Are Contemporary Central Banks Transparent about Economic Models and Objectives and What Difference Does it Make?

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Abstract

This paper documents the opaqueness of central banks about the economic models they use to choose policy but argues that this is largely due to the lack of consensus about the correct model of the economy within the economic profession. The latter is illustrated by contrasting three currently popular models of the transmission mechanism. Although the inflation targets of Western central banks are currently quite clear they tend to be hazy about their output targets and about whether they are strict or flexible inflation targeters (in Svensson's (1997) sense), and in the second case, how flexible. They are also remarkably silent about the shape of their loss function, particularly so with respect to losses from alternative values of the output gap in spite of the fact, that in an uncertain world, policy decisions are affected by the shape of the loss function in the entire range of output gaps.

The second part of the paper first reviews the case for believing that at least some central banks are, given inflation, more averse to negative than to positive output gaps and then investigates the consequences of this asymmetry for average inflation. It is shown, for both an expectations augmented Phillips curve as well as for a New -Keynesian transmission mechanism, that in the presence of uncertainty about the upcoming state of the economy flexible inflation targeters with asymmetric objectives induce an inflation bias even if their output target is the potential level. Furthermore the inflationary tendencies of policymakers who believe in sticky prices are stronger than of those who do not. But, provided prices are really sticky, the economy is non neutral even in the long run, and the policies of the former also induce a higher level of output. The consequences of transparency about those mechanisms for credibility are evaluated.

Zusammenfassung

Dieses Papier zeigt zunächst, dass Notenbanken hinsichtlich des Modells, das sie ihrer Politik zugrundelegen, Stillschweigen wahren. Es wird weiterhin argumentiert, dass dies daran liegt, dass sich die Volkswirte über das richtige Modell nicht einig sind. Dazu werden 3 verbreitete Modelle des Transmissionsprozesses einander gegenübergestellt. Während die Inflationsziele westlicher Zentralbanken recht klar sind, besteht größere Unsicherheit über ihre Outputziele und darüber, ob sie ihr Inflationsziel strikt oder flexibel (und gegebenenfalls wie flexibel) anstreben (im Sinne von Svensson, 1997). Zentralbanken sind auch bezüglich der Form ihrer Verlustfunktion verschwiegen, insbesondere was die Output-Lücke angeht. Dies gilt, obwohl in einer unsicheren Welt Politikentscheidungen von der Form der Verlustfunktion abhängen. Der zweite Teil des Papiers geht zunächst auf den Fall ein, dass zumindest einige Zentralbanken, bei gegebener Inflation, eine größere Abneigung gegenüber negativen als gegenüber positiven Output-Lücken haben. Die Folgen dieser Asymmetrie für die durchschnittliche Inflation werden untersucht. Sowohl bei einer erwartungsabhängigen Phillipskurve als auch bei einem Neo-Keynesianischen Transmissionsmechanismus haben Zentralbanken mit einer flexiblen Inflationsstrategie und einer asymmetrischen Zielfunktion mit einem Inflationsbias zu tun. Das gilt selbst wenn das Outputziel mit dem Produktionspotential übereinstimmt. Zudem sind die Inflationstendenzen höher wenn Wirtschaftspolitiker daran glauben, dass sich die Preise nur allmählich an ihr Gleichgewicht anpassen, als wenn sie solche Vorstellungen nicht hätten. Wenn allerdings solche Vorstellungen über die Preise tatsächlich zutreffen, dann ist Geld auch langfristig nicht neutral. Die Politiker vom ersten Typ ermöglichen dann ein höheres Output-Niveau. Es wird geprüft, welche Folgen es für die Glaubwürdigkeit hat, wenn für Transparenz über diese Mechanismen gesorgt wird.

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1 Introduction

The worldwide increase in delegation of authority over monetary policy to central banks with substantially higher levels of independence than in the past precipitated the twin issues of accountability and of transparency to the forefront of the debate on monetary institutions. The current debate is particularly intense on the European side of the Atlantic where the formation of a monetary union (MU) and a European Central Bank (ECB) facing eleven different fiscal authorities and differently structured labor markets transformed those hitherto mainly academic questions into practical policy issues.

There is nowadays a good deal of consensus about the objectives and desirable organization of monetary policy making institutions. In particular there is widespread consensus that the main objective of monetary policy should be price stability, that the central bank (CB) should have the freedom to set the interest rate without political interference and that the objectives and the procedures followed by the CB should be reasonably transparent. The insistence on transparency is motivated by the desire to ultimately make the central bank accountable to the general public either directly or through the intermediation of elected officials. But once those general principles are operationalized some differences appear. The consensus about transparency is most fragile to the introduction of practical guidelines as illustrated by a recent interchange between Buiter (1999) and Issing (1999). Buiter's position largely reflects what I have called elsewhere the (new) Bank of England (BE) approach and Issing's position reflects the approach of the ECB which has been largely shaped by the philosophy of the Bundesbank

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(BB) during the last several decades.[1]

Both approaches agree on the principle that a CB should be transparent and accountable but differ on the means to achieve those goals. The most vocal disagreements have been about the early publication of CB forecasts and the votes of individual monetary policy council members. The BE approach is for early release of this information while the BB approach is against it. Those differences partly reflect the BB view that there should be "collective responsibility" at the CB while the BE approach puts relatively more emphasis on the accountability of individual council members. They also reflect the fact that since the second half of the nineties countries like the UK and Sweden have put in place an explicit mechanism of inflation targeting in conjunction with a numerically specified inflation target that is decided upon by government.[2] In such systems the early publication of CB forecasts is believed to be an essential element of accountability since it enables the principal (government) to judge whether *ex post* deviations from the target were due to poor performance by the agent (the CB) or to unanticipated economic shocks. The colorful debate about publication of forecasts and CB votes overshadowed two possibly more fundamental areas in which most (perhaps even all) existing central banks are rather opaque. One concerns the economic model, or models, used in making policy decisions and the other concerns the operational objectives of the CB .

This paper focuses on those issues. It has two main parts. The first evaluates the degree of transparency about the economic models used by contemporary central banks and about their objective functions. It argues that in spite of the recently acknowledged importance of transparency, (particularly in some inflation targeting countries) there is substantial haziness about the economic models used by central bankers in generating forecasts as well as about their objective function. Some of this haziness is due to the absence of clear knowledge about the "true" model of the economy and some to the attempt of policymakers to hedge their positions in the face of model and of political uncertainties.

The second part of the paper examines whether haziness about objectives matters for

[1] A fuller discussion of the differences between those two approaches regarding the operationalization of transparency and other issues appears in the concluding section of Cukierman (2000b). See also de Haan and Eijffinger (2000) for an appraisal of the Buiter - Issing interchange.

[2] Other countries with explicit inflation targeting systems are New-Zealand, Canada, Finland, Australia and Spain. By contrast, in the case of the Bundesbank and the ECB the target is chosen by the CB.

credibility when monetary policymakers are more sensitive to negative than to positive output gaps. The initial motivation for this exercise is the following statement from Blinder (1998, pp. 19, 20), made shortly after his resignation from the office of Vice Chairman of the Fed:

"In most situations the CB will take far more political heat when it tightens preemptively to avoid higher inflation than when it eases preemptively to avoid higher unemployment"

A fuller description of the second part is provided after the following recent literature review.

Since the early eighties the dominant academic paradigm for conceptualizing the positive and sustained inflation rates experienced by most countries during the twenthieth century has been the Kydland-Prescott (1977), Barro-Gordon (1983) framework (henceforth KPBG). On this view there is an inflation bias that is due to the fact that, owing to tax and/or other labor market imperfections, the natural level of employment is lower than the level targeted by policymakers. This induces policymakers to try to stimulate employment by means of inflationary surprises. Since the public anticipates such behavior it adjusts nominal wages (and other) contracts accordingly. This leads to an equilibrium in which inflation has a positive bias but output remains at the natural level.

Recently two central bankers with strong academic backgrounds have expressed the view that decisions maker in their respective central banks are not trying to maintain employment above its natural level and conclude, therefore, that the KPBG bias story is not applicable to their respective central banks.[3] In particular, Blinder (1998, p.43) argues that policymakers at the Fed do not try to systematically maintain employment above the natural level. As a matter of fact he personally felt duty bound to pick monetary policy so as to hit the natural rate when in office. In a similar vein, while recently summarizing the UK experience with inflation targeting John Vickers (1998, p. 369) expressed the following view;

" *There is a large literature on inflation bias but it simply is not applicable to the MPC. We have no desire to spring inflation surprises to try to bump output above its natural rate (wherever that may be).*"

Coming from a former Fed's Vice Chairman and from an Executive Director and Chief

[3] McCallum (1995, 1997) expresses a similar view.

Economist at the Bank of England such introspective statements certainly deserve serious consideration, not the least because acceptance of this view carries with it the important implication that the credibility problem of monetary policy is a thing of the past.[4]

In parallel recent inflation targeters like the (reborn with instrument independence since 1997) Bank of England acknowledge that, although their primary objective is price stability, they are also averse to excessive short run fluctuations of actual around potential or natural output. Hence, they attempt to achieve the inflation target on average rather than in each period. In Mervyn King's (1997) words they are not "inflation nutters". For example, if an adverse supply shock pushes inflation above target for some time they do not seek to put inflation back on target immediately because of the associated excessive fluctuations this would create in the output gap.

Svensson (1997) refers, somewhat more neutrally, to such a bank as a "flexible inflation targeter" and to King's "inflation nutter" as a "strict inflation targeter". Recent inflation targeters like the UK, New-Zealand, Canada and Sweden have been rather transparent about the fact that they are flexible rather than strict inflation targeters. In terms of the familiar quadratic loss function used by KPBG and much of the ensuing literature this means that, although they do not try to maintain output above its natural level, their loss function assigns a positive weight **also** to deviations of output from its potential level. I shall refer to the relative weight assigned to deviations of output from target in comparison to deviations of inflation from target as the "flexibility parameter" and denote it by"A".

In any precise characterization of optimal policy in such a context A is obviously an important determinant of the speed with which policy seeks to put inflation back on target following adverse shock realizations. The larger is A the larger is the "flexibility" allowed in returning to the inflation target following a shock. Hence, along the optimal policy plan of a flexible inflation targeter the parameter A determines the period by period deviations of inflation from its target. In spite of its obvious importance and of their insistence on transparency recent inflation targeters have been rather hazy about the magnitude of the flexibility parameter. This

[4]The views expressed by Blinder and Vickers are not inconsistent with the existence of a KPBG inflationary bias prior to the nineties provided policymakers, at the time, believed in a stable tradeoff between inflation and economic activity. As the idea of no tradeoff perculated policymaking circles during the nineties policymakers, realizing the futilty of the attempt to maintain output above its natural level, settled for the natural rate. Sargent (1999) models this process using least square learning about the slope of the long run Phillips curve.

is recognized by Vickers (1998 p. 370) who candidly writes;

"The MPC remit is silent on this parameter of the loss function, but optimal policy is arguably not too sensitive to its value within a reasonable range."[5]

While most explicit inflation targeters openly admit that they are of the "flexible" variety that was not usually the case with the Bundesbank when it was in charge of German monetary policy, nor is it currently the case with it successor - - the ECB. In view of the strong and unequivocal priority given to price stability in the charter of those banks their officials probably prefer to view and to project to the public an image of the Bank as a strict, rather than a flexible, inflation targeter. But evidence presented in Clarida and Gertler (1997) is consistent with the view that the actual policy of the Bundesbank did not significantly differ from that of a flexible inflation targeter. Thus, there seems to be substantial haziness about the parameter A both among explicit as well as among implicit inflation targeters.

The second main part of the paper takes the statements of Vickers and of Blinder (that the output target of policymakers at the Bank of England and at the Fed is the natural rate) at face value and examines the consequences of flexible inflation targeting, and of haziness about the parameter A, for credibility in the presence of asymmetric objectives. Besides the statement by Blinder pointing to an asymmetry in the objectives of the US political establishment this exercise is motivated by the following considerations.

Cukierman (1999) shows that, with a Lucas type transmission mechanism, uncertainty about the future state of the economy and asymmetries in the output gap segment of the CB loss function, there will be an inflation bias even if the CB targets the normal level of output. This framework implies that there should be a positive association between the variability of economic activity over the cycle and the magnitude of the inflation bias. Preliminary cross sectional evidence in Gerlach (2000) supports this implication. Last but not least, the quadratic objective function originally postulated by KPBG carries the rather unintuitive implication that, **given inflation**, an upward deviation of employment from its desired level is as costly as a downward deviation of the same size. It is hard to see why policymakers, or social planners

[5] The qualifier refers to work by Bean (2000) and Batini and Haldane (1999) who claim, that for recent structural parameters of the UK the optimal policy of a flexible inflation targeter is insensitive to the precise value of A.

for that matter, would object, given inflation, to a positive output gap. As a matter of fact its quite likely that, in the range of positive output gaps, the quadratic was postulated mainly for analytical convenience rather than for its descriptive realism.

Since there is substantial uncertainty about the correct model of the economy the consequences of asymmetric objectives are examined also for an economy with a Neo-Keynesian transmission mechanism of the type recently reviewed by Clarida, Gali and Gertler (1999). In this case there is an inflation bias that has two distinct origins. One of those arises, as in the case of an expectations augmented Phillips curve, due to the interaction of asymmetries in the output gap segment of the loss function with uncertainty about the future state of the economy. Thus, flexible inflation targeting in conjunction with asymmetric output gap objectives lead to credibility problems even when the employment target is at the natural level. Furthermore, contrary to conventional wisdom (with an expectations augmented Phillips curve) this bias is an increasing function of the extent to which the CB is "flexible" in targeting inflation as measured by the parameter A. Since this is precisely the parameter about which contemporary central banks tend to be hazy it follows that there is also uncertainty about the size of the bias.

The additional inflationary tendency that arises in the New - Keynesian framework is related to the fact that, since prices are sticky, policymakers face within some range a long run tradeoff between average inflation and the average output gap. Policymakers with asymmetric losses from positive and from negative output gaps choose a point along this tradeoff that is characterized by both positive average inflation and a positive average output gap.[6]

Section 2 documents existing haziness about the economic models used by decision makers in central banks and about the level of output that they target. It is argued that, while a large part of this haziness is due to lack of clear consensus about the transmission mechanism within the economic profession itself, this state of affairs leaves quite a bit of discretion to central banks and opens the door for strategic use of information. Section 3 examines the extent to which contemporary central banks are transparent about their objectives and concludes that here too there is quite a bit of haziness particularly among the new "flexible inflation targeters". It then reviews recent theoretical arguments and empirical literature which support the hypothesis that,

[6] I refer to this second mechanism as "tendency" rather than "bias" since it is associated with some gain in the average value of output.

at least some central banks, have different attitudes to positive and to negative output gaps.

Section 4 shows, for a Lucas type transmission mechanism, that in the presence of such asymmetries and uncertainty about the upcoming state of the economy, policymakers "hedge" their position on the side of expansion to reduce the likelihood of surprise recessions. This behavior is shown to induce an inflationary bias even when the policymakers' output target is potential output. Section 5 first shows that a similar mechanism operates also in sticky price models of the economy. But , since in such frameworks policymakers can control the real rate of interest and have asymmetric preferences, there is an additional inflationary tendency which is associated with average positive real effects on the output gap. This is followed by concluding remarks.

2 Haziness about the economic model used for choosing policy

Practically all central banks are rather non committal about the economic model or models they use in deciding about policy. Admittedly, many of the major central banks have at least one big econometric model of the economy in store. But the forecasts generated by such models are only one of many inputs used in formulating policy. Decision makers at major central banks have access to a multitude of alternative "models" and information. The aggregation of this information by each board member and the further aggregation of the position of each board member into a collective decision is a rather complex process whose full description would require very detailed tracking of the thought process of each board member as well as of the committee work interaction among the board members. Vickers (1998, p. 370) candidly admits that there are serious limits to how much of this process can be put in the public domain:[7]

" *While transparency-inflation reports, MPC minutes, Treasury Committee hearings and so on-increases what is in the public domain (desirably in my view), there is surely information relevant for policy-making that is simply incapable of being put in the public domain".*

[7] Even if all those details could be put in the public domain it is unlikely that, due to cognitive limitations, the bulk of (the largely non professional) public would have absorbed and digested them accurately. A fuller discussion of those and related issues appears in Winkler (2000).

A substantial part of this ambiguity is caused in the first place by the absence of consensus within the economic profession about the correct model of the economy. In the absence of consensus a "reasonable" central banker is likely to hedge his position by intuitively assigning non negative weights to alternative conceptions of the economy. This complicates the decision making process of central bankers, makes them vulnerable to *ex post* critisism but also leaves them substantially more discretion than they would have otherwise. As a matter of fact current economic literature entertains several conceptually different views of the transmission process of monetary policy even before taking into account differing views about length of lags, parameter magnitudes and functional form within a given broad conception of the transmission mechanism.

This section illustrates some of this conceptual variety by briefly reviewing and contrasting three well known alternative conceptions of the transmission process of monetary policy used in the current economic literature. One is a monetarist Lucas type expectations augmented Phillips curve and the other two are Neo - Keynesian in spirit in that both rely on staggered nominal price setting in conjunction with costs of price adjustment. In both variants the CB is able to influence the real rate by means of the nominal rate of interest because the price level is temporarily sticky. In the first version current prices are fully backward looking in the sense that current pricing decisions depend only on predetermined past prices and in the second they are fully forward looking in that current pricing decisions depend on expected future inflation rather than on past pricing decisions.[8]

2.1 A Monetarist Lucas type transmission mechanism (model 1)

This transmission mechanism is the one most frequently used in models of endogenous monetary policy. The main idea is that monetary policy has real effect only to the extent that it creates unexpected inflation. In particular the deviation of output from its natural level is an increasing function of unexpected inflation. Formally;

$$y_t \equiv Y_t - Y_{nt} = \alpha(\pi_t - E_t\pi_t), \quad \alpha > 0 \tag{1}$$

[8] An additional trasmission channel that is not captured by either of those models is the credit channel.

where Y and Y_n are actual and natural output, π is the rate of inflation, $E\pi$ is the (rational) expectation of that rate of inflation when output decision are made and t is a time index. The instrument of monetary policy is not modeled explicitly but it is assumed, at least implicitly, that the monetary authority can set its instrument (the money supply or the interest rate) so as to bring about the inflation rate that it desires. Hence, from a formal point of view the "instrument" of the monetary authority here is the rate of inflation.[9] Equation (1) is also known as an "expectations augmented Phillips curve". In its starkest monetarist interpretation prices and wages are fully flexible and monetary policy has real effects only when inflation is not fully perceived currently. In the presence of nominal wage contracts which are preset one period in advance on the basis of expected future inflation there are real effects when there are deviations between the rate of inflation that had been expected at contracting time and the subsequent realization of inflation. In this variant $E_t\pi_t$ is replaced by $E_{t-1}\pi_t$.[10]

2.2 A Neo - Keynesian transmission mechanism with backward looking pricing (model 2)

In this framework the current output gap, normally defined as the deviation of actual from potential output, depends on the lagged real interest rate and on its own lagged value. Current inflation is positively related to the lagged value of the output gap and to its own lagged value. A compact formulation of the model, due to Svensson (1997), is;

$$x_{t+1} \equiv Y_t - Y_{pt} = -\varphi(i_t - E_t\pi_{t+1}) + \phi x_t + g_t \tag{2}$$

$$\pi_{t+1} = \pi_t + \lambda x_t + u_{t+1} \tag{3}$$

[9] In some versions of this model policymakers have only imperfect control of inflation. In such a case the planned rate of inflation becomes the instrument of monetary policy.

[10] A fuller discussion appears in chapter 3 of Cukierman (1992).

where Y_{pt} is potential output, x_t is the output gap, π_{t+1} is the rate of inflation between period t and period $t+1$, $E_t\pi_{t+1}$ is the (rational) public's forecast of this inflation given the information available to it in period t, i_t is the nominal rate of interest on one period loans contracted in period t, u_{t+1} is a cost shock, g_t is a non monetary shock to aggregate demand, and φ, ϕ, and λ are non negative parameters. Note that although there is some analogy between x_t and y_t from the first model they are not identical since natural and potential output are not necessarily identical concepts. The difference between them is discussed later in this section.

In this framework the monetary policy instrument is the nominal rate of interest. Due to price stickiness the CB can affect the real rate (and through it the output gap and future inflation) by choice of the nominal rate. Svensson (1997) notes that, in spite of its simplicity this model captures some of the essential features of more elaborate econometric models used by some central banks. The model reflects the declared belief of some central banks, like the Bank of England, that current interest rate policy affects the output gap with a lag of one period, and the rate of inflation only with a lag of two periods. The model is fully backward looking in that current pricing behavior depends only on lagged variables..

2.3 A New - Keynesian transmission mechanism with forward looking pricing (model 3)

The main difference between this framework and the previous one is that current price setting and the current output gap depend on expectations of future inflation and on the expected future output gap respectively rather than on the lagged values of those variables. Thus, the model is fully forward looking. The main idea is that a change in expectations of future variables alters current pricing behavior. This modification has its origin in more explicit micro foundations with monopolistic competition and costs of price adjustment. A stylized aggregate version of such a model has recently been summarized compactly by Clarida, Gali and Gertler (1999) and is reproduced in what follows;

$$x_t = -\varphi(i_t - E_t\pi_{t+1}) + E_t x_{t+1} + g_t \tag{4}$$

$$\pi_t = \lambda x_t + \beta E_t \pi_{t+1} + u_t \tag{5}$$

Here φ, λ and β are positive coefficients. All the variables have the same meaning as in the previous model. The expected future output gap appears in the output gap equation to reflect the notion that, since individuals smooth consumption, expectations of higher consumption next period (associated with higher expected output) leads them to demand more current consumption, which raises current output.

As in stylized models of sticky staggered prices pioneered by Calvo (1983), current inflation depends on future expected inflation. In this type of models only a fraction of firms has the opportunity to adjusts its price each period and, due to costs of price adjustment, each firm adjusts its price at discrete intervals. Hence when it is given the chance to adjust its price the firm adjusts it by more the higher is expected future inflation. This interpretation implies that β is a discount factor.

2.4 Comparison between the conceptions underlying the different models

The three models above are grounded in different conceptions regarding the channels through which monetary policy affects output and inflation. In the Lucas type model monetary policy affects output only if it is unanticipated, either currently or when relevant nominal contracts have been concluded. Inflation in those type of models is usually thought of as being directly related to the choice of money supply via the quantity theory of money. By contrast in the last two models, since output is demand determined, a change in the rate of interest by affecting demand, also affects output independently of whether inflation is anticipated or not. Furthermore, the effect of policy on inflation in those models is through the effect that policy has on the output gap.

The main conceptual difference between the second and the third model is that in the second the current setting of the policy instrument cannot affect current inflation and the current output gap while in the third model current policy can affect the current values of both variables

by changing current expectations of future variables. Woodford (1999) utilizes this feature of the third model to show that, under an appropriate form of commitment to interest rate inertia, changes in current policy, by changing expectations, have an immediate effect on inflation and the output gap. This is a far cry from the Bank of England view (illustrated by the second model) according to which policy in year t can affect inflation only from year $t+2$ and on.

2.5 Haziness about the meaning of potential or normal output

At the broad conceptual level potential output is meant to capture long term supply determinants of output. But there are several related concept like the natural level of output and the NAIRU (non - accelerating inflation rate of unemployment). At the empirical level those concepts are often operationalized by means of some statistical smoothing procedure like the Hodrick-Prescott (1997) filter.

Are those concepts identical? I believe the answer is not necessarily. Friedman (1968) and subsequent US based Neo - Monetarists like Lucas (1972, 1973) conception of the natural level of employment is the level of employment that is generated by the **real** general equilibrium of the system in the absence of inflationary surprises. Its counterpart in the UK is the NAIRU or the non - accelerating inflation rate of unemployment. Layard, Nickell and Jackman (1991, pp. 14,15) characterize this rate as the rate of unemployment below which inflation is accelerating and above which it is deccelerating.

Although related, Lucas' and Layard et. al. conceptions are not necessarily identical. More importantly both concepts generally differ from potential output since, due to the existence of real business cycles, the gap between actual and potential output may be non zero even when inflation is fully expected and the rate of inflation stable. As a consequence the output gap, x_t from Neo - Keynesian frameworks is not identical to the monetarist deviation, y_t, of actual from natural output. Nor is there a clear relation between the output gap and the deviation of actual output from the NAIRU.

2.6 Implications for model transparency and for accountability

The brief survey of alternative current models of the transmission process presented above illustrates the objective difficulties faced by the contemporary honest central banker. When faced with those and other different conceptions of how the economy works what will he do? It is likely that he is going to intuitively assign some non negative weight to each of the models and to many other bits of information and ideas not surveyed here.

What should he do when asked to be transparent about the economic model he is using to generate forecasts? This is not just an academic but also a practical question. As a matter of fact when recently confronted with such a demand the president of the ECB (Duisenberg) responded by promising to publish, in due time, the forecasts generated by the econometric model of the ECB. Although such an action is desirable it is unlikely to come close to the actual aggregation of information and of models that decision makers at the ECB, the Bank of England or the Fed go through when making monetary policy decisions.

To a large extent the inability of central bankers to be fully transparent about the economic model or models they are using is tied to the proliferation of alternative views of the transmission mechanism within the economic profession. Since central bankers are consumers and not providers of economic models they obviously cannot be faulted for this state of affairs.[11] But the absence of consensus about the "correct" model of the economy endows them with considerable discretion which they can also use to hedge their positions in the face of model uncertainty and of political pressures. It also opens the door for the strategic use of information.[12]

Most contemporary central banks are pretty transparent about their inflation target both in terms of the index used and the numerical target value. There is substantially less transparency about output targets. Even in countries that insist on high levels of transparency like the UK, there is quite a bit of murkiness about the output or employment target that the

[11] One way to bridge the gap between this proliferation of models and practical policymaking is to look for a policy rule that is uniformly best for many models. A recent attempt for two variants of microfounded structural models appears in McCallum and Nelson (1999).

[12] Reflecting on his term in office as Chairman of the Board of the Fed Burns once said that when Keynesians on one side and Monetarists on the other assailed him with diametrically opposite critisisms he found it safe to duck in the middle.

central bank is supposed to attain.

Again a non negligible part of this haziness about the output target is due to (and made possible by) the different concepts of "normal" output surveyed above. Those different conceptions leave substantial leeway for the measurement of potential or natural output leaving room for the reintroduction of discretionary monetary policy through the back door. This is obviously the case whether or not the output target of contemporary central banks is at the natural or the potential level of output or above them.[13]

In the long run, transparency and accountability will be enhanced when better and more accurate models of the ways monetary policy affects the economy become available. The wider implication of this conclusion is that until this happens accountability by means of transparency about the economic models used by decision makers at the CB will be limited. What should be done in the mean time? There is no easy answer to this question. My own view is that, given the current state of economic knowledge, the discharge of accountability should be achieved to a large extent by appointing individuals with high levels of integrity and professional standards as decision makers at the CB, and making sure they have little or no association with particular interest groups.

3 Are new CB transparent about their objectives?

In comparison to past decades there is nowadays substantially more transparency about the main objective of monetary policy. In most contemporary central banks the main **legally mandated** objective of monetary policy is price stability and all other objectives are either non existent (as is nearly the case in the charter of the ECB) or relegated to being (at least legally) a distant second priority (as is the case with the growth and employment objectives in the charter of the Bank of England). This is a substantial increase in transparency in comparison to the eighties and previous decades during which most CB charters featured several conflicting objectives with no clear specification of the subjective tradeoffs among them. Nowadays all explicit inflation targeters even specify a precise numerical value in terms of a well defined index for the target

[13] Staiger, Stock and Watson (1997) show, for the US, that there is substantial uncertainty about the location of the natural rate. Faust and Svensson (2000) show that more *ex post* transparency about the output target of policymakers raises social welfare.

rate of inflation and even the ECB, which is not an explicit inflation targeter, has specified a numerical inflation target for the Euro area.

In spite of those advances there still are non negligible dark spots about the output gap segment of the loss function of modern central banks. For **truly strict** inflation targeters, or inflation nutters, this murkiness is unimportant. Since the output gap is not part of their objectives, transparency about the output gap segment of their loss function is irrelevant. But practically all explicit inflation targeters openly acknowledge that they also care about the output gap, i.e; they are flexible rather than strict inflation targeters. For such banks the features of the output gap segment of the loss function and its importance relatively to achieving the inflation target in each period become relevant. To illustrate consider the following specification of the one period CB loss function;

$$L_t = Af(x_t) + \pi_t^2. \tag{6}$$

When $A = 0$ the CB is a strict inflation targeter so murkiness about $f(x_t)$ does not matter. But when A is positive the CB is a flexible inflation targeter and murkiness about the precise form of the function $f(x_t)$ and the magnitude of the parameter A become important. Following Svensson (1997) I will refer to A as the "flexibility parameter".[14] There is little doubt that all central banks are quite opaque about the parameter A. This is admitted quite candidly in a recent review of the UK experience with inflation targeting by Vickers who notes that the MPC's remit is silent on the parameter A (the full quote and source appear in the latter part of the introduction).

Ironically the lack of transparency about $f(x_t)$ seems to matters the most in countries like the UK which strongly insist on formal transparency and the least in countries like Germany which, judging by the Bundesbank charter, should be classified as a strict inflation targeter. But the matter is not as simple. Recent empirical work by Clarida and Gertler (1997) supports the view that the Bundesbank actually conducted policy in a way that is indistinguishable from

[14]Note that A is the inverse of Rogoff's parameter of CB conservativeness. The terminology in the text is chosen to highlight the fact that, within the context of the present discussion, it determines the degree of flexibility in targeting inflation.

that of a flexible inflation targeter. As a matter of fact the currently emerging consensus seems to be that, whether they admit it or not, all central banks are behaving in a manner that is consistent with flexible inflation targeting. The main difference, on this view, is only whether the bank and its charter admit the "flexible" part openly or not. In terms of the loss function in equation (6) this means that there generally is a lack of transparency with respect to the coefficient A.

How about $f(x_t)$? Available public information on this term is rather scant for two reasons. First neither the CB nor the political authorities have taken the trouble to indicate what it is. Vickers (1998, p. 370), ventures several remarks on the shape of the Bank of England's loss function since 1997 and concludes that, at least as far as inflation is concerned losses are symmetric but remains silent on what the shape of $f(x_t)$ might be. Secondly, as discussed at some length in the previous section there are numerous ambiguities in the definition of potential, normal, natural or NAIRU output. Obviously the output gap that enters into the loss function inherits those ambiguities. In summary existing central banks are generally quite opaque about their output objective, the shape of the function $f(.)$ and the flexibility parameter A.

3.1 The case for asymmetries in CB losses from the output gap

In the absence of solid information about $f(.)$ the academic literature has assumed that $f(.)$ is a quadratic implying that losses from negative and from positive output gaps are the same as long as the absolute value of the gap is the same.[15] But it is hard to see why central bankers, social planners or political authorities would consider, **given inflation**, a positive output gap of a given magnitude to be equivalent to a negative output gap of the same magnitude. A negative output gap means that employment is below the normal level while a positive output gap means employment is above the normal level. While casual observation suggests that policymakers dislike employment below the normal level it does not support the notion that, given inflation, they also dislike employment above the normal level.[16]

[15] From here on I abstract, for simplicity, from the ambiguities in the definition of the output gap and assume that the output target of monetary authorities is equal to a well defined and publicly known measure of "potential or natural output".

[16] Given inflation, some politicians probably even **like** positive output gaps on the view that the higher is output, the better it is. As a matter of fact it is quite likely that the quadratic on the output gap so often used in

Recently this casual empiricism got backing from Blinder after his resignation from the office of Vice Chairman of the Fed. Blinder expressed the view that the Fed takes far more political heat when it tightens preemptively to avoid inflation than when it eases preemptively to avoid unemployment (the precise quote and reference appear in the introduction). To the extent that the CB is not totally indifferent to the priorities of the political establishment this asymmetry is likely to partially affect the Fed's policy choices. Preliminary empirical work by Gerlach (2000) and by Dolado, Maria-Dolores and Naveira (2000) supports this hypothesis for the Fed.[17]

Recent theoretical work by Cukierman (1999) shows that with a Lucas type transmission mechanism, uncertainty about the future state of the economy and asymmetries in the output gap segment of the CB loss function, there will be an inflation bias even if the CB targets the normal level of output. This framework implies that there should be a positive association between the variability of employment over the cycle and the magnitude of the inflation bias. Preliminary cross sectional evidence in Gerlach (2000) supports this implication. Ruge - Murcia (2000) extends the asymmetric loss function proposed by Cukierman ((1999) and uses it to perform a test of the asymmetry hypothesis over time within five countries and finds support for the hypothesis in some countries.

In summary, in spite of the silence of policymakers about the shape of $f(.)$ there seems to be sufficient early indications to warrant a more serious investigation of the consequences of an asymmetric $f(.)$. The remainder of the paper investigates the consequences of this asymmetry for the credibility of monetary policy and related issues.

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the academic literature was chosen mainly for analytical convenience rather than for descriptive realism. In the usual KPBG setup this assumption does not make a difference as long as policymakers do not face uncertainty or are risk neutral since the equilibrium is in the range of negative output gaps in which the quadratic is reasonable. A formulation of the KPBG framework under certainty in which the quadratic is limited to the range of negative output gaps without making any difference for their basic result appears in Cukierman (1992, ch. 3 equation (3.1)). But once it is recognized that policymakers face uncertainty the characteristics of their objective function in the **entire range** of output gaps become important.

[17] However Dolado, Maria-Dolores and Naveira (2000) do not find evidence of assymmetry in losses from the output gap for the Bundesbank, the Banque de France and the Banco de Espana.

4 Is the credibility problem gone when the CB targets the normal level of output?

The discussion in this section is built on two presumptions. First, that contemporary central banks do not attempt to maintain output above its normal or natural level so that there is no credibility problem because of the classical KPBG reasons. In doing that this section takes at face value the statements by Blinder and Vickers and also addresses McCallum's (1995, 1997) critisism of the KPBG conception of the reasons for inflation. It will be recalled that those statements and McCallum's arguments imply that the output target of central bankers is identical to the normal or potential level of output. The second presumption is that the central bank loss function is more sensitive to negative than to positive output gaps. The main result of the section are;

1. The presence of asymmetries in losses from the output gap in conjunction with uncertainty on the part of the CB about the state of the economy induces an inflation bias even when the CB targets potential or natural output.

2.. There is no bias when the CB is a strict inflation stabilizer ($A = 0$).

Those results hold both for a Lucas type, expectations augmented Phillips curve, as well as for many other models including, in particular, a New - Keynesian, sticky, staggered prices, transmission mechanism of the type reviewed in Clarida, Gali and Gertler (1999). But in the second case there is an additional inflationary tendency that arises even when decision makers at the bank are fully informed about the relevant shocks at the time policy choices are made. This section demonstrates the existence of a bias within the framework of a Lucas type expectations augmented Phillips curve (model 1). The next section shows that, besides this bias, there is in New - Keynesian economies (model 3) an additional average inflationary tendency. A third result, which to date I have established only for the Lucas type economy, but which I conjecture is true also in the New - Keynesian framework is;

3. Other things the same the bias is larger the larger the (inflation targeting) flexibility parameter A.

4.1 An asymmetry cum uncertainty inflation bias with a Lucas type transmission mechanism

The results in this subsection draw on Cukierman (1999). Here I briefly present the basic framework, the main result and the intuition underlying it, and move on to discuss its wider implications. For further details and some of the derivations the reader is referred to that article. The asymmetry in CB losses regarding the output gap is modeled by postulating that period's t loss function is given by

$$L_t = \left\{ \begin{array}{c} \frac{1}{2}\left(Ax_t^2 + \pi_t^2\right) \ when \ x_t < 0 \\ \frac{1}{2}\pi_t^2 \ when \ x_t \geq 0 \end{array} \right\} \tag{7}$$

where $x_t \equiv Y_t - Y_{pt}$ is the output gap. This specification of the loss function states that the employment target of policymakers is potential output, and that as long as the output gap is negative the standard quadratic loss function is in effect. But when the output gap is positive or zero policymakers do not incur any losses or gains. The kink at the zero output gap introduces an effect that is analogous to the condition that leads to a precautionary saving motive in the theory of savings and consumption under uncertainty. A basic result from this literature is that there is a precautionary saving motive if and only if marginal utility is convex, ie., the third derivative is positive (Kimball (1990).[18] I shall return to the consequences of this analogy later.

The natural level of output is given by;

$$Y_{nt} = Y_{pt} + \epsilon_t \tag{8}$$

where $\epsilon_t = Y_{nt} - Y_{pt}$ is the output gap in the absence of inflationary surprises. Actual output is given by the expectations augmented Phillips curve in equation (1). For simplicity, ϵ_t is specified as a zero mean stochastic shock to the natural level of output with distribution function $G(\epsilon)$. Inflation is determined both by the choice of monetary policy as well as by the realization of

[18] The kink at zero in equation (7) implies that the marginal **benefit** from higher economic activity is globally convex.

the shock, ϵ_t and is given by the following equation :

$$\pi_t = m_t - \gamma\epsilon_t, \tag{9}$$

where m_t is the rate of inflation planned by the CB and γ is a positive parameter that determines the effect of shocks to employment on inflation. For concreteness I think of ϵ_t as a supply shock so its effect on inflation is negative. But the basic result of this subsection goes through also for the case in which ϵ_t is a demand shock so that γ is negative or when ϵ_t is a combination of supply and demand shocks. Equation (9) states that, given planned inflation, actual inflation is lower the larger is the supply shock to the economy. Provided there is no instrument uncertainty, this formulation is consistent both with cases in which the policy instrument is the interest rate as well as situations in which it is some nominal stock.

I focus on a one shot game with three stages. The sequence of events and the structure of information is as follows. First expectations, $E_{t-1}\pi_t$, are formed and embedded into nominal contracts. In the second stage the CB picks the value of its instrument, m_t. Finally the stochastic real shock to employment, ϵ_t, realizes and determines, along with monetary policy, both employment and inflation. This sequence is illustrated in Figure 1. A crucial element is that, when it chooses the setting of its instrument, the CB is uncertain about the magnitude of the real shock to output. This is *a fortiori* true for the public when they form their expectation.

Figure 1 : The Sequence of Events

1.$E_{t-1}\pi_t$ is formed——>**2**.policy, m_t, chosen——->**3**. ϵ_t realizes——>

The shock, ϵ_t, affects employment directly, as well as indirectly by creating, given monetary policy, unanticipated inflation in a direction that is opposite to the sign of the shock. From equations (1), (8) and (9) the combined marginal impact of the shock on employment is

$$q \equiv 1 - \alpha\gamma. \tag{10}$$

I assume that the direct effect of the shock on employment dominates its indirect effect via unexpected inflation so that q is positive. Substituting equations (1), (8) and (9) into the loss function in equation (7) the expected value of the CB loss function is;

$$\frac{A}{2}\int_{-\infty}^{b(\pi^e-m)}\left[q\epsilon+\alpha(m-\pi^e)\right]^2 dG(\epsilon)+\frac{1}{2}E_{t-1}\left(m-\gamma\varepsilon\right)^2 \tag{11}$$

where $b\equiv\frac{\alpha}{q}, \pi^e\equiv E_{t-1}\pi_t$ and the time index has been suppressed for simplicity Minimization of equation (11) with respect to m yields the following reaction function for the monetary authority

$$m=\frac{1}{1+\alpha^2 AG\left[b(\pi^e-m)\right]}\left[\alpha^2 AG\left[b(\pi^e-m)\right]\pi^e-\alpha Aq\int_{-\infty}^{b(\pi^e-m)}\epsilon dG(\epsilon)\right]. \tag{12}$$

I turn next to expectation formation which occurs at the first stage of the game. Although individuals do not know the realization of ϵ at this stage, they do know its stochastic structure as well as the structure of the economy and of CB objectives. Taking the expected value of inflation conditioned on this information as the operational proxy for the public's rational expectation of inflation and using equation (9), we obtain

$$\pi^e=m=-\alpha Aq\int_{-\infty}^{b(\pi^e-m)}\epsilon dG(\epsilon). \tag{13}$$

In equilibrium both equations (12) and (13) must be satisfied. It follows that $\pi^e-m=0$ so that equation (13) becomes

$$E_{t-1}\pi_t\equiv\pi^e=m=-\alpha Aq\int_{-\infty}^{0}\epsilon dG(\epsilon)=-\alpha AqG(0)E\left[\epsilon\mid\epsilon<0\right]. \tag{14}$$

$G\left[0\right]$ is the probability of a recession. More precisely it is the probability that the realization of the employment shock, ϵ, is lower than the mean of this shock which is zero. $E\left[\epsilon\mid\epsilon<0\right]$ is

the expected value of ϵ conditioned on the economy being in a recession (ϵ negative). Since the probability of a recession is positive and the expected value of ϵ conditioned on the economy being in a recession is negative both planned and expected inflation are positive. Furthermore, in spite of its attempt to reduce the size of recessions the CB has no influence on output which remains at its natural level. Had the CB been committed to a zero rate of monetary expansion output would still be at its natural level. Hence there is an "inflationary bias" on average.

Intuitively, this bias arises because the CB is more sensitive to policy errors in which monetary policy is too tight than to policy errors in which it is too expansionary in conjunction with the fact that it does not have perfect information about the state of the economy. The upshot is that an inflationary bias arises even when the CB targets potential output. This bias arises whenever the CB is more averse to negative than to positive output gaps in conjunction with the fact that it is uncertain about the state of the economy. The second condition is obviously highly realistic and the first one appears to be satisfied for at least some central banks.

Although, like in KPBG the bias arises because of the CB concern (at least in some states of nature) about the output gap, the new bias identified here does not rely on dynamic inconsistency. To see this, note that this bias is present also if the choice of policy in Figure 1 precedes the formation of expectations as long as both the formation of expectations and the choice of policy precede the resolution of uncertainty about the shock, ϵ_t. The origin of the bias resides, instead, in the precautionary behavior of the CB with respect to recessions in a world of uncertainty, in conjunction with the public's awareness of this asymmetry in CB objectives.[19]

4.2 Discussion

The expression for the inflation bias in equation (14) implies that, other things the same, the bias is larger the larger is the variability of natural output. Gerlach (2000) presents preliminary cross sectional evidence suggesting that there is a positive association between the average level of inflation in a country and the variance of its rate of growth.

[19] Obviously, it is not easy to verify expost whether the CB is conducting policy so as to build in a precautionary demand for expansions. As a consequence it is not straightforward to verify a precommittment to conduct policy in a symmetric manner.

Equation (14) also implies that the bias is an increasing function of the flexibility parameter A. Hence the central banks of countries that are more flexible inflation targeters have a more serious credibility problem. Since we saw earlier that transparency concerning the flexibility parameter is generally rather poor, the magnitude of this bias is generally opaque too. But, holding other things the same, it is likely to be higher in countries like the UK than in the Euro area if only because of the fact that the 1997 charter of the Bank of England explicitly mentions growth and employment as objectives for the CB while that of the ECB does not.

Those rather pessimistic conclusions appear to conflict, at first sight, with the remarkable era of price stability that Western Democracies have recently experienced. The "new inflation bias story" presented here is consistent with this observation since it implies that when the probability of recession is low and/or its expected depth mild the bias will be negligible for most values of the flexibility parameter, A. But this observation should also be taken as a warning against over optimism in the long run. In particular, if and when the likelihood of a serious recession increases, the countries of more flexible inflation targeters are likely to experience larger inflationary accelerations.

Let me conclude this discussion with a theoretical remark regarding the analogy between the behavior of policymakers in the "new inflation bias story" presented above and the theory of precautionary savings. The kink at a zero output gap in the loss function in equation (7) implies that the marginal **benefit** from higher economic activity is globally convex. As shown by Kimball (1990) there is a precautionary saving motive if and only if the marginal utility from consumption is convex. Similarly asymmetric preferences with respect to the output gap lead central bankers to "precautionary savings" in economic activity by inflating.[20]

But there is also a crucial difference between the two cases. While the individual consumer "buys" more desired future security by foregoing some current consumption, the central banker does not buy any improvement in economic activity because individuals in the economy undo that by setting their nominal contracts in a way that anticipates this tendency of the central banker.

[20]Incidently, this analogy also implies that there will be a tendency to inflate for **all** assymmetric output gap loss functions in which the marginal benefit of higher economic activity is convex in the level of output. Another specification of an assymmetric output gap loss function that satisfies this requirement appears in Ruge-Murcia (2000).

5 The effects of an asymmetric loss from the output gap in a Neo - Keynesian framework

This section investigates the consequences of an asymmetric objective function as specified in equation (7) when the economic structure is characterized by a Neo - Keynesian transmission mechanism with forward looking pricing of the type given by equations (4) and (5). I abstract, for simplicity, from persistence in the stochastic behavior of the shocks g_t and u_t by assuming that both are zero mean white noise processes

Note first that the mechanism which produces the inflationary bias in the Lucas type transmission mechanism depends mainly on the fact that the objective function is asymmetric in conjunction with the fact that, when it chooses policy, the CB is uncertain about the realization of shocks at the time its policy decision is going to impact the economy. In particular, this type of mechanism will operate within the framework of many transmission processes, including a (linear) Neo - Keynesian transmission process, as long as the CB possesses the loss function in equation (7) and is uncertain about the relevant state of the economy. This intuitive argument is demonstrated rigorously for the New - Keynesian framework in the appendix.

But in the case of the Neo - Keynesian transmission mechanism there is an **additional** mechanism which tends to make inflation even higher. This additional inflationary tendency is directly related to the fact that, due to temporary price stickiness, the CB is able to alter the real rate of interest and through it the level of employment and production. This happens even when the CB is not uncertain about relevant shocks to the economy. The analysis in this subsection focuses on this additional inflation creating mechanism in isolation by assuming that the CB has full information about relevant shocks at the time policy choices are made. In terms of model 3 this means that the CB knows g_t and u_t when it picks period's t interest rate, i_t.

Consider now a CB whose objective is to minimize

$$E_0 \sum_{t=0}^{\infty} \delta^t L_t \tag{15}$$

where δ is the discount factor and L_t is given by equation (7). Since there are no endogenous

state variables, and since future expectations are not affected by current policy the minimization of the objective function in equation (15) is equivalent to period by period minimization.

In each period there are two possible alternative interest rate rules for the CB. If the realization of the cost shock, u_t is such that, given inflationary expectations, the output gap is either positive or zero when inflation is zero, the CB picks the rate of interest that achieves the zero inflation target. In this range the CB behaves as an "inflation nutter" or strict inflation targeter. If the realization of the cost shock, u_t, is such that, given inflationary expectations, the output gap is negative at a zero rate of inflation, the CB faces a tradeoff between its output and its inflation objective. Hence, given inflationary expectations it picks the interest rate that equalizes the marginal loss from inflation to the marginal loss from a negative output gap. In this range the CB behaves as a flexible inflation targeter. Equation (5) implies that at a zero inflation rate

$$\begin{aligned} x_t \geq 0 \;\Leftrightarrow\; u_t + \beta\pi_t^e \leq 0 \;\Longleftrightarrow\; CB\ is\ strict \\ x_t < 0 \;\Leftrightarrow\; u_t + \beta\pi_t^e > 0 \;\Longleftrightarrow\; CB\ is\ flexible \end{aligned} \tag{16}$$

where $\pi_t^e \equiv E_{t-1}\pi_t$. In the first case the CB just picks the nominal rate of interest which achieves the zero inflation target. Equations (4) and (5) imply that in this case the interest rate rule is;[21]

$$i_t^s = \pi_t^e + \frac{1}{\varphi}\left[g_t + x_t^e + \frac{1}{\lambda}(u_t + \beta\pi_t^e)\right] \tag{17}$$

In the second case there is a meaningful intra period tradeoff between the inflation and the output gap targets. Hence the CB picks the nominal interest rate so as to minimize;

$$L_t = \frac{1}{2}\left(Ax_t^2 + \pi_t^2\right) \tag{18}$$

[21] The superscipts "s" and "f" that are attached to i_t indicate that equations (17) and (19) refer to the interest rate rules of strict and flexible inflation targeters respectively.

subject to equation (5). The interest rate rule that emerges in this case is given by;

$$i_t^f = \pi_t^e + \frac{1}{\varphi}\left[g_t + x_t^e + \frac{\lambda}{A+\lambda}(u_t + \beta\pi_t^e)\right]. \tag{19}$$

Comparison of equations (17) and (19) reveals that, for the same realizations of current shocks and the same values of the expected future output gap and inflation, both the nominal and the real, interest rates are lower in the second case. Furthermore, the difference between the two interest rates is larger the larger is the flexibility parameter A. Using equation (17) in the expression for inflation (equation (5)) the rate of inflation in the range $u_t + \beta\pi_t^e > 0$ is given by;

$$\pi_t = \frac{A}{A+\lambda^2}(u_t + \beta\pi_t^e). \tag{20}$$

The rate of inflation does not respond to the demand shock and to the expected future output gap because the full offsetting of those variables improves performance both on the inflation and on the output gap objectives. On the other hand some of the cost shock and of inflationary expectations are allowed to pass through to inflation since, in the case of those variables, there is a tradeoff between the inflation and the output gap objectives. Since, in the range $u_t + \beta\pi_t^e \leq 0$ the CB behaves as a strict inflation targeter, inflation in this range is always at the zero target. Using the interest rate rules for the two ranges in equation (4) and rearranging, the output gaps in the two ranges are given respectively by;

$$\begin{aligned} x_t^s &= -\tfrac{1}{\lambda}(u_t + \beta\pi_t^e) \\ x_t^f &= -\tfrac{\lambda}{A+\lambda^2}(u_t + \beta\pi_t^e). \end{aligned} \tag{21}$$

Thus, in the first range the output gap is always non negative and in the second it is always negative, but not by as much as it would have been in the absence of some output stabilization by the CB.

5.1 Demonstration that expected inflation is positive

Since there is no persistence in shocks and no endogenous state variables the expected value of the rate of inflation is the same for any horizon and is also the same in each period.[22] Thus

$$E_{t-1}\pi_t = E_t\pi_{t+1} = ... \equiv E\pi \equiv \pi^e \tag{22}$$

so the time index attached to the expectation can de deleted. It follows from equation (20), and the fact that in the range $u_t \leq -\beta\pi_t^e$ inflation is zero, that;

$$\pi^e = \int_{-\infty}^{-\beta\pi^e} 0.dF(u) + \int_{-\beta\pi^e}^{\infty} \frac{A}{A+\lambda^2}(u+\beta\pi^e)dF(u) = \frac{A}{A\left[1-\beta(1-F(-\beta\pi^e))\right]+\lambda^2}\int_{-\beta\pi^e}^{\infty} udF(u) \tag{23}$$

where $F(u)$ is the distribution function of u and where, without risk of confusion, the time index has been suppressed since the distribution of u is time invariant. This expression determines the expected rate of inflation, π^e, but only implicitly since π^e also appears on the right hand side of the equation. It is nonetheless possible to establish that expected inflation is positive, even without an explicit solution for it. Note that $\pi^e = -\infty$ cannot be a solution since, for that value of π^e the right hand side of the equation would be zero and the left hand side $-\infty$. Hence $-\beta\pi^e > -\infty$. It follow, since the expected value of u is zero, that the integral on the extreme right hand side of equation (23) is positive establishing that both average and expected inflation are positive.

At first blush one may be tempted to conclude from this finding that there is an inflationary bias. But this is premature since in the present sticky price framework the average positive rate of inflation may also be associated with a higher level of output. It is thus more accurate to refer to it as an "inflationary tendency" rather than an inflationary bias. The following subsection shows that this inflationary tendency is associated with an output gap that

[22] Essentially the no persistence assumption shuts off any adjustment in inflationary expectations in response to changes in exogenous economic conditions.

may be positive on average.

5.2 The average value of the output gap

As was the case with average inflation, since there is no persistence in shocks and no endogenous state variables, the expected value of the output gap is the same for any horizon and is also the same in each period. I will therefore omit the time index and just denote it $x^e \equiv Ex$. Using equation (21);

$$x^e \equiv -\frac{1}{\lambda}\int_{-\infty}^{-\beta\pi^e}(u+\beta\pi^e)dF(u) - \frac{\lambda}{A+\lambda^2}\int_{-\beta\pi^e}^{\infty}(u+\beta\pi^e)dF(u). \tag{24}$$

Expanding and using equation (23), this expression can be shown to equal, after some algebra, to;

$$x^e = \frac{1-\beta}{\lambda}\pi^e \tag{25}$$

Thus (since average inflation is positive) provided $\beta < 1$ the average output gap is positive as well. But if $\beta = 1$ the average output gap is zero. It is therefore important to have an idea about the meaning and magnitude of the parameter β. Gali and Gertler (1999, p. 207) refer to it as the subjective discount factor and provide empirical estimates suggesting that it is about two standard errors below 0.99 which is the typical value used for this parameter in the literature (Op. Cit. footnote 15). Hence existing evidence is not incompatible with the possibility that $1-\beta > 0$. It appears therefore that in a Neo - Keynesian world it is possible to obtain permanent gains in output at the cost of permanently higher average inflation. This obviously violates the long run neutrality of monetary policy and may appear surprising at first sight. To understand the deeper origin of this result it is useful to digress and characterize the behavior of the average values of inflation and of the output gap when the CB is a strict inflation targeter in the entire range of shock realizations.

5.3 Average inflation and output gaps under a strict inflation targeter as a benchmark

In this case the flexibility parameter, A is equal to zero and the interest rate rule in equation (17) applies everywhere. Inserting the condition $A = 0$ into equation (23) and equation (25) we obtain;

$$x^e = \pi^e = 0. \tag{26}$$

Thus, under a strict inflation stabilizer, expected inflation and the expected output gap are both at their zero target values. Inserting equation (26) into equation (17) the interest rate rule of a strict inflation stabilizer is;

$$i_t^s = \pi_t^e + \frac{1}{\varphi}\left[g_t + \frac{1}{\lambda}u_t\right]$$

which implies that the expected value (as well as the average value) of the real interest rate is zero.

5.4 Summary thoughts on the long run non neutrality of the New - Keynesian framework and the implications for transparency

The analysis above suggests that, in a Neo - Keynesian economy, a flexible inflation stabilizer with asymmetric preferences induces more inflation on average, but also more output (at least when $\beta < 1$) than a strict inflation stabilizer. This implies that, contrary to model 1, in such an economy the CB faces (possibly within some restricted range of low rates of inflation) a long run tradeoff between the average level of inflation and the average level of the output gap.[23] The

[23] The qualification restricting the statement to low rates of inflation refers to the possibility that when inflation increases beyond a certain threshold the intervals between price adjustments become shorter. This ultimately pushes β towards one, and eliminates any long run tradeoff between average inflation and the average output gap.

ability to affect output arises because, due to temporarily sticky prices, the CB can influence the real rate by means of the nominal rate of interest.

For a flexible inflation targeter with asymmetric preferences it is desirable to have a positive, rather than a zero, average rate of inflation in order to be able to reduce the magnitude of negative output gaps when such gaps occur. As a consequence the average output gap, which was zero under a strict inflation targeter, becomes positive. It is therefore not quite appropriate to refer to the higher inflation produced by the flexible targeter as a "bias". I refer to it instead as an "inflationary tendency". Ultimately whether the CB or society prefer more inflation and more stabilization of negative output gaps to less inflation and less stabilization of such gaps is a matter of taste.

But, to my knowledge no central bank has ever publicly acknowledged that there might be such a tradeoff. Thus, to the extent that there are at least some central banks with asymmetric preferences they have been remarkably silent and opaque about the tradeoff between output stabilization and inflation and about their attitude to alternative values of the output gap. For example, the public stance taken by most explicit inflation targeters is that there is no relation between the degree of flexibility in targeting inflation and the **average** rate of inflation.

One possible reason for this position is that public acknowledgment of asymmetric attitudes to positive and to negative output gaps may raise inflationary expectations and necessitate a higher average level of real rates which, central banks fear, will depress the average level of output and investment. Such a fear is irrational in the models I have presented since, by the rational expectations assumption, individuals know what the true objectives of the CB are in any case. But once this extreme informational assumption is released for at least some individual price setters in the economy it becomes rational for the CB to de-emphasize institutional factors that might raise inflationary expectations. Simon has been emphasizing cognitive and related limitations on the individual's ability to absorb information for many years.[24] In the presence of such cognitive threshold effects within a sufficiently large fraction of price setters it is rational for central banks to de-emphasize a high flexibility parameter and asymmetric preferences in order to maintain credibility.

[24] A summary view with implications for economics appears in Simon (1992). A recent enlightening discussion of Simon's view for transparency in monetary policy appears in Winkler (2000).

5.5 Implications of degree of flexibility in targeting inflation for real rates of interest

What are the implications for the average value of real rates?. Is it going to be above or below the average value of the real rate under strict inflation targeting? There are two offsetting effects. On one hand, since $\frac{1}{\lambda} > \frac{\lambda}{A+\lambda}$ it follows from a comparison of equations (17) and (19) that, for the **same** shock realizations and expectations the real rate under flexible targeting is always lower than under strict targeting in the range of negative output gaps. This effect tends to make the average value of the real rate under flexible targeting lower than under strict targeting. On the other hand, since inflationary expectations are higher under flexible targeting a higher real rate is needed to achieve a given rate of inflation under flexible than under strict targeting. This effect tends to make the real rate higher under flexible targeting. The final relation between the average level of real rates under strict and under flexible inflation targeting depends, therefore, on the relative strength of those two effects.

6 Concluding remarks

The main messages of the paper can be summarized as follows. First contemporary Western central banks are rather opaque about the economic models they use in reaching policy decisions, as well as about major attributes of their objective functions. Second, although Western central banks have recently been quite precise about their inflation targets, there is substantial haziness about output targets and about the degree of flexibility allowed in targeting inflation.

Third, in a world characterized by uncertainty about the future state of the economy, the shape of the loss function over the **entire** range of inflation and of output gaps shapes policy choices. All central banks have been remarkably silent about that. The paper makes a case for the existence of asymmetric attitudes to positive and to negative output gaps at least for some central banks.[25] It shows, both for sticky and for flex price transmission mechanisms, that in the

[25] Casual observation suggests that most politicians definitely have asymmetric attitudes toward positive and negative output gaps.

During periods of disinflation and attempted buildups of credibility the CB may behave as if it incurrs a higher loss from an upward, than from a downward deviation of inflation from target. Nobay and Peel (1998) analyze the case in which both the inflation and the output gap terms in the loss function of the CB are asymmetric.

presence of such asymmetries and uncertainty about the upcoming state of the economy there is an inflation bias even when the CB targets potential output. The reason is that such central banks are willing to take some higher inflation in order to reduce the risk of unexpectedly deep recession. This effect is analogous to the precautionary saving motive in the theory of savings under uncertainty as generalized by Kimball (1990).

This "new inflation bias" result implies that even if Blinder (1998), Vickers (1998) and McCallum (1995, 1997) are all right in believing that contemporary central banks target potential output, the risks of inflation are not gone. Although, like in KPBG the bias arises because of the CB concern (at least in some states of nature) about the output gap, the new bias **does not** rely on dynamic inconsistency. The origin of the bias resides, instead, in the precautionary behavior of the CB with respect to recessions in a world of uncertainty, in conjunction with the public's awareness of this asymmetry in CB objectives.

Fourth, in sticky price frameworks with forward looking pricing there is, within some range, a long run tradeoff between average inflation and average output. Fifth, theory predicts that central banks with asymmetric preferences will locate at a point along this tradeoff that is characterized by both positive average inflation and a positive output gap. This finding implies that asymmetrically inclined policymakers who believe in sticky prices models of the economy rather than in flex price expectations augmented Phillips curves are inherently more inflationary. But this does not mean they have a larger bias, since their policies also bring, under sufficiently low inflation, a larger level of output.

Following conventional rational expectations' practice, the new inflation bias story presented here assumes that all agents in the economy are perfectly rational and fully aware of what they are doing. Individuals familiar with the decision making process within central banks may argue that most policymakers are not solving an explicit expected utility maximization problem as postulated here. Although it is probably true this observation does not necessarily invalidate the relevance of the new inflation bias result . Policymakers can hedge against deeper than wanted recessions by means of various rules of thumb and institutional arrangements.

The view, currently held by some European central banks, that current monetary policy

My, gut feeling is that, particularly at low inflation, the output gap asymmetry is likely to dominate in the long run.

can affect inflation only in the second year after the implementation of the policy may be thought of as such a built in institutional hedging device mainly against unexpected recessions. This device builds in a "flexible inflation targeting" hedging procedure into the policy process from the outset. The reason is that, given this belief, it would be foolish to immediately attempt to put inflation back on target following, say, a cost shock. But the belief leading to this policy prescription of flexible targeting may be disputed. Woodford (1999) for example as well as many New - Keynesians appear to believe that monetary policy can have an immediate impact on current inflation via expected inflation. It thus is not unreasonable to believe that part of the "two year lag" institutional belief is motivated by hedging behavior in the face of uncertainty and asymmetries in the attitudes of central banks about positive and negative output gaps.

Part of the haziness regarding objectives is understandable in view of the fact that, in New - Keynesian models, inflationary expectations affect current pricing decisions.[26] In particular a flexible inflation targeter with a non negligible flexibility parameter has good reason to appear less flexible than he really is. This may have underlied the traditional historical public position of the Bundesbank according to which it was not concerned about output, as well as a recent observation by Mervyn King from the Bank of England. King's argument is that it is difficult to distinguish, in practice, between strict and flexible inflation targeters since both raise interest rates when inflation and output are above target. I doubt that a strict inflation targeter would have made such a statement. As a matter of fact, central banks with asymmetric output gap concerns have, in view of the new inflation bias result presented here, a credibility reason for not highlighting this fact. By contrast, simple monetary policy games with signalling imply that a strict inflation targeter would like to send messages that would make his identity clear to the public.[27] Such a "type" is unlikely to claim that it is not possible to distinguish flexible from strict inflation targeters.

Lack of transparency about objectives is probably more easily remedied than lack of transparency about economic models since the former is largely due to lack of consensus about the true model of the economy within the economic profession. It follows that significant ad-

[26] Jensen (2000) shows that in such cases full transparency about objectives is not necessarily desirable.

[27] This is the implication of formal models of monetary policy games with private information. Two simple formulations appear in Vickers (1986) and in Cukierman (2000a).

vances in our understanding of the channels of monetary policy are likely to substantially raise the transparency about models used and with it the accountability of central banks.

During the second part of the nineties many Western economies experienced remarkably low rates of inflation. Particularly striking is the experience of the US, in which inflation was quite low in spite of the powerful and persistent expansion it went through during the last decade. Is this all due to the higher independence of central banks and a stronger focus on price stability? It is likely that this is part of the explanation, but not the whole story. This paper suggests an additional possibility. Believing that the probability of recession is low, those banks behaved nearly as strict inflation targeters would have. This conjecture is supported by the fact that inflation was low also in countries whose central banks are flexible inflation targeters (with possibly asymmetric preferences). If correct, this conjecture also implies that when the fears of recession increase again, inflation may take off as the (currently latent new inflationary bias) of those banks comes back into being.

Finally, to maintain the paper within managable proportions I deliberately avoided a systematic discussion of two important questions. Is full transparency feasible and is it always desirable?. The answer to the first question is likely to be "no" as suggested by Vickers (1998) and Winkler (2000). This still leaves open a question about whether it is desirable to extend transparency as far as the feasibility constraints would allow. The answer to this question is by no means clear cut. Recent arguments for and against doing that appear in Faust and Svensson (2000), Geraats (1999), Jensen (2000), Cukierman (2000b), and are partially summarized in the last paper. Fuller understanding of the benefits and costs of transparency must await further economic outcomes as well as academic work.

7 Appendix

7.1 Demonstration that uncertainty cum asymmetry of objectives produce a bias in the New - Keynesian framework

Substituting equation (4) into equation (5) and solving for the interest rate;

$$i_t = \frac{1}{\lambda\varphi}\left(-\pi_t + (\lambda\varphi+\beta)\pi_t^e + \lambda x_t^e + \lambda g_t + u_t\right). \tag{27}$$

Substituting equation (27) into equation (4) and rearranging

$$x_t \equiv Y_t - Y_{pt} = \frac{1}{\lambda}\left(\pi_t - (\lambda\varphi+\beta)\pi_t^e - u_t\right) \tag{28}$$

which states that, given expectations and the realization of the shock u_t the output gap is larger the larger the rate of inflation. Since, as far as the inflation part of the loss function is concerned, certainty equivalence holds it is possible to view inflation, rather than the nominal rate of interest, as the instrument under the control of policymakers. Viewed in this way equation (28) implies that if policymakers desire to reduce a negative output gap they must accept a higher rate of inflation.

Since there are no endogenous state variables and no persistence in shocks the minimization problem in equation (15) reduces to a series of one period minimization problems and the expected values of inflation and of the output gap are time invariant. I shall, therefore, omit time indices from now on. Equation (7) implies that, in each period, the form of the loss function depends on whether the output gap is negative or not. Equation (28) implies that the output gap is negative if and only if

$$x = \frac{1}{\lambda}\left(\pi - (\lambda\varphi+\beta)\pi^e - u\right) < 0 \tag{29}$$

which is equivalent to

$$u > \pi - (\lambda\varphi + \beta)\pi^e \equiv \pi - k\pi^e. \tag{30}$$

In this case the loss is given by the first line in equation (7), and otherwise it is given by the second line in that equation. Substituting (29) into equation (7), the typical one period, time invariant, minimization problem is to choose π so as to minimize the following expression;

$$\frac{A}{2\lambda^2}\int_{\pi-k\pi^e}^{\infty}(\pi - k\pi^e - u)^2\, dF(u) + \frac{1}{2}E\pi^2 \tag{31}$$

where $F(u)$ is the density function of u and E is the expected value operator. Here π should be understood as the rate of inflation **planned** by the CB since actual inflation also depends on the shock realizations which are unknown at the time the interest rate and, consequently, planned inflation are chosen. Differentiating with respect to π and rearranging yields the following policy reaction function for the rate of inflation planned by the CB;

$$\pi = \frac{Ak(1 - F(u))\pi^e + A\int_{\pi-k\pi^e}^{\infty} u dF(u)}{\lambda^2 + A(1 - F(u))}. \tag{32}$$

Dynamic stability requires that the coefficient which characterizes the response of actual inflation to expected inflation in that equation is smaller than one. There are two possible cases. If $1 - k \equiv 1 - (\lambda\varphi + \beta) > 0$ dynamic stability is satisfied for any degree of flexibility in targeting inflation. But if $1 - k < 0$ dynamic stability puts an upper bound on the degree of flexibility in targeting inflation. The precise bound is;

$$A < \frac{\lambda^2}{(1 - F(u)((\lambda\varphi + \beta - 1)}. \tag{33}$$

Note that the bound is more severe the larger is the sensitivity, φ, of the output gap with respect

to the interest rate in comparison to the sensitivity, λ, of inflation with respect to the output gap.

Since individuals understand the *modus operandi* of the CB and have rational expectations, expected inflation, π^e, equal planned inflation π. Using this in equation (32) and rearranging yields;

$$\pi = \pi^e = \frac{A\int_{(1-k)\pi}^{\infty} udF(u)}{\lambda^2 + A(1-F(u))\,(1-(\lambda\varphi+\beta))}. \tag{34}$$

The dynamic stability condition in equation (33) implies that the denominator of equation (34) is positive. Unless $(1-k)\pi$ is equal to minus infinity the numerator is positive too since the expected value of u (calculated over the entire range from minus to plus infinity) is zero. But $(1-k)\pi$ cannot equal minus infinity since this violates equation (34). Hence both the numerator and the denominator of equation (34) are positive implying that average and expected inflation are positive. QED

8 References

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