The Role of Expectations in Monetary Policy
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* Views expressed are those of the individual author and do not necessarily reflect official positions of De Nederlandsche Bank.
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Abstract

Recent literature on monetary policy has emphasised the role of expectations and the merits of tying them down through credible commitment. However, although always in favour of reaping the benefits of having committed, Central Banks worry about the fact that in real time, it is not always easy to assume that they are in such a position. Decisions need to be taken then, under the assumption of predetermined expectations. We argue that in these circumstances, the provision of clear inflation objectives helps agents understand Central Bank objectives better and is thus beneficial to all.

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1 Introduction

The literature on central bank (CB) independence developed in the 1990s was very concrete in terms of the policy recommendations it put forward. As a consequence, these recommendations found their way into the policy sphere in a timely and effective manner. The more recent literature on the issues of communication and transparency of monetary policy has, however, not been equally unambiguous. Views on the merits of transparency vary widely and different reasons are often provided to justify similar views. Few disagree, however, that it is through expectations that transparency affects macroeconomic variables and that private sector expectations themselves are crucial in assisting or hindering a central bank’s ability to achieve its objectives. This point was originally touched upon by Kydland and Prescott (1977). Since then, more and

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more authors have given expectations a pivotal role in monetary policy problems, typically by applying forward-looking models in which expectations are endogenous. Beyond that, authors often also devote separate sections to the way that expectations are assumed to be formed in their exercises, and discuss how different assumptions affect the ability to achieve price stability.

The three books discussed here are very appropriate representations of such attempts and are chosen to reflect both policy as well as academic views on this issue. The paper is organised as follows. We provide a summary and discussion of the books in section 2. In section 3, we outline a standard monetary policy model, showing how theory treats expectations and why they matter. Section 4 then introduces the idea that monetary policy is an information game in which coordination elements become important and examines how private agents use the information they have to form expectations. Last, we look at how central banks can organise their modus operandi to help coordinate these expectations and thus achieve price stability more easily. The concluding section summarises the lessons that our work draws in relation to the three books described.

2 New Literature


2.1 ‘Imperfect knowledge and Monetary Policy’ by O. Issing, V. Gaspar, O. Tristani and D. Vestin

This book is written by people who have been for the most part policy makers but have also had a keen eye on what the academic literature has to say. Their prime intention is to draw those lessons that are unequivocal and thus commonly accepted in the literature. But in doing that, they also aim to remain flexible enough in their analysis in order to be able to deviate from those prescribed recommendations when the implementation of monetary policy requires it. Pragmatism is, therefore, what the reader feels the authors aim to bring to the discussion.

The book is split into two chapters. The first chapter touches on a widely agreed upon fact - that the way the private sector forms expectations about inflation affects the central bank’s ability to achieve its objectives. Tying down expectations becomes, therefore, of great importance. The authors then argue that in
order to do that, it is necessary for a monetary authority to achieve credibility, which comes by revealing a very clear and well understood price stability objective. While the literature is very clear in identifying this issue and its relevance, it is less clear in helping the central bank design reactions in its day-to-day activities. Achieving the latter requires the use of ‘judgement’ and thus a more eclectic application of the numerous recommendations available. Demonstrating formally why this may be superior in terms of effectiveness becomes naturally difficult. They thus opt for showing two examples that were unique in terms of the level of uncertainty that policy makers had to operate with: German unification and the creation of a pan-European monetary authority, the European central bank. As both of these events were unique, the authors argue that they are good examples of “uncharted territory”, and therefore appropriate cases in which the lack of information and knowledge required that monetary policy “...keep a firm sense of direction, while relying on judgement ...”.

The second chapter then discusses in greater detail the implications of operating within an uncertain environment. The authors concentrate here on uncertainty about information lags or misperceptions of unobservable variables, namely the output gap, and how central bankers make inferences about the economy. At the same time they address the issue of expectations explicitly, by allowing them to be endogenous in the system. Through choosing to examine growth the reader is reassured that, despite their conservatism, central banks are not inflation ‘nutters’. Nevertheless, the prescription they arrive at is very much in line with Rogoff’s (1985) conservatism, in that because output variability is very much the result of persistent inflationary or deflationary outcomes, what is required is a sufficiently low weight on output gap stabilisation in the CB’s objectives.

There are three main lessons that the authors draw from these two summary chapters:

1. It is important to identify and apply ‘robust results of monetary economics’ in order to build credibility. Beyond that, however, the implementation of monetary policy in the short-run and tackling shocks as they occur require the application of judgement.

2. One such robust result that modern monetary economics has arrived at is that expectations about inflation are as important in affecting the final inflation outcome as are the actions of the monetary authorities themselves. Making an effort to align those with the objectives of the central bank, through communication and transparent operations, is by consequence as important as the actual interest rate decision itself.

3. Three features help tie those expectations down: “primacy to the price stability objective, rule-based behaviour... and a firm response to inflationary shocks”.

3
These three lessons implicitly address the issue of which set-ups allow authorities to reap the benefits of ‘commitment’ without foregoing the flexibility of ‘discretion’ that circumstances often warrant. We will discuss this in greater detail further down and show that the difference between ‘commitment’ and ‘discretion’ is in the way they tackle expectations.

The book is sensible both in terms of the issues it chooses to address as well as the lessons it draws. Who could argue against the benefits of credibility or indeed the seriousness of having to operate under great sources of uncertainty? In addition the book is commendable in its attempt to explain, through examples, the actual application of monetary policy and how real problems are tackled. What the book is not, however, is an attempt to push the frontiers of our understanding forward or indeed add new insights to well established problems. But then again, is it the job of central bankers to push those frontiers, or is it their job to identify the common denominator in the plethora of interpretations available and simply implement what ‘fits best’? Central bankers often argue that what they need is to be as predictable as possible, so much so that achieving a state of ‘boringness’ becomes a virtue in its own right! (Lambert, 2004). By this measure then - and paraphrasing the famous film - this book is an excellent example of central bankers as ‘conformists with a cause’.

2.2 ‘Knowledge, Information and Expectations in Modern Macroeconomics’ by P. Aghion, R. Fryman, J. Stiglitz and M. Woodford (eds)

On the other end of the spectrum now, academic economists address the issue of knowledge and the role of expectations in macroeconomics in general. This collection of papers is written in honour of Edmund Phelps and his extensive contributions in the field of macroeconomics. The book is organised in four parts, each addressing an area to which Phelps has been a contributor. In a fashion appropriate to his contribution to the issue of higher order expectations, it is interesting to read how at the end of each part, Phelps reflects on how others have read his work and in turn how he reads their work in relation to his.

The editors provide a very succinct summary of what they call “The ‘Phelps Programme’ in Macroeconomics” in the second of the introductory chapters. They maintain that the main contribution by Phelps has been emphasising the inability to achieve the equilibrium unemployment rate and the inefficiencies caused by informational asymmetries between agents. His work during the late 1960s laid down a framework for using micro-foundations to analyse main macro phenomena. Firms and employees formed decisions with what they knew about themselves before inferring main macroeconomic magnitudes like prices and wages. His work in the 1970s on staggered wage and price commitments allowed for the possibility of firms making large and persistent errors. In the 1980s, in what the editors call a ‘radical’ effort, Phelps introduced the idea that agents have their own private models when forming expectations and understand that
others will use different information when forming their own decisions. But as others’ decisions are relevant to the final outcome, this implied that apart from trying to make one’s own decisions, agents also felt compelled to second guess the ‘average opinion’. This generated the idea of higher order expectations, which, in Phelps’s own words, became “...a causal force in its own right”\(^1\). Last, his work in the 1990s showed how the equilibrium level of unemployment can be seriously affected by exogenous changes in economic structures.

All contributors take these issues and expand on them in ways that at times confirm and at times contradict Phelps’s views. Both approaches, however, increase our understanding. Part I in the book touches on Phelps’s work on the relevance of incomplete information in explaining the real effects of monetary disturbances. The new Keynesian literature has identified delayed moves in wages and prices as the source of such real effects of monetary disturbances. The question then is what prevents wages and prices from adjusting immediately. There is naturally a big literature on inflation inertia but Phelps’s contribution to this issue, discussed extensively by most of the contributors here, is the role of agents’ expectations. It is not, therefore, just past inflation that determines how current inflation affects the real economy; it is also (if not primarily) the continuing effect of past inflation expectations. Agents look at how others change prices to decide how to change theirs, and therefore at the information they have about other peoples’ knowledge. As everyone engages in such practices, inevitably this leads to the formation of higher order expectations, an iterative process of second-guessing each others’ expectations. To the extent that such information, and indeed their “knowledge of the minds of others” is incomplete price adjustment is staggered and thus inertial.

Part II of the book, on imperfect knowledge, expectations and rationality, focuses then on how expectations are formed. Taking the Rational Expectations hypothesis a little further, the authors implement expectations formation processes that rely on imperfect knowledge and/or incomplete information to explain macroeconomic dynamics. Two chapters are interesting in this regard: Frydman and Goldberg and Kurz et al. The former argue that agents’ expectations are not perfect because they are formed under imperfect knowledge. Seen from the individual's perspective this does not imply that they are not rational. The latter then put forward a process in which monetary policy has real effects which stem directly from agents’ beliefs in such effects. Both chapters thus loosen the rigid connection between private sector expectations and the economist’s structural model but argue that such processes are consistent with the Rational Expectations paradigm.

The last two parts refer to somewhat different aspects of Phelps’s contributions. Part III touches on the determinants of equilibrium unemployment and is of great interest, because of its attempt to describe a number of country labour markets and put forward policy recommendations. The chapter by James Heckman in particular is notable for the fervour with which it argues the urgent need

\(^1\) p278.
for reform in Germany’s labour markets to alleviate its chronic structural unemployment problem. Last, Part IV discusses issues that are affected by Phelps’s contribution to models of long-run economic growth. Here the authors mention the relation between education, skills and technical progress, an area where Phelps has been an important contributor, and examine how they help explain wage inequalities. Acemoglu relies on the literature on “induced innovation” to ask why technical change is skill biased, and increasingly so, and how human capital differences among countries can help explain income differences.

This book is not one to be read cover to cover. It is both broad in the issues it addresses as well as detailed enough to be of use to the non-specialist. It does, however, provide a comprehensive summary of the contributions of the 2006 Nobel laureate in economics, and how his contributions have been understood and applied by others in recent years. It will, therefore, constitute a useful reference on “Phelpsonian themes” in many macroeconomic debates to come.

2.3 ‘Central Banking, Monetary Theory and Practice’ by P. Mizen (ed)

This book is also a compendium of papers honouring, this time, Charles Goodhart’s contributions in Monetary Policy, in his twin profession as an academic economist and a central banker. It is an equally interesting volume and a lot more accessible to a generalist audience. A number of papers here are worth a mention, starting with the contribution of the person who is being honoured himself. Goodhart thus begins the discussion and in a rather introspective, often humorous and at times even nostalgic manner provides us with an account of events as he has witnessed them since his student years at Cambridge in the late 1950s. His narrative takes us through his very prolific academic and policy career, which culminated in his MPC appointment in the Bank of England.

Still a very active contributor to both policy debates as well as the academic literature, Goodhart provides a rare collection of his views on a multitude of issues that continue to be crucial to monetary policy making. And it is notable how, deeply appreciative of the multiple facets of policy problems, Goodhart is very convincing in his implicit depiction of the compromise between theoretical rigour and pragmatism necessary in policy implementation. The chapter abounds with such examples. Take his discussion on what came to be known as the ‘Walsh contracts’, referring to the coupling of a central bank governor’s salary to the attainment of the inflation objective. Aware of their theoretical superiority and a proponent of such an institutional set-up himself, he is at the same time troubled by the suggestion that central bankers be rewarded when increasing interest rates - an action necessary in terms of stabilising inflation - when at the same time such an action reduces the public’s disposable income! Similarly, while academic literature often sets up central bank preferences with an explicit interest rate smoothing term, Goodhart argues that, at least in his work, he had been careful to take decisions that would preclude its occurrence.
Any evidence of *ex post* interest rate smoothing therefore is, in his view, not the result of the decision process but simply the outcome of revisions in the inflation forecast. Decision makers do not deliberately, therefore, refrain from acting against information they have; it is the auto-correlation of forecast errors that forces policy makers into a game of ‘catch-up’\(^2\). Last, it is interesting to see his view on the issue of the constant interest rate rule as an input to the inflation forecast. This is an issue that is, and will continue to be, very relevant in any central bank’s operations. Goodhart argues that even though a constant interest rate path has very little chance of reflecting the actual path of interest rates over the relevant horizon, he had nevertheless chosen to defend its application. The justification he gives is the simplicity it entails, but also because it forces the MPC into acting more preemptively and more aggressively than otherwise. He thus explains that his backing of such a rule is based on wishing to ‘‘..adjust interest rates now, so that if they were to be held constant thereafter, we would have the best possible chance of hitting our target...at an horizon of about 18-24 months.’’

Two other chapters are ‘eye-catching’. In a lucid and thought-provoking essay, Benjamin Friedman addresses the importance of communication in modern monetary policy implementation. Friedman argues that one of the most salient developments in the sphere of policy making in recent decades is the creation and adoption of inflation targeting (IT) as a framework for monetary policy. He then discusses the merits that advocates of such a regime put forward and raises two objections. The first is that such a regime gives monetary policy far too little a role in achieving stable and sustainable growth. When defenders of IT then argue that the intention is not to achieve price stability to the detriment of growth but merely to give priority to such matters, he then raises a second objection that stems from the importance of the language applied. He argues that ‘‘...the language in which that debate takes place exerts a powerful influence on the substance of what the participants say, and eventually even over what they think’’. He then goes on to say that ‘‘...a powerful motivation for adopting this framework, at least in some quarters, is the hope that if the explicit discussion of the central bank’s policy is carried out entirely in terms of an optimal inflation trajectory, concerns for real outcomes may somehow atrophy or even disappear from consideration altogether’’. However, the strength of the ‘use and meaning of words’ argument notwithstanding, this reasoning inevitably implies that it is the choice of monetary policy regime that causes the extent of ‘conservativeness’ in CB preferences. But when seen from the point of view of designing monetary policy, it is precisely the opposite direction in causality that holds, such that it is the extent of inflation aversion that leads to the choice of regime. It is not obvious then, why adopting an inflation target should subsequently lead to lesser concerns for output growth by comparison to an absent inflation target. Moreover, it is imperative in our view to address how well an inflation targeting regime ties down private sector inflation expectations. Friedman chooses,

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\(^2\)Rudebusch (2002) makes a similar point.
instead, to base his argument on whether the ordering of preferences affects the central bank’s ‘conservativeness’, and gives scant emphasis on this issue. We will illustrate further down why we believe IT to do better than other regimes on precisely this aspect. This issue however, attracts undeservedly little attention in Friedman’s argumentation, thus weakening, in our view, its standing.

In an equally thought provoking essay, Adam Posen discusses practical views of central bank transparency. He argues that two channels of greater central bank transparency appear to affect the market’s reaction to monetary policy. The first is the ‘reassurance’ channel, namely the bank’s attempt to inform the public about the uncertainties in the short-run, and the second, the ‘provision of details’ channel through which the CB provides information about economic developments that make planning easier and more effective. He then goes on to argue that concerns about greater transparency compromising a central bank’s independence are ill-founded. On the whole therefore, he argues that transparency is beneficial to economic magnitudes and a good thing in its own right. That said however, increasing transparency is also not sufficient to achieve the levels of accountability that are necessary in democratic societies. He thus argues that both transparency as well as accountability should increase, the former in terms of the two empirically founded channels described above, and the latter in terms of removing the goal independence from central banks that still have it.

Subsequent to the publication of this book, there have been new arguments put forward in the literature, which suggest that if private agents’ objectives require coordinating with others, then they will tend to give disproportionately more attention to the public (i.e. commonly available) information they have than is justified by the degree of its precision (Morris and Shin (2002)). This in turn implies that ever-increasing transparency in the sense described by Posen is not necessarily always beneficial (see Demertzis and Hoeberichts (2005) for a discussion).

3 The Role of Expectations

The common thread that runs across these three books, and actually a reflection of the latest developments in monetary policy, is the role of expectations. We have seen that Posen has argued for greater transparency and better communication from central banks, and Issing et al have argued for rule-based behaviour. The intention behind their recommendations is to make monetary policy more predictable, thus giving agents better information platforms to base their decisions on. This would in turn manage expectations better and help the central bank achieve price stability. Recent contributions in the literature have helped enhance our understanding of how this happens and developments in technology have allowed us to identify the paths through which expectations affect inflation.

The role of expectations in the economy has been the springboard for the extensive rules (commitment) versus discretion discussion. It has been advocated
therefore that a central bank that announces the rules based on which it decides its actions commits to a certain path that is understood by everyone. This willingness to commit, the argument goes, achieves credibility that manifests itself in the fact that expectations are tied to that level of inflation that is consistent with the rule followed. This, as has been shown extensively in the literature, can produce superior results in terms of society’s welfare.

There are, however, two difficulties with such an approach. First, while rule-based monetary policy has the advantage of being predictable, at the same time it is not as flexible as events might occasionally warrant. Committing to a specific operational rule runs the risk of it never being applied. Discretion, on the other hand, is as flexible as events warrant, as it allows for a period-by-period reconsideration of what is optimal, but at the cost of not necessarily helping expectations move in the desirable direction. This implies a trade-off in the choice of set-up, whereby the merits of commitment pull against the time-consistency of discretion. The second difficulty is that in practice, although always in favour of reaping the benefits of having committed, central banks worry about the fact that it is not always easy to assume that they are in such a position in real time. In actual decision making they therefore need to allow for the possibility that private sector expectations are not the result of past pre-committing policies, but instead the result of updated beliefs that rely on the information the private sector has at any given point in time. To get insight into this process central banks need to know how these expectations are formed and what they can do to tackle resulting inefficiencies. We allow for a discretionary set-up in what follows, which addresses these issues by separating the formation of expectations from actual policy making. Based then on Phelps’s contribution to the formation of expectations we will examine how agents use information they have to update their beliefs. The timing of the game assumed will have shocks occur first, then have private agents form expectations based on information available about these shocks and policy objectives, and finally have the CB form policy.

We start first however, by demonstrating how expectations feature in a typical monetary policy problem. We apply a standard forward-looking New Keynesian model, as described in Clarida, Gali and Gertler (1999) and Woodford (2003) in which expectations play a central role. The economy is described by the following pair of log-linear relations in deviation from their steady state:

\[
\begin{align*}
\pi_t &= \beta E_t \pi_{t+1} + \alpha y_t + \kappa_t \\
y_t &= E_t y_{t+1} - \gamma (r_t - E_t \pi_{t+1}) + \zeta_t
\end{align*}
\]

where (1) is an expectations-augmented “AS” relation in which present inflation is a function of private sector inflation expectations one period ahead, and (2) is an intertemporal “IS” relation. Notation follows convention\(^3\) and coefficients

\(^3\)Thus, \(\pi_t\) is inflation, \(y_t\) is the output gap, \(r_t\) is the nominal interest rate, and \(\kappa_t\) and \(\zeta_t\) are the supply and demand shocks, respectively.
satisfy, $\alpha, \gamma > 0$. Supply shocks are uncorrelated autoregressive processes, i.e.:

$$\kappa_{t+1} = \rho \kappa_t + v_{t+1}, \quad 0 < \rho < 1$$

where $v_t$ has zero mean and known constant variance. For simplicity and without any loss of generality, we solve under the AS constraint only in which output gap is considered the intermediate instrument. The central bank reflects society’s welfare and minimises the following intertemporal objective function conditional on the supply shock $\kappa$:

$$\min_y L_{t|\kappa} = \frac{1}{2} E_t \sum_{\tau=0}^{\infty} \beta^\tau \left\{ (\pi_{t+\tau} - \pi^T)^2 + y_{t+\tau}^2 \right\}$$

(3)

where $\pi^T$ is the CB’s inflation objective. We assume also the discount factor $\beta$ to be one. The time-consistent discretionary solution reduces to a period-by-period optimization of the loss function, i.e.:

$$\min_y L_{t|\kappa} = \frac{1}{2} E \left\{ (\sigma_t - \pi^T)^2 + y_t^2 \right\}$$

(4)

Minimising then (4) subject to (1) gives the familiar monetary policy reaction functions for output and inflation respectively:

$$y_{t|\kappa} = \frac{\alpha}{1 + \alpha^2} \pi^T + \frac{\alpha}{1 + \alpha^2} E_t \pi_{t+1} + \frac{\alpha}{1 + \alpha^2} \kappa_t$$

(5)

$$\pi_{t|\kappa} = \frac{\alpha^2}{1 + \alpha^2} \pi^T + \frac{1}{1 + \alpha^2} E_t \pi_{t+1} + \frac{1}{1 + \alpha^2} \kappa_t$$

(6)

Representation (6) is of a structural form in the sense that expectations are not replaced (Leiteno, 2005). Svensson (2003) argues in favour of such a representation in order to indicate that factors like judgement, that contribute to the way expectations are formed but cannot always be modelled, are an important contributor to monetary policy. The contribution of expectations in the final outcome features even more prominently in the presence of parameter uncertainty.

To show this, assume now that there is limited knowledge about the monetary transmission mechanism. Similar to Brainard’s (1967) contribution, this is represented by coefficient $\alpha$ in the AS equation being stochastic, i.e.: $\alpha_t$, with mean $\bar{\alpha}$ and constant variance $\sigma^2_{\alpha}$, which has come to be known as Brainard Uncertainty. The existence of such uncertainty implies that the period-by-period objective function (4) can now be expressed in terms of the first and second moment of the stochastic term:

$$\min_y L_{t|\kappa} = \frac{1}{2} E \left\{ (\bar{\pi}_t - \pi^T)^2 + y_t^2 \left( 1 + \sigma^2_{\alpha} \right) \right\}$$

(7)

Based on the solution for $y_t$, we can then back out the solution for the interest rate based on (2).
where $\bar{\pi}_t = E_t \pi_{t+1} + \alpha y_t + \kappa_t$. Term $y^2 \sigma^2_\alpha$ now represents the extra cost the CB incurs as a result of existing uncertainty in the parameter structure of the model. Expectations are again parametric and the discretionary solution implies optimising loss function (7) subject to (1). This gives:

$$y_{BR}^t |_\kappa = \frac{\alpha}{1 + \alpha^2 + \sigma^2_\alpha} \pi^T + \frac{\alpha}{1 + \alpha^2 + \sigma^2_\alpha} E_t \pi_{t+1} + \frac{\alpha}{1 + \alpha^2 + \sigma^2_\alpha} \kappa_t$$ (8)

$$\pi_{BR}^t |_\kappa = \frac{\alpha^2}{1 + \alpha^2 + \sigma^2_\alpha} \pi^T + \frac{\alpha^2}{1 + \alpha^2 + \sigma^2_\alpha} E_t \pi_{t+1} + \frac{\alpha^2}{1 + \alpha^2 + \sigma^2_\alpha} \kappa_t$$ (9)

We observe that the existence of parameter uncertainty implies the following things:

- As uncertainty increases ($\sigma^2_\alpha \rightarrow \infty$), the (intermediate) instrument $y$ is used less and less, from (8), in line with Brainard’s classical attenuation effect.
- As a consequence, the relative contribution of policy to the inflation outcome - coefficient of $\pi^T$ in (9) - reduces in uncertainty.
- By contrast, that of expectations - coefficient of $E_t \pi_{t+1}$ in (9) - increases in the level of prevailing uncertainty. At the limit when uncertainty is infinite ($\sigma^2_\alpha \rightarrow \infty$), it is straightforward to show that the target of the central bank becomes irrelevant and all that matters is private sector expectations.

### 3.1 Solving for Expectations

It is straightforward to see from (6) and (9) that achieving the inflation objective $\pi^T$ hinges on expectations $E_t \pi_{t+1}$ reaching that target. In the presence of parameter uncertainty, this need to tie down expectations to the inflation objective becomes all the more urgent, as any deviations from it contribute more and more to the inflation outcome. However, applying Rational Expectations (RE) through recursive substitution leads to the following reduced form solutions, respectively for the two cases:

$$\bar{\pi}_t |_\kappa = \pi^T + \frac{1}{1 + \alpha^2 - \rho} \kappa_t$$ (10)

$$\bar{\pi}_{BR}^t |_\kappa = \pi^T + \frac{1 + \sigma^2_\alpha}{\alpha^2 + (1 + \sigma^2_\alpha) (1 - \rho)} \kappa_t$$ (11)

and the central bank achieves its inflation objective. It is the case therefore, that deriving reduced form solutions based on the RE algorithm obfuscates the relevance of expectations in the final outcome described above. Similarly, the discrepancy mentioned earlier - how policy and expectations contribute to that final outcome in the presence of uncertainty - is totally eliminated. But this
is the result of the way we apply the rational expectations procedure. Expectations $E_t \pi_{t+1}$ act as a ‘jump’ variable that always moves to compensate for any shortcomings in the policy action and ensures inflation is in line with the CB’s objective. But this is a technical issue: in practice, there is no reason for expectations to behave according to this technical oddity at all times. Indeed, if expectations do not adjust in the way the iterative RE methodology imposes, or are not subject to the benefits of commitment, then the CB is unable to achieve its first-best outcome. In the spirit of Kurz et al described in section 2.2 above, we attempt next to depart from the rigid application of RE by asking how private agents go about forming expectations and what this implies for the CB’s ability to achieve its objective.

4 Monetary Policy as an Information Game

In an effort to explain now how agents form expectations $E_t \pi_{t+1}$, we describe monetary policy as an information game. For demonstration purposes we revert to a static model and strip the set-up down to its bare essentials. The central bank has the same period-by-period loss function in which it chooses the rate of inflation $\pi_t$ to minimise the distance from the inflation objective $\pi^T$ and close the output gap $y$, i.e.:

$$\min_{\pi} L|_{\xi} = \frac{1}{2} E \left[ (\pi - \pi^T)^2 + y^2 \right]$$

but this time subject to a simple Lucas supply function, $y = \pi - \pi^e + \xi$ where $\xi$ is now the supply shock with zero mean and constant variance, $\sigma^2_\xi$. Optimisation of (12) this time implies:

$$\pi|_{\xi} = \frac{\pi^T}{2} + \frac{\pi^e}{2} - \frac{\xi}{2}$$

equivalent to (6) where $\pi^e$ is now the relevant private sector expectations. As mentioned earlier, the objective here is to depart from the standard application of RE expectations formation. We do that by starting with the way an individual, $i$, interprets and utilises the information she has. Every individual will thus be forming an expectation for inflation $\pi_i$, such that the collective, and therefore relevant, macroeconomic outcome for a continuum of agents is $\pi^e = \int_0^1 \pi_j dj$.  

5 The literature on "Learning" is naturally a well established example in which expectations do not align immediately with the CB’s objectives. See also Demertzis and Viegi 2006b for an example on how expectations subject to differential information introduce inertia in the system and prevent the attainment of the target.

6 The details of this can be found in Demertzis and Viegi (2006a).

7 $\pi$ is therefore, the instrument now as well as the state variable.

8 We assume homogenous agents.
4.1 The Formation of Expectations

Typically, every individual forms expectations based on two information sets, namely what is publicly available and therefore common to everyone, and what is available to them privately. Furthermore, every individual is aware of the fact that the *ex post* outcome of inflation \(\pi\) is represented by (13), and is therefore, affected by the policy the central bank pursues to attain its objectives, as well as the average of expectations formed by the public. The individual’s action is now motivated by her need to negotiate wages. She therefore forms an expectation for inflation, based on which she negotiates nominal wages, \(w_i = \pi_i\). Her objective then is to predict inflation correctly, captured here by the following expected dis-utility:\(^9\)

\[
\min_{\pi_i} u_i(\pi^e, \pi^T) = \frac{1}{2} E_i(\pi_i - \pi)^2
\]  

(14)

Note that subscript \(i\) in the expectations operator indicates that the individual will be seeking to minimise her expected dis-utility, given her own perceptions. The individual decides her action \(\pi_i\) based on the first-order condition of (14), i.e.:

\[
\arg \min_{\pi_i} u_i(\pi^e, \pi^T) = E_i(\pi)
\]

Based on (13) the individual knows that

\[
\begin{align*}
\pi_i &= E_i(\pi) \\
\pi_i &= E_i \left( \frac{\pi^T}{2} + \frac{\pi^e}{2} - \frac{\xi}{2} \right) \\
\pi_i &= \frac{1}{2} E_i (\pi^T - \xi) + \frac{1}{2} E_i (\pi^e)
\end{align*}
\]  

(15)

Individual \(i\)’s optimal action shown in (15) is thus a function of three things: the central bank’s objectives and hence the policy it pursues, the magnitude of the shock that has occurred, and the average expectation formed by all individuals. In addition, these three components will be accessed subject to the information available to her, captured by the \(E_i\) notation. It follows that if \(\pi_i = \pi_j \forall j\), then \(\pi_i = \pi^e\) and individuals’ expectations are matched. However, although desirable, coordination between agents at any level of inflation is not sufficient; the optimal outcome for society occurs when agents coordinate at the target set by the central bank\(^10\). Coordination at any other expectation rate still leaves agents away from the level of inflation that the CB aims to achieve. Following Morris and Shin (2002), we argue that information used by the agents is available in the form of a public signal common to all, and a private signal which is specific to each agent in the economy. These take the following form:

---

\(^9\)Model based on Canzoneri (1985).

\(^{10}\)Because, \(\pi_i = \pi^e\) hence \(\int_0^1 \pi_i d\phi = \pi^e\) and therefore, \(\pi|_{\xi} = \pi^T - \xi\).
Public signal: \[ p = (\pi^T - \xi) + \eta \] (16)

Private signal: \[ z_i = (\pi^T - \xi) + \varepsilon_i \] (17)

Both \( \eta \) and \( \varepsilon_i \) have a zero mean and known variance \( \sigma^2_\eta \) and \( \sigma^2_\varepsilon \) respectively. Furthermore, the two error terms are independent of \( \pi \) and of each other, and \( E(\varepsilon_i \varepsilon_j) = 0 \) for \( i \neq j \). The clarity of public information is not under the full control of the CB but it is affected by a combination of the CB’s information strategy, general market information available and noise. Based then on Phelp’s notion of higher order expectations described in section 2.2, Morris and Shin (2002) use these two types of signals to show that agent \( i \)’s action from (15) can now be written as:

\[
\pi_i = \frac{2\alpha p + \beta z_i}{2\alpha + \beta} = \pi^T - \xi + \frac{2\alpha \eta + \beta \varepsilon_i}{2\alpha + \beta} \tag{18}
\]

where \( \alpha = \frac{1}{\sigma^2_\eta} \) and \( \beta = \frac{1}{\sigma^2_\varepsilon} \) represent the level of precision for the two information sets respectively. We call this the MS action. The aggregate inflation expectation across all agents is then equal to:

\[
\pi^* = \int_0^1 \pi_i \, dj = \pi^T - \xi + \frac{2\alpha \eta}{2\alpha + \beta} \tag{19}
\]

Equation (19) shows that average expectations will be distorted by the (lack of) precision of the two signals. The best individual \( i \) can do is (18), which relies on what public and private information she has about the CB’s inflation objective and the supply shock. It is then straightforward to calculate central bank losses by substituting (19) in the Lucas supply curve and together with the solution for inflation, in the objective (12). Morris and Shin (2002) have shown that these losses are not unequivocally reduced for all increases in public information. If we associate increases in public information with increased transparency, this is then the argument that runs against Posen’s assertion in section 2.3 above, about the unequivocal benefits of increasing transparency. Faced with (19) then, the question that arises is what the central bank can do to bring expectations closer to its own objective, \( \pi^T \).

### 4.2 Central Banks as Coordinators of Expectations

Operating in a discretionary set-up implies that from the point of view of the central bank, expectations are predetermined and actual policy decisions at any given period cannot affect them. To address the issue then, we need to turn instead to either changes in the communication strategy that the CB follows or
alternative institutional set-ups that can improve the platform of information the individual has. We discuss next how a change in the latter attempts this.

In the volume by Issing et al reviewed in section 2.1, the authors have argued for the need for a clear and well understood price stability objective as a means to effective monetary policy making. But how does this help increase credibility and therefore anchor expectations better? As argued earlier, the CB’s objectives are captured by (12). We assume that all central banks communicate to the public that their objective is ‘price stability’; not all elaborate however, what this means quantitatively. We identify those central banks that do not have an explicit quantitative target with ‘non-inflation targeters’. Action (18) then is the individual’s best shot at guessing what the inflation outcome will be, subject naturally to the value of $\pi^T$. An ‘inflation targeter’, by contrast, is then a bank that announces to the public that ‘...price stability is identified with $\pi^T$’.

In his contribution discussed earlier, Friedman argued that inflation targeting biases the discussions towards greater price stability and lower output growth. We, instead, investigate what the provision of an explicit target implies for the choices available to the individual$^{11}$. We argue that the individual now receives an extra signal in addition to (16) and (17):

\[ h = \pi^T \]  

(20)

As a result, every individual is now faced with the choice between two alternatives for her action $a_i$: either weigh all information available to her and thus follow the strategy suggested by Morris and Shin ($\pi_i$), or driven by her desire to coordinate, fix her expectation at the inflation target announced by the central bank, ($\pi^T$). The decision to follow the latter however, is subject to how credible the central bank is, and how likely others are to follow it as well, as we will show later on. In modelling terms, these choices are summarised respectively in (21) and (22), i.e.:

\[ a_i: \pi_i = \pi^T - \xi + \frac{2\alpha \eta + \beta \xi_i}{2\alpha + \beta}, \]  

(21)

\[ a_i: \pi^T \]  

(22)

By analogy, the same applies for the collective action $\bar{a}$, such that again respectively for the two alternatives, the MS action leads to an average inflation expectation of $\pi^e$, whereas following the CB target leads to $\pi^T$. Similarly, in modelling terms these amount to (23) and (24) respectively:

\[ \bar{a}: \pi^e = \pi^T - \xi + \frac{2\alpha \eta}{2\alpha + \beta}, \]  

(23)

\[ \bar{a}: \pi^T \]  

(24)

$^{11}$We appreciate that this is a crude distinction and not one that necessarily captures all the differences between inflation and non-inflation targeters. Our objective is to simply differentiate between a central bank that provides a quantitative target and one that does not.
We can now calculate the dis-utility for individual $i$ based on her own action ($a_i$) and the inflation outcome which is affected by the collective action ($\bar{a}$). Generalising (14), individual $i$'s dis-utility is:

$$u_i(a_i, \bar{a}) \equiv E_i (a_i - \pi)^2$$

The important point is that the very provision of an inflation target increases the number of options available to the individual and thus the number of potential outcomes. Table 1 summarises the pure form strategies available to individual $i$ - and the dis-utility outcomes associated with them from (25) - for the two alternative monetary regimes of non-inflation targeting (NIT) and inflation targeting (IT):

<table>
<thead>
<tr>
<th>NIT</th>
<th>IT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a_i$</td>
<td>$\bar{a}$</td>
</tr>
<tr>
<td>$\pi_i$</td>
<td>$\frac{\alpha + \beta}{(2\alpha + \beta)^2}$</td>
</tr>
</tbody>
</table>

Thus, if the CB does not announce a value for its inflation objective, the best individual $i$ can do is apply the MS action. However, if the CB does announce a quantitative objective for inflation then, which response is optimal for individual $i$ depends crucially on what the general action is, and in turn on the relative size of the variance of the supply shock, $\sigma^2_\xi$. As we assume homogenous agents, there can only be a choice between two actions. Two results follow:

A. Table 1 shows that for any given level of precision for public and private information, adopting the inflation target $\pi^T$ becomes a dominant strategy for individual $i$ if the variance of the supply shock is below a given threshold, i.e.:

$$\sigma^2_\xi < \frac{\beta}{(2\alpha + \beta)^2}$$

The game then has one Nash equilibrium, $(\pi^T, \pi^T)$ and individual $i$ faces disutility equal to $\frac{1}{4}\sigma^2_\xi$. It is important therefore, that the supply shock is relatively small in relation to the given ratio of public and private information precision. Indeed, if the economy is hit by big shocks instead, then it is unlikely that this condition is met, implying that the provision of a target does not help agents coordinate at the level intended by the central bank. We find this intuitively appealing because it evaluates the effectiveness of the target publicized within the context of the economic conditions in which it is applied. Moreover, it is also true that if public information is very imprecise ($\alpha$ is low) then the condition becomes easier to satisfy, ceteris paribus, and the provision of an inflation target is indeed helpful. This implies that numerical targets are therefore, substitutes for imprecise public information. In other words, absent concrete alternative information, the provision of one clear inflation target becomes the only unequivocal
piece of information available to all. The incentive to coordinate implies that individuals will then seek to exploit it.

B. However, if condition (26) is not satisfied, i.e. \( \sigma_i^2 > \frac{2}{(2\alpha + \beta)} \), then individual \( i \)'s optimal response in pure form strategies requires 'matching' the average action. In other words, \( a_i = \pi_i \) is the best response to \( \bar{a} = \pi_e \), and \( a_i = \pi_T \) is the best response to \( \bar{a} = \pi_T \). The game has now two Nash equilibria in pure form, \((\pi_i, \pi_e)\) and \((\pi_T, \pi_T)\), and differentiating between the two requires adding an extra dimension to the problem. That is that the individual forms an opinion about how the target is perceived by others. This implies having to quantify how many people consider the target credible as shown in Demertzis and Viegi, (2006a). Based on that, she can then infer how likely the target is to be followed and therefore, match the 'average action' accordingly. The more credible she understands the target to be, the more likely it is that others will follow it. Matching the average action then implies her forming expectations according to the target as well. The opposite leads to the application of the MS action. Interestingly, it is the case that if large shocks are expected, then individual \( i \) needs an ever greater degree of confidence that the target is perceived to be credible before she picks it herself. This is consistent with what is mentioned above, namely that in the presence of large shocks inflation targets are less convincing in their role as coordinators of expectations.

5 Conclusions

The soundness of monetary policy decisions is not solely determined by their own worth. By implication, policy mistakes alone are not always enough to produce long term negative effects on monetary stability and by the same token, correct decisions are not sufficient to guarantee successful results. In both cases, what people believe about these decisions and subsequent policies is just as important. This point stems from Phelps’s contribution to the relevance of expectations in price stability. That said, central banks acquire a dual role: the first is naturally to assess the conditions at hand and make as sound decisions as their information and skills allow; equally important is the second task, which is to inform and convince the public about the value of their intentions. This, according to Issing et al, can be done by rule-based behaviour and transparent operations. In order to examine how such behaviour affects expectations we describe monetary policy as an information game and confirm Issing et al’s argument of the importance of explicit quantitative targets in monetary policy implementation. Our analysis takes this issue further and shows that it is important to evaluate the merits of any regime in the context of the economic environment it operates in. We thus demonstrate that in the presence of unstable economic conditions, namely large shocks, announcing a clear inflation target cannot be the incontestable nostrum. This is then in line with Goodhart’s appreciation of the at times necessary lack of correspondence between monetary theory and monetary practice or with Issing et al’s need for the application of ‘judgement’. 
References


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