Working Paper

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IT Framework Design Parameters

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Research Department

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Abstract

This is the third chapter of a forthcoming monograph entitled "On Implementing Full-Fledged Inflation-Targeting Regimes: Saying What You Do and Doing What You Say." It examines a number of elements in the design of an inflation-targeting framework. These include the definition of the target variable, the relevance of core measures of inflation, and the advantages and disadvantages of point targets, point targets with a band, and range targets. It then discusses the choice of a long-term inflation rate, the target horizon, and the policy horizon.

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I.   Introduction

The organization of an IT framework requires decisions about a number of key design parameters. These include: (1) the definition of the target variable; (2) the use of measures of core inflation; (3) the use of a point target (with or without a band) or a range target; (4) the choice of the numerical value for the long-run inflation target; (5) the target horizon; and (6) the policy horizon, which is based on the loss function in combination with the structure of the economy.

The design parameters have become more sophisticated over time as experience has been gained with different versions of the IT framework. Initially, descriptions and explanations of the design parameters were relatively simplistic, which created communication problems and potential confusion. For example, it was not uncommon for many observers to conclude that IT central banks had a fixed policy horizon for bringing inflation back to the target and in fact some observers described this as a fundamental difference between IT frameworks and other flexible exchange rate regimes—see Truman (2003). This was unfortunate, because in practice the policy horizon has never been fixed in IT central banks, but has depended on the type and persistence of the shocks that they have faced. In addition, some observers have had the impression that IT central banks try to keep inflation inside their bands all the time. While this might be desirable in a world without significant shocks, it is important to understand that good monetary policy will be associated with inflation moving outside the bands from time to time. Several of these types of communication problems have been overcome recently by central banks publishing medium-term forecasts with explicit confidence bands that include endogenous paths for the policy interest rate and the output gap, and/or being more explicit in their descriptions of the outlook for economic and inflation developments and their implications for policy actions over the policy horizon.

II.   Definition of The Target Variable

The options available are the CPI (or some variant) or a broader measure, such as the GDP deflator. The CPI is the most widely understood and recognized measure of inflation. It is available relatively frequently. And it is typically not revised. The fact that the total CPI represents the cost of the bundle of goods and services consumed by an average urban family enhances its meaningfulness as the official target measure for the general public and contributes to the ability of the central bank to communicate its messages.

CPI inflation typically suffers from an upward bias, on the order of one half to one percentage point in industrialized countries. There are a number of sources for this bias—base (or Laspeyres) weighting, imperfect adjustment for quality changes, delays in introducing new goods into the index, outlet substitution over time, and in some cases a formula bias. The bias in measuring the CPI is one of the reasons why central banks target a positive value for

inflation rather than zero.[2]

Some commentators have challenged the use of the CPI in IT because it refers only to the prices of currently produced goods and services and ignores future prices.[3] They argue that some weight should be given to asset prices, which contain (discounted) information about the future prices of goods and services. To this there are three responses. First, central banks do not target the current CPI inflation, but rather expected future inflation. Second, asset prices are a very imperfect indicator of future goods and service prices. And third, the volatility of asset prices is sufficiently great that including anything more than a very small weight on them in the target variable would result in very volatile instrument settings.[4]

Roger and Stone (2005) find that all inflation targeting countries have used the CPI or one of its variants as the target for policy.

III.   Core Inflation

There have been differences across central banks about whether to use total CPI or some measure of core CPI as the official target. In favor of using some measure of core CPI is the volatility of the total CPI measure and the desire on the part of central banks to downplay short-term fluctuations in certain components of the CPI, such as food prices and energy prices, as well as one-off changes in the overall price level resulting, for example, from changes in the VAT rate or long-lasting level changes in energy prices. Core measures help the central bank to communicate developments in trend inflation and downplay temporary volatility in inflation measures.

According to Roger and Stone (2005), the great majority of IT countries use the total CPI (sometimes called the headline CPI) as their target measure, and only a very small number of IT countries use a core CPI measure as the official target of policy.

The main problem with the core measure is the difficulty in communicating to the public why the central bank is focusing on a measure that excludes a considerable proportion of the typical family budget. This is particularly important in emerging economies, where food typically has a significantly greater weight in the CPI than in industrialized countries.

One way of combining the advantages of both measures is to treat total CPI as the official target and core CPI as an operational guide to policy. Implicit in this approach is the idea that

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[2]Other possible reasons are concerns about wage or price stickiness, the zero lower bound on nominal interest rates, and the perceived high cost of deflation.

[3]See, for example, Alchian and Klein (1973) and Goodhart (1995).

[4]A related issue, which has occasioned considerable debate in the literature, is whether some measure of asset prices should be included in the central bank's reaction function.

transitory movements of the CPI inflation rate will normally not affect expectations of future inflation.[5] The approach has considerable benefits. It helps the public and financial markets to see through short-term fluctuations in volatile components of the CPI. And, empirically, core inflation may be a better predictor of future total CPI than current total CPI. Its main drawback is that it may be hard to communicate the roles of the two measures to the public and to journalists.

There are a variety of core inflation measures that can be used by central banks. Some involve removing certain volatile components from the CPI, for example the CPI excluding food and energy and the CPI excluding mortgage interest costs. Other such measures remove one-off changes in the CPI that affect the level of the CPI permanently but are assumed to affect the rate of inflation only temporarily. An example is the CPI excluding indirect taxes. The CPI excluding food, energy, and indirect taxes combines the two features. In a somewhat different approach to estimating core inflation, the core measure removes components that are defined by their empirical volatility rather than by their type. For example, the trimmed mean excludes a certain proportion of the CPI components that are most volatile and does not try to identify them ex ante by their nature. A related measure weights components by their volatility. Thus, rather than excluding a component because of its volatility, it can be included in the core measure but with a weight that varies inversely with its volatility.

Typically, central banks using core inflation as a guide to policy will focus mainly on one particular measure in their communications. Nonetheless, in making policy, they will also examine a number of other measures of core inflation to ensure that the preferred measure, on which the most attention is being focused, is not giving a misleading picture of overall inflation developments.

IV. Point Target, Point Target with Band, and Range Target

While the terminology differs in the literature, for our purposes we will define a point target without a band to be a single quantitative number (e.g., 2%), a point target with a band to be a number plus or minus an uncertainty interval (e.g., 2% +/- 1%), and a range target to be an interval without a single quantitative central number (e.g., 1% to 3%).

The choice of point versus range is not very significant in the broader scheme of things. What is important is how the chosen arrangement is interpreted. (1) On most occasions monetary policy should treat movements of inflation above and below the point target or the center of

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[5]If this were not the case in a particular situation, such transitory movements would show up in core inflation in the future and would require the central bank to adjust the policy interest rate. If transitory changes in the CPI frequently or always resulted in a corresponding movement in inflation expectations, core inflation would not be a good leading indicator of future inflation, and hence would not be a useful guide to policy or a useful communications device.

the target range symmetrically.[6] (2) If the central bank adopts a band or a range, it should make it clear that it expects to be within the band or range most of the time, but not all of the time. That is, the band or range is like a confidence interval in which outcomes are expected to fall, say, two thirds of the time. (3) A band around the point target or a target range should not be treated as hard-edged. That is, the movement of inflation to the boundaries of the range or band should not be treated as requiring an exceptionally strong interest rate response.

What are the advantages and disadvantages of a range or band interval? It helps to communicate where the central bank expects to be most (but not all) of the time.[7] The interval helps to emphasize the symmetry of response. However, the evidence suggests that an interval may be less effective than a point target in focusing inflation expectations over the medium to long term. Indeed, recent evidence shows that long-term inflation expectations have become better anchored in inflation-targeting countries that have a well-defined point target for inflation and have established a track record achieving results. Using data on consensus inflation forecasts from Consensus Economics, Levin, Natalucci, and Piger (2004) show that long-term inflation expectations (6 to10 years in the future) for a group of five inflation-targeting countries (Australia, Canada, New Zealand, Sweden, and the United Kingdom) have become delinked from actual inflation outcomes, while they still respond to actual outcomes in the United States and the euro area, two economies that are viewed as targeting low inflation but which do not have a point target. They also point out that in emerging market economies a target point "appears to be more effective in focalizing inflation expectations" than a target range.[8] Similar findings were obtained by Gürkaynak, Sack, and Swanson (2005), who argue there is "excessive" volatility in the forward-yield curve in the United States because the Federal Reserve does not have a numerical objective for inflation to help tie down long-term inflation expectations. In particular, Gürkaynak, Sack, and Swanson show that long-term forward yields in the United States respond "excessively" to economic news, including surprises in the Federal Reserve's long-term inflation objectives. To contrast their results with an inflation-targeting country, Gürkaynak, Sack, and Swanson show that such "excess" sensitivity in long-term inflation expectations does not exist in the United Kingdom after the change in its regime in May 1997, which specified a 2.5 percentage point target for inflation and assigned instrument independence to the Bank of England. Indeed, following the changes in the United Kingdom's monetary arrangements in May 1997, there

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[6]There are two possible exceptions to symmetry. One is in the early period of IT when it is important for the inflation rate to be at or below the target rate (i.e., asymmetric in the downward direction) in order to establish the credibility of the new monetary policy regime. The other is when the inflation rate is getting close to zero and there is concern about the constraints on policy interest rates of the zero lower bound. In this case, there can be asymmetry in the upper direction.

[7]The same result can, however, be accomplished by publishing fan charts of the forecast of future inflation—their center converges to the point target over the policy horizon, while the fan portrays the uncertainty associated with the forecast.

[8]Goretti and Laxton (2005) apply the same methodology to a data set for emerging-market economies and find that long-term inflation expectations have become much better anchored in IT countries relative to a group of non-IT emerging-market economies.

was a dramatic reduction in long-term inflation expectations—see Figure 1.[9] Thus, the point target may be better at reducing long-run inflation uncertainty.

Figure 1: UK Inflation Expectations 10 Years Ahead

United Kingdom: Inflation Expectations 10 Years Ahead
(In percent)
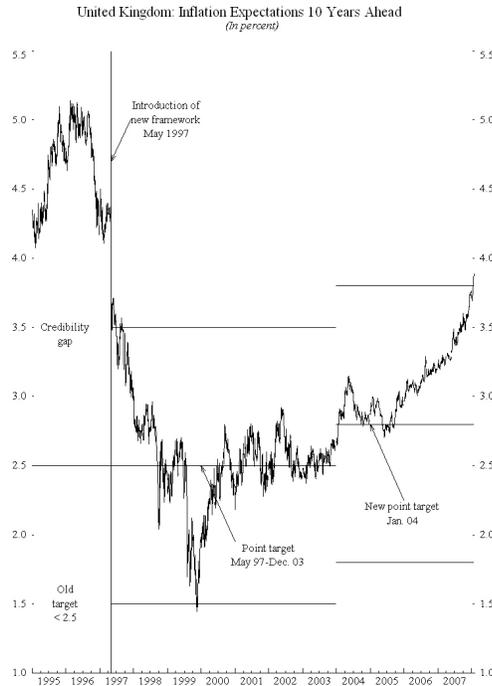
If the central bank adopts a target band or target range, it should be thought of as an interval of uncertainty, not an interval of indifference. Thus, for example, with a 1% to 3% band or range, the central bank should make it clear that it wants to be near 2% and that it is less comfortable as the rate of inflation rises toward 3% or falls toward 1% than when the rate is near 2%.

In contrast to this view of the appropriate way to interpret a range, the Reserve Bank of South Africa has announced itself comfortable with inflation results that fall anywhere in the 3% to 6% range that it has chosen.[10] This approach increases the likelihood of inflation moving away from the center of the range because the central bank is seen as less willing to act as long as inflation remains within the range. It also raises questions about how the staff should model the central bank reaction function in providing advice to senior management.

If the central bank does treat the range as an interval of uncertainty rather than a range of

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[9]The point target was revised in January 2004 and is now expressed in terms of the Harmonized Index of Consumer Prices (HICP), which has been set at 2.0%. The Bank of England reported at the time that this would be consistent with a target of 2.8% expressed in terms of the Retail Price Index (RPI), which was the index previously used as its target and is the index used in indexed bonds.

[10]See Section 4.5 of the announcement of the IT framework by the Reserve Bank of South Africa (2000).

tolerance, but it is anticipated that the public and/or the markets will have difficulty understanding that the central bank is not equally happy with inflation at all points within the target range, the authorities should opt for a point target with or without a band. Also, if there is a concern that MPC members might not agree on the use of the center of the range as the objective of policy, with some wanting to use changes in the policy interest rate to hit the top of the range, others focusing on the center, and yet others on the bottom of the range, the central bank would do better to use a point target, with or without a band, than a range target.

Some central banks, such as the Bank of England and the Central Bank of Turkey, use a point target plus the requirement for an open letter when inflation moves a prescribed distance from the point target. This is similar to the use of a point target plus a band in focusing attention upon the central target, while also giving an indication of the interval within which inflation is expected to fall a significant proportion of the time.

According to Roger and Stone (2005), almost half of IT central banks use a point with a band, over a third use a range, and the remaining 20 percent use a point without a band (although in some cases the latter have an explicit requirement for an explanation if inflation deviates by a specified amount from the point target). The most common width for a band or a range is +/- 1 %, although some are narrower and a number are larger, with a maximum being a band of +/- 2.5%. Typically, the band or range for the inflation target in industrialized economies tends to be narrow while that in emerging economies tends to be wider.

V. Choice of Long-Term Inflation Rate

IT central banks in most industrialized countries have now settled on a 2% target (with or without a band, where the band is most commonly +/- 1%) or a 1% to 3% target range as the long-run equilibrium. The choice of a positive target rather than a zero target reflects a number of considerations. First, as noted earlier, there is a bias in CPI inflation of most industrialized countries on the order of one half to 1 percentage point. Second, it has been argued that there are disadvantages to choosing a target inflation rate that is too low. These include the possibility of wage stickiness, the zero lower bound for nominal interest rates (which lessens the ability of the central bank to counter negative demand shocks when inflation is very low), and the perceived high cost of deflation. By choosing a positive target for the rate of inflation, it is argued, the possible deleterious effects from these sources would be reduced. While each of these arguments is debatable, it would appear that the perceived benefits of reducing inflation from 2% to, say, 1% are not at present so clear-cut as to obviously outweigh the possible costs of reducing the target to 1%.[11]

Emerging economies typically choose a higher inflation rate than industrialized economies. This might reflect greater difficulties in measuring the CPI (because of data collection

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[11]In some countries, this issue is the subject of an active research initiative. See, for example, Bank of Canada (2006).

problems or more difficulty adjusting for quality changes, for example) or more uncertainty about the flexibility of the economy in the context of a more rapid pace of structural change. If emerging economies aim at having traded goods inflation similar to that in industrialized countries in the long run, their target for CPI inflation would have to be higher than that in the industrialized countries because of their higher relative productivity growth in the traded goods sector and the Balassa-Samuelson effect. Also, as noted in chapter 2, some empirical work suggests that the threshold above which inflation results in lower economic growth might be higher for emerging economies than for industrial economies.

VI.   Target Horizon

The target horizon is the period over which the central bank and/or the government specify the target path for inflation. It differs considerably across countries, with those countries already at their equilibrium typically having a longer horizon than those still on the disinflation path. Indeed, once a country is in its equilibrium situation, it may decide to have an indefinitely long target horizon.

On the disinflation path from moderate levels of inflation, it is important for the central bank to have a multi-year target horizon (for example, at least three years), rather than the shorter horizons that have often been used in some emerging-market economies. The importance of a multi-year horizon showing that the authorities are committed to pursuing the disinflation policy to its conclusion can be critical when the economy is being subjected to supply shocks, which can result in significant and persistent upward revisions in the central bank's inflation forecast and a delay in the expected date that inflation is expected hit the long-term target. Experience suggests that targeting horizons that are too short can be counterproductive and undermine credibility if they do not provide enough time for policy actions to have their effects on the rate of inflation, given the length of the lags between policy actions and the rate of inflation. Roger and Stone (2005) show a wide range of choices by IT countries regarding the target horizon. While disinflating countries typically have finite target horizons, target horizons tend to lengthen, sometimes to indefinite, when inflation stabilizes and a consensus emerges on the value for the optimal long-term inflation target.

VII.   Loss Function and Policy Horizon

The policy horizon is the length of time that it takes inflation to return to the announced long-run target following the combination of a shock and the appropriate monetary policy response. The policy horizon should generally be somewhat longer for countries that are disinflating when credibility is low than for countries that have been successful in anchoring long-term inflation expectations to the long-run target. It may also be longer following a supply shock than a demand shock.

A number of important insights with respect to disinflation paths and responses to demand and supply shocks have been developed using a model based on endogenous policy credibility first proposed by Isard and Laxton (1999) and Isard, Laxton and Eliasson (1999), and later extended by Isard, Laxton and Eliasson (2001), Argov and others (2007) and Alichi and others (2009). The novel feature of recent work using this modeling framework is to derive the optimal interest rate path by minimizing a loss function instead of using a more conventional reaction function approach such as the Taylor rule. The advantage of the loss function approach is that the interest rate path will automatically respond more aggressively when credibility is low and inflation is high, compared to a situation when the central bank has established a track record and been successful in anchoring long-term inflation expectations to the target. The rest of this section uses model-based simulations (taken from Alichi and others, 2008) to illustrate the optimal responses of interest rates and the inflation-forecast path to a supply shock in two types of economy with different levels of credibility.

Equation 1 provides a conventional loss function that penalizes current and future expected deviations from the long-term inflation target ($\pi_t - \pi^*$), the output gap (y_t) and changes in the policy rate ($i_t - i_{t-1}$).

$$L_t = \sum_{j=0}^{\infty} [\Psi_1(\pi_{t+j} - \pi^*)^2 + \Psi_2 y_{t+j}^2 + \Psi_3(i_{t+j} - i_{t+j-1})^2] \tag{1}$$

The choice of weights in the loss function in combination with a model and forecast for the economy will determine the speed at which the inflation forecast moves to the long-run inflation target.

Figure 2 provides an illustrative scenario for the optimal response to supply shocks based on Alichi and others (2009). We subject two types of economy to favorable and unfavorable supply shocks. The first type of economy is assumed to have been conducting monetary policy under a framework of inflation targeting for some period of time and to have already achieved its long-run 2% inflation target. At the time of the supply shocks, it has relatively high credibility of 0.75, its nominal interest rate is at 4% (and its real interest rate is therefore at the equilibrium level of 2%), and it has a positive output gap of 1%. In contrast, at the time of the shocks, the second type of economy has an inflation rate of 8% and has just announced its commitment to the inflation-targeting framework and to a long-run target inflation rate of 3%. It has relatively low initial credibility of 0.25, nominal interest rates are 7%, implying real interest rates of -1% (well below the equilibrium real interest rate of 2.5%), and a positive output gap of 1% (the same as in the first type of economy). The supply shocks take place in period 1.

The two types of economy that are subject to the supply shocks are intended to represent the two types of economy that have had to face commodity price shocks under very different circumstances. The model economy with relatively high credibility represents mainly the advanced, industrialized economies with low inflation, but the category also includes some emerging-market economies that adopted inflation targeting some time ago and have attained a high level of credibility because of their achievement of the long-run inflation target. These

economies were hit with commodity price shocks at a time when their inflation rates were low and their real interest rates were close to neutral. The model economy with relatively low credibility represents the many emerging-market economies that are more vulnerable to the commodity price shocks because at the time of the shocks their rate of inflation was overly high, their real interest rates were well below neutral, and their economy was in excess demand. Although some of them had earlier adopted inflation targeting, they did not have a very long track record delivering low inflation and hence credibility remained low. See Helbling and others (2008) for a detailed discussion of the two types of countries.

The simulations involve one-off, 3 percent positive and negative shocks to the disturbance term in the inflation equation—e.g., an increase in the level of world food prices that is not expected to reverse. The results for the unfavorable (positive) shock for the more credible economy are shown as dots, and the results for the favorable (negative) shock as triangles in the left-hand panels of figure 2. The results for the less credible economy with more problematic initial conditions are shown in the right-hand panels of figure 2.

Begin with the unfavorable supply shock in the more credible economy, which starts at equilibrium for inflation and the real interest rate (although it has a small positive output gap). With 0.75 credibility, the central bank of this economy has to raise the nominal interest rate at the peak only about 2 percentage points relative to its baseline starting point, and to hold it less than 100 basis points above baseline after about a year. There is an appreciation of the domestic currency of just over 1% that lasts for about a year before gradually dissipating. The modest tightening of monetary conditions is sufficient to cause the upward pressure on inflation to start reversing after about a year and to return to baseline (and equilibrium) after about two years, followed by a small undershoot. In the course of bringing about the return to baseline, policy causes the output gap to move into excess supply, but by less than one percentage point. The ability of policy to offset the unfavorable supply shock with relatively little difficulty is the result of the public's inflation expectations being anchored reasonably strongly to the target.

Turning to the favorable supply shock in the more credible economy, we find that interest rates hardly adjust. The reason is that the favorable supply shock puts downward pressure on inflation at a time when the positive initial output gap would otherwise have required an interest rate increase to prevent it from pushing inflation above target.

In the case of an unfavorable supply shock in the less credible economy with more problematic initial conditions, the movements in interest rates, inflation and the output gap are both larger and more prolonged than in the case of the more credible economy. In this situation, the nominal interest rate has to rise from 7% to almost 15% subsequent to the shock. To some extent, the increase in interest rates was needed because of the starting point problem of real interest rates being negative and the output gap being positive. The lack of credibility also plays an important role in that the upward pressure on inflation prevents the credibility stock from increasing as fast as it otherwise would have in the context of the disinflation. Thus, it takes longer for expectations to become more forward-looking and thereby to become more anchored because of the rise in inflation over the first year to almost 10%. The output

gap falls to -3% during the second year and remains below baseline for over six years.

A favorable supply shock clearly has positive benefits for the less credible disinflating economy, allowing it to achieve its new equilibrium with considerably smaller output gaps, lower nominal interest rates, and lower transitional inflation than baseline. Nonetheless, interest rates still have to rise because of problems associated with low real interest rates and excess demand at the time of the shock.

There are a number of lessons that can be drawn from this analysis. The results are in line with the experience of the past two decades in many countries that have moved from high inflation to stable low inflation. In the 1970s and 1980s, unstable inflation expectations in many countries transformed price level shocks—e.g., energy price increases and currency depreciations—into prolonged inflation spirals. Monetary policy contained the problem in the end, but only with very aggressive policy actions and at the cost of a substantial output loss. Since the early 1990s, however, many central banks have re-established a low-inflation environment and monetary policy credibility. In many inflation-targeting countries, the public now has confidence that the low-inflation policy objective will prevail, even after substantial shocks to the price level. This has substantially lessened, and in some cases has virtually eliminated, the second round of price increases.

The difficulty faced by policymakers with respect to an unfavorable supply shock in the less credible economy is that policy has to guard against an inflationary spiral, as the short-run increase in inflation causes the public to expect higher inflation in the future and to lose confidence to some extent in the announced longer-term inflation objective. As a consequence, policy needs to generate considerably higher interest rates, which in turn lead to the opening of an appreciable negative output gap. Thus, policymakers are faced with upward pressure on inflation and downward pressure on output at the same time, resulting in a form of stagflation. As shown in the figure, the loss-minimizing policy calls for a substantial and prolonged increase in the interest rate relative to the base case. In part, the increase is needed to return the real rate of interest to a neutral level; in part, it is needed to contain the pressures on inflation arising from the price shock and, to a much lesser extent, from the initial excess demand. This reaction, and the large appreciation of the exchange rate that accompanies it for a couple of years, does not prevent a prolonged divergence of inflation from the optimal path for disinflation without the shock. The main reasons for this are the adverse, self-reinforcing, impact of the increase in inflation on expectations and credibility, and the lags in response of the output gap to interest rate and exchange rate movements along with the lags of inflation in response to movements in the output gap.

Favorable and unfavorable supply shocks have somewhat more symmetric implications under conditions of high monetary policy credibility than under conditions of low credibility. The asymmetries during the process of inflation reduction and credibility building are no longer present. These contrasts between low and high credibility situations illustrate the dictum by Woodford (2005) about the paramount importance of expectations—"For not only do expectations about monetary policy matter, but at least under current conditions, very little else matters." Thus, in comparing the results with low and high credibility, one can attribute

the major part of the policy problem with an unfavorable supply shock to the weak anchor for inflation expectations.

It is clear that an exogenous price level increase presents a very difficult problem for monetary policy in the absence of well-anchored expectations. An exogenous price level decrease, in contrast, allows for the possibility of inflation declining more rapidly than in the baseline. This appears to suggest the benefits of a policy of "opportunistic disinflation" (Meyer, 1996 and Orphanides and Wilcox, 2002) in which the central bank would wait for favorable supply shocks to occur and then take advantage of them to bring about a less costly disinflation. The strategy also called for a strong reaction to "incipient increases in inflation" or "sustaining the expansion and preventing an acceleration in inflation". However, the opportunistic disinflation model did not take account of endogenous shifts in credibility associated with letting inflation getting stuck at moderate levels. Waiting for favorable supply shocks in the context of the disinflation strategy under imperfect credibility would suffer from a potential loss of credibility in a stochastic setting.

The potential size and duration of the effects of unfavorable supply shocks on the inflation rate, even when policy provides appropriate resistance, is a major reason for avoiding rigid adherence to pre-announced short-run target ranges during a process of disinflation. It would be better for the central bank to set out the baseline disinflation path as a conditional forecast in the absence of shocks, and explain to the public the impact of shocks on the optimal path to the long-run equilibrium. In particular, it would have to explain that an unfavorable supply shock would lead to higher inflation and lower output on the way to the long-run target and a longer time period to arrive at equilibrium.

Under optimal monetary policy with a quadratic loss function, the inflation forecast will not be steered back to the target in a manner consistent with the notion of "smooth landing" but will return to the target faster and consequently may display some undershooting. This property of optimal policy will be consistent with inflation being significantly closer to the target on average over short periods, as periods where inflation is above the target will be followed by periods where inflation is below the target.[12] This provides another reason for making sure that the policy horizon is sufficiently long to show that this undershooting property helps anchor long-term inflation expectations.

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[12]Over short periods, optimal monetary policy of this type will produce inflation outcomes on average that may look as if the central bank cares about the path for the price level.

Figure 2: Responses to Unfavorable and Favorable Supply Shocks (Positive Shock Circle; Negative Shock Triangle)
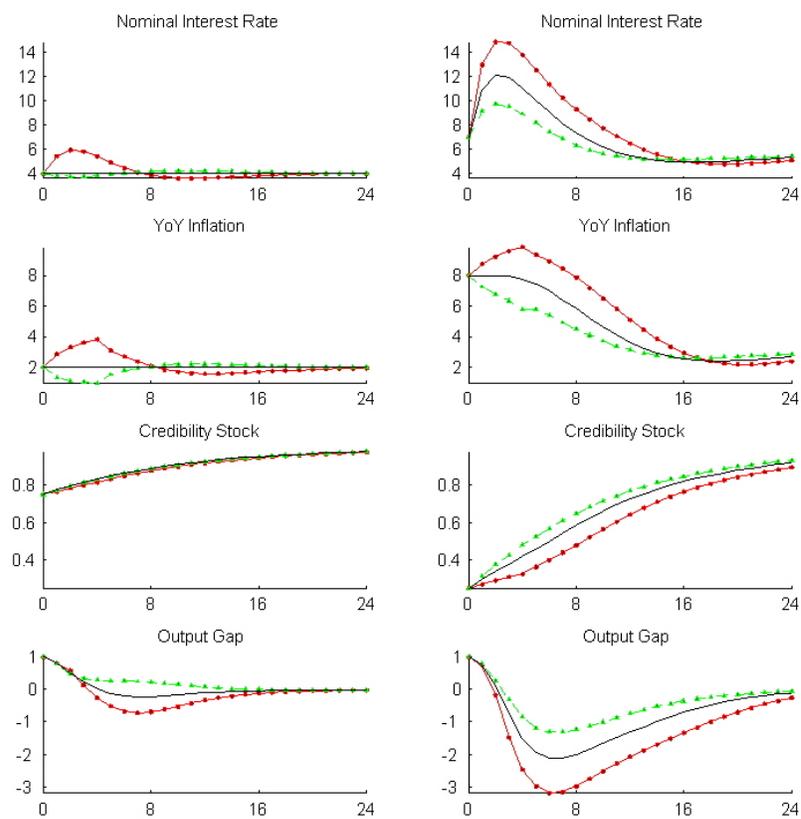
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