*)^2 + (y - y^*)^2,$$

where p is the actual price level, p^* is the socially optimal price target, y is the actual output level, and y^* is the socially optimal output target.

The central bank commits to an optimal NGDP target ($= p^* \times y^*$). Notice this NGDP target can be achieved with a combination of a price target and an output target. We assume that central banks differ in the relative weights placed on the price target and the output target. Following Rogoff (1985), we label central banks placing a relatively larger weight on the price target as ‘conservative’. Denote δ as the weight placed by the central bank on the price target, and θ as the weight on the output target. The optimal NGDP target can be achieved by choosing δ and θ such that $\delta p^* \times \theta y^* = p^* \times y^*$, which implies $\delta \times \theta = 1$. Thus, a conservative central bank is one with $\delta > 1$ (which implies $\theta < 1$). To facilitate discussion, we label central banks with $\delta < 1$ (which implies $\theta > 1$) as ‘liberal’, and central banks with $\delta = 1$ (which implies $\theta = 1$) as ‘neutral’. We assume that the public can observe δ and θ .

Given δp^* and θy^* as the central bank’s price and output targets, the loss function becomes:

$$L = (p - \delta p^*)^2 + (y - \theta y^*)^2. \quad (1)$$

For simplicity, we consider a deterministic economy facing a short-term trade-off between output and unexpected inflation (Wickens, 2008, p. 379). This Phillips curve relationship is described by the following aggregate supply equation:¹

$$y = y^* + \alpha (p - p^*), \tag{2}$$

where α is a constant equal to the inverse of the slope of the aggregate supply curve.

In the model economy, the central bank uses the nominal interest rate as its monetary policy instrument in order to achieve the NGDP target. Following Barro and Gordon (1983a), we assume a direct connection between the nominal interest rate and the inflation rate, and therefore the central bank has p as the choice variable to solve its optimization problem. It is standard in this type of models to treat price or the inflation rate as the central bank's policy choice variable.²

Specifically, the central bank minimizes its loss function (1), subject to the constraint of the short-term Phillips curve relationship (2). Substitute (2) into (1), we have:

$$L = (p - \delta p^*)^2 + [(1 - \theta)y^* + \alpha (p - p^*)]^2.$$

Differentiating L with respect to p , we obtain the following first-order condition:

$$\frac{\partial L}{\partial p} = 2(p - \delta p^*) + 2[(1 - \theta)y^* + \alpha (p - p^*)]\alpha = 0.$$

From the above equation, we obtain:

$$p = \frac{\alpha^2 + \delta}{\alpha^2 + 1} p^* - \frac{\alpha(1 - \theta)}{\alpha^2 + 1} y^*. \tag{3}$$

Substituting (3) into (2), we obtain:

$$y = \frac{\alpha(\delta - 1)}{\alpha^2 + 1} p^* + \frac{\alpha^2\theta + 1}{\alpha^2 + 1} y^*. \tag{4}$$

Equations (3) and (4) indicate that the central bank's choice of price level p and output level y are functions of the optimal price and output levels (p^* and y^*), the Phillips curve slope parameter (α), and the degree of conservatism or liberalism of the central bank captured by the weight parameters (δ and θ).

We follow the literature to assume that the central bank and the society share the same objective function.³ The loss function can be viewed interchangeably as reflecting the preference by both the central bank and the society. Given this assumption, the central bank maximizes the following social welfare function:

$$SW = -L = -(p - \delta p^*)^2 - (y - \theta y^*)^2. \tag{5}$$

Substituting (3) and (4) into (5), and with some algebra, we obtain:

$$SW = -\frac{\alpha^2(1 - \delta)^2}{\alpha^2 + 1} (p^*)^2 + \frac{2\alpha(1 - \delta)(1 - \theta)}{\alpha^2 + 1} p^* y^* - \frac{(1 - \theta)^2}{\alpha^2 + 1} (y^*)^2. \tag{6}$$

Here we establish the benchmark case where the central bank is neutral in its stand on conservatism or liberalism ($\delta = 1$ and $\theta = 1$). From equations (3), (4) and (6), we find that the equilibrium price and output are at their optimal levels ($p = p^*$ and $y = y^*$) and there is no social welfare loss ($SW = 0$).

¹In our one-period model, by normalizing the initial price level, p measures inflation rate.

²See, for example, Lohmann (1992) and Walsh (1995).

³See, for example, Barro and Gordon (1983a). Although a loss function is not based explicitly on consideration of social welfare, Rotemberg and Woodford (1997) show that social welfare can be approximated by a loss function.

III. RESULTS

In this section, we first derive results for a non-neutral central bank ($\delta \neq 1$ and $\theta \neq 1$), and then examine the case of a conservative central bank ($\delta > 1$ and $\theta < 1$).⁴

Using (3) and (4), and applying the constraint of $\delta \times \theta = 1$, we obtain:

$$p - p^* = \frac{(\delta - 1)(p^* - \frac{\alpha y^*}{\delta})}{\alpha^2 + 1}, \tag{7}$$

$$y - y^* = \frac{\alpha(\delta - 1)(p^* - \frac{\alpha y^*}{\delta})}{\alpha^2 + 1}. \tag{8}$$

Equations (7) and (8) indicate that when a NGDP targeting rule is implemented by a non-neutral central bank, the equilibrium will not feature optimal price and output levels except in the knife-edge case of $\delta = \frac{\alpha y^*}{p^*}$ (which implies $\theta = \frac{p^*}{\alpha y^*}$).

By substituting $\delta = \frac{\alpha y^*}{p^*}$ and $\theta = \frac{p^*}{\alpha y^*}$ into (5), we obtain:

$$SW = -\left(1 + \frac{1}{\alpha^2}\right)[p^*(1 - \delta)]^2. \tag{9}$$

Based on (7), (8) and (9), we establish:

Lemma 1. Under the optimal NGDP targeting rule, (i) $p = p^$ and $y = y^*$ only if $\delta = 1$ (which implies $\theta = 1$) or $\delta = \frac{\alpha y^*}{p^*}$ (which implies $\theta = \frac{p^*}{\alpha y^*}$); (ii) $SW = 0$ only if $\delta = 1$ (which implies $\theta = 1$).*

Lemma 1(i) indicates that if the central bank is non-neutral ($\delta \neq 1$; biased towards conservatism or liberalism), then the implementation of a NGDP targeting rule will not achieve the optimal price and output levels except in the knife-edge case of $\delta = \frac{\alpha y^*}{p^*}$. Lemma 1(ii) indicates that as long as the central bank has a bias towards conservatism or liberalism, the equilibrium will feature a social welfare loss. We state these results in:

Proposition 1. When a central bank is biased towards either conservatism or liberalism (defined by $\delta \neq 1$, which implies $\theta \neq 1$), the social welfare level of the economy will be suboptimal. Equilibrium price and output levels will not be optimal except in the knife-edge case where parameter values satisfy the condition of $\delta = \frac{\alpha y^}{p^*}$ (which implies $\theta = \frac{p^*}{\alpha y^*}$).*

Next, we examine the case of a conservative central bank, which places a relatively larger weight on the price target ($\delta > 1$) when implementing a NGDP targeting rule. From equations (7) and (8), we observe that the signs of $(p - p^*)$ and $(y - y^*)$ depend on the value of δ . With some algebra, we can prove the following lemma:⁵

Lemma 2. (i) If $\delta > \max\{1, \frac{\alpha y^}{p^*}\}$, then $p > p^*$ and $y > y^*$; (ii) If $1 < \delta < \frac{\alpha y^*}{p^*}$, then $p < p^*$ and $y < y^*$.*

Lemma 2 shows two possible scenarios for a conservative central bank when it implements a NGDP targeting monetary policy rule. In the first scenario, the Phillips curve parameter α is sufficiently small ($\alpha < \frac{\delta p^*}{y^*}$), and hence the aggregate supply curve is sufficiently steep, with the equilibrium featuring $p > p^*$ and $y > y^*$. In the second scenario, the Phillips curve parameter

⁴To save space, we omit the case of a liberal central bank, which is symmetric to the case of a conservative central bank presented in the paper. The results of the case of a liberal central bank are available from the authors upon request.

⁵An unpublished appendix contains detailed steps of deriving equations (3)-(4) and(6)-(9), and proofs of lemmas 1 and 2, which is available from the authors upon request.

α is sufficiently large ($\alpha > \frac{\delta p^*}{y^*}$), and therefore the aggregate supply curve is sufficiently flat, with the equilibrium featuring $p < p^*$ and $y < y^*$.

In the literature, $p > p^*$ is called an ‘inflationary bias’. Barro and Gordon (1983a) show that when a central bank can derive benefits from inflation surprises *ex post*, the market equilibrium will feature an ‘inflationary bias’. The reason for this ‘inflationary bias’ is a time-inconsistency problem, in which the announcement of an optimal inflation target is time-inconsistent, because a central bank with discretion will inflate *ex post*, and the public knows this *ex ante* and will adjust their behaviour by spending more, which leads to an immediate increase in price. So in Barro and Gordon (1983a), the ‘inflationary bias’ arises from a discretionary monetary policy.

Lemma 2(i) shows that an ‘inflationary bias’ ($p > p^*$) can also arise from a rule-based monetary policy with NGDP targeting. The reason lies in the fact that the Barro-Gordon result is derived from a single-variable rule (inflation rate), whilst our result is derived from a composite-variable rule (NGDP = price x output). By committing to a NGDP level, the central bank has no discretion to adjust the NGDP target, but its stand in conservatism or liberalism leads it to place different weights on price and output (which is at its discretion with the rule) in implementing the NGDP target.

Lemma 2(ii) shows further that for a conservative central bank, a NGDP targeting policy does not always result in an ‘inflationary bias’ ($p > p^*$); under some parameter conditions, the equilibrium will feature a ‘dis-inflationary bias’ ($p < p^*$). We summarize these findings in the following proposition.

Proposition 2. In a country where a NGDP targeting rule is implemented by a conservative central bank (defined by $\delta > 1$),

- i. the equilibrium price and output levels will be higher than their socially optimal levels if aggregate supply responds sensitively to price (defined by a sufficiently small $\alpha < \frac{\delta p^*}{y^*}$);*
- ii. the equilibrium price and output levels will be lower than their socially optimal levels if aggregate supply responds insensitively to price (defined by a sufficiently large $\alpha > \frac{\delta p^*}{y^*}$);*
- iii. in both cases, the country’s social welfare level will be lower than its optimal level.*

In Proposition 2, when a conservative central bank implements a NGDP targeting rule, the economy will adjust and the results are sensitive to parameter values. If the aggregate supply curve is sufficiently steep, the adjustment will be mainly on price, and hence the equilibrium will feature a price level higher than optimal (that is, an ‘inflationary bias’). However, if the aggregate supply curve is sufficiently flat, the adjustment will be mainly on output, and the output adjustment can be so large that the equilibrium will feature a price level lower than the optimal (that is, a ‘dis-inflationary bias’).

Extension

Our analysis may be extended in several directions. One direction is to consider the case where the public does not observe δ .

First, we consider the case of a central bank with a neutral degree of conservativeness ($\delta = 1$). If the public perceives the central bank to be conservative ($\delta > 1$), then they will adjust their behavior by spending more, which leads to an immediate increase in the price level. To counter-balance this public behavior, the neutral central bank will behave like a conservative bank ($\delta > 1$) in order to achieve the optimal price target. Using the same reasoning, if the public perceives the central bank to be liberal ($\delta < 1$), then the neutral central bank will behave like a liberal bank ($\delta < 1$).

Next, we consider the case of a conservative central bank ($\delta_c > 1$). If the public perceives the central bank to be conservative and with $\delta_p = \delta_c > 1$, then the results would be the same as when the public observes δ . However, if the public views the central bank as being more conservative ($\delta_p > \delta_c > 1$), then the central bank will behave like δ_p . From these analyses, we conclude that the central bank will behave in accordance with the degree of conservativeness perceived by the public, if the public does not observe δ . It follows that the implication on social welfare depends on the perceived δ . If the central bank is perceived neutral in its degree of conservativeness, then the social welfare will be at its optimal level. If the central bank is perceived to be non-neutral in conservativeness, then the social welfare is at a suboptimal level (Proposition 1).

IV. CONCLUSION

In the existing literature on monetary economics, we have the result that with discretionary monetary policy, there will be an ‘inflationary bias’, which is due to the time-inconsistency problem by the central bank; but in a rule-based monetary policy setting, this ‘inflationary bias’ can be eliminated. In this research paper, we study the suitable targets for the conduct of monetary policy in an effort to shed light on the debate regarding the appropriateness of rules versus discretion in monetary policy making. In this context, we examine the case of a NGDP targeting rule, which is a rule-based monetary policy setting. In a stylized model with a central bank minimizing a quadratic-form loss function, we allow the central bank to have different combination of the price and output targets, in order to achieve its NGDP target, which depends on the degree of conservativeness by the central bank. The outcome depends on the responsiveness of the aggregate supply curve to the price level. If the aggregate supply responds sensitively to price, there will still be an ‘inflationary bias’ in the equilibrium. But if the aggregate supply responds insensitively to price, then the equilibrium will feature a ‘dis-inflationary bias’. This finding is new in the literature regarding the appropriateness of rules versus discretion in monetary policy making.

The results from our paper provide useful policy implication. Previous research studies argue that when faced with macroeconomic shocks, inflation targeting places the entire burden on output adjustment, whilst NGDP targeting has the merit of absorbing macroeconomic shocks in both the price and output adjustments. Moreover, Bhandari and Frankel (2017) advocate NGDP targeting for developing countries, as developing countries are more vulnerable to supply shocks and terms-of-trade shocks, and one main advantage of a NGDP targeting monetary rule is that it can better accommodate such shocks.

In our research paper, we show another advantage of a NGDP targeting rule is that it has the inherent flexibility as a NGDP target can be divided between a price goal and an output goal. But this inherent flexibility of a NGDP targeting rule, combined with the degree of conservativeness by the central bank, can lead to an ‘inflationary bias’ or a ‘dis-inflationary bias’ result, which in turn depends on the degree of responsiveness of the aggregate supply to the price level. So when a country considers adopting a NGDP targeting rule, it should consider the price bias inherent in this rule, and balance it against its advantage in accommodating adverse shocks.

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