THE DOG THAT DIDN'T BARK: HAS INFLATION BEEN MUZZLED OR WAS IT JUST SLEEPING?

"Is there any point to which you would wish to draw my attention?"
"To the curious incident of the dog in the night-time."
"The dog did nothing in the night-time."
"That was the curious incident," remarked Sherlock Holmes.
    Silver Blaze, *Arthur Conan Doyle*

Inflation has been remarkably stable in the wake of the Great Recession even though unemployment has increased significantly. The analysis reported here finds that, over the past decade or so, inflation in advanced economies has become less responsive to changes in economic slack and that longer-term inflation expectations have become more firmly anchored. Thus, the recent stability of inflation is consistent with the prevalence of ongoing economic slack and a more muted response of inflation to cyclical conditions. Looking to the future, our analysis suggests that ongoing monetary accommodation is unlikely to have significant inflationary consequences, as long as inflation expectations remain anchored. In this regard, preserving central banks' independence is key. Notwithstanding this, policymakers must remain alert to possible imbalances that may not be reflected in consumer price inflation.
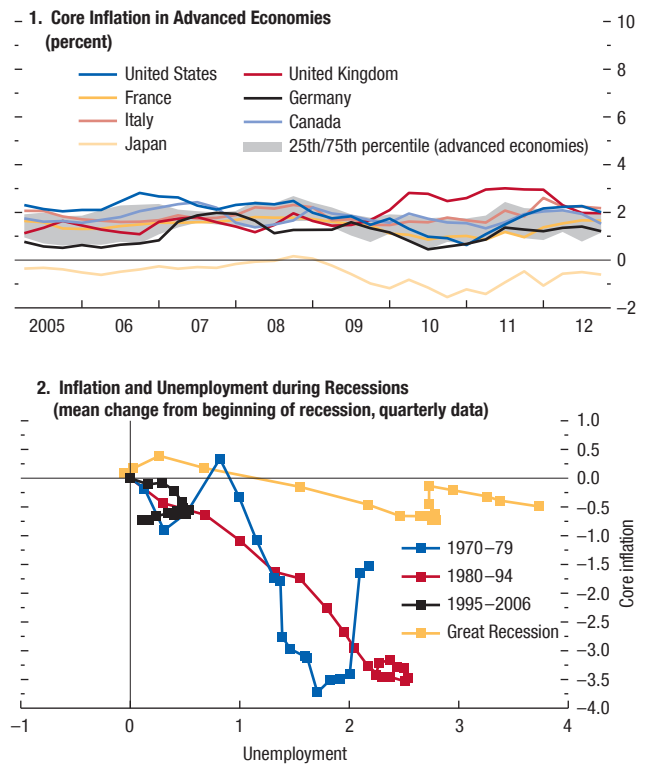
Introduction

Inflation has been remarkably quiet of late. While previous recessions were usually associated with marked declines in inflation, the Great Recession barely made a dent (Figure 3.1). And so, in a curious incident, we find a dog that did not bark. Some have inferred that the failure of inflation to fall is evidence that output gaps are small and that the large increases in unemployment are mostly structural. Thus, they fear that the monetary stimulus already in the pipeline may reduce unemployment, but only at the cost of overheating and a strong increase in inflation—just as during the 1970s. Others have argued that the stability of inflation reflects the success of inflation-targeting central

Figure 3.1. The Behavior of Inflation Has Changed

Despite large rises in unemployment during the Great Recession, inflation has been remarkably stable in almost all advanced economies. This is different from the recessions in the 1970s and 1980s, when inflation fell much more when unemployment rose.

1. Core Inflation in Advanced Economies (percent)

2. Inflation and Unemployment during Recessions (mean change from beginning of recession, quarterly data)

Sources: Organization for Economic Cooperation and Development; and IMF staff calculations.

banks in anchoring inflation expectations and, thus, inflation.

This chapter seeks to grasp, in Sherlock Holmes's words, "the significance of the silence of the dog, for one true inference invariably suggests others." To do this, we use a simple economic framework to interpret some basic summary data on recent developments. This provides some suggestive hints about what may have been going on. We then put the data together in an econometric model that more formally tests the alternative views of what drove inflation in the past and what is driving it now. These tests suggest that inflation has been quiescent recently because expectations have become more anchored and the relationship between cyclical unemployment and inflation has become more muted. We then look to the future and ask what other inferences these findings suggest for inflation. We first assess the implications for the risks, alluded to above, that ongoing monetary stimulus may lead to a strong cyclical increase in inflation. We then consider the possibility that current conditions may be a prelude to stagflation, facilitated by a disanchoring of expectations as occurred during the 1970s. To do this, we consider lessons from the contrasting experiences of the United States and Germany in the 1970s. We conclude by considering the policy implications of our findings.

The Missing Disinflation: Why Didn't Inflation Fall More?

Two broad explanations have been offered for the recent stability of inflation. The first suggests that much of the rise in unemployment during the Great Recession was structural and, consequently, current high levels of unemployment exert less of an influence on wages and prices than in the past.[1] The second suggests that the behavior of inflation has changed and it is now much less volatile and less responsive to changes in economic slack than in the past. We discuss these two hypotheses informally, introduce an economic framework that helps organize the competing explanations, and look at what the data suggest.

The first explanation focuses on the behavior of the labor market. In normal recessions, when many unemployed workers are looking for jobs, inflation tends to be lower since wage pressures are more moderate and

[1]Kocherlakota (2010), for example, expresses this view in the case of the United States.

people have less money to spend. If, however, many of those who are unemployed cannot effectively compete for jobs, they may have much less influence on the wages of those who are employed. This can translate into less influence on the prices firms charge for their goods and services. Such unemployment is termed "structural."

There are certainly reasons for suspecting that many currently unemployed workers could be structurally unemployed. For example, the length of the Great Recession has put long-term unemployment near record levels. And the longer people are out of work, the more likely it is that their skills have faded or become less applicable to the available jobs. Thus, the high levels of long-term unemployment may suggest high levels of structural unemployment.

The second explanation for the stability of inflation focuses on the behavior of inflation more directly. For example, it is argued that the strengthening of central banks' credibility and their success in delivering stable inflation over the past decade have affected the way people think about future inflation. And people's expectations about the future affect inflation today. For example, if prices are expected to increase in the future, workers will demand increased wages today, and those increases will be passed on in the form of higher prices today. Thus, more stable inflation expectations resulting from credible central banks may have contributed to more stable inflation.

The behavior of inflation may also have been affected by central banks' low inflation targets. It has been suggested that at low levels, inflation may become stickier and less responsive to economic fluctuations. For example, workers are very resistant to wage cuts, and this may prevent producers from cutting prices when aggregate demand falls. It has also been suggested that the presence of costs to adjustment in nominal prices (menu costs) leads firms to change prices less frequently when inflation is lower. Similarly, globalization may have made inflation more responsive to global demand developments and less responsive to domestic demand developments.

Framework

Each of these explanations is reflected in the conceptual framework known as the New Keynesian Phillips curve, which focuses on the core issue of interest here—the relationship between inflation and unemployment. Under this framework, inflation, π_t, is

determined by inflation expectations, π_t^e, and the level of cyclical unemployment, $\tilde{u}_t$, according to the following simple equation:

$$\pi_t = \pi_t^e - \kappa\tilde{u}_t, \qquad (3.1)$$

in which κ is a parameter commonly referred to as the slope of the Phillips curve.[2] It captures the strength of the relationship between cyclical unemployment and inflation. Viewed through the lens of this framework, we can then summarize the ideas above as follows. First, inflation may not have fallen much because the increased unemployment was structural and there was minimal change in cyclical unemployment, $\tilde{u}_t$. Second, improved central bank credibility may have made inflation expectations more stable. Finally, the lower level of inflation at the beginning of the Great Recession, or other changes, may account for the reduced inflationary response to cyclical developments—that is, the Phillips curve is flatter than in the past and κ is smaller.

A Look at the Data

Critical elements in thinking about these possibilities are the amount of economic slack in economies today, the anchoring of inflation expectations, and the responsiveness of inflation to economic slack. We begin with the available estimates of economic slack. As shown in Figure 3.2, current estimates from the IMF, Organization for Economic Cooperation and Development (OECD), and national authorities indicate the presence of significant output gaps, suggesting considerable economic slack. A similar picture emerges from a comparison of current and precrisis capacity utilization and unemployment (see Figure 3.2). The OECD and national authorities estimate that capacity utilization decreased by about 5 to 6 percent since the beginning of the Great Recession. The picture is similar in the labor market.[3] Unemployment gaps average about 2 percent, judging by changes in short-term

Figure 3.2. Measures of Current Economic Slack

A wide range of indicators prepared by various institutions suggest that advanced economies are confronting considerable economic slack. This condition is particularly acute in a few countries, as seen in the fact that the cross-country means tend to be above the medians.
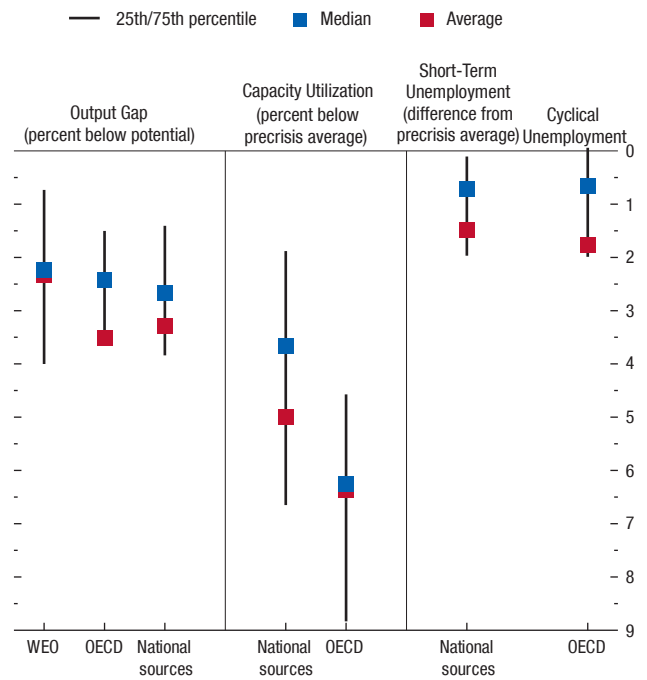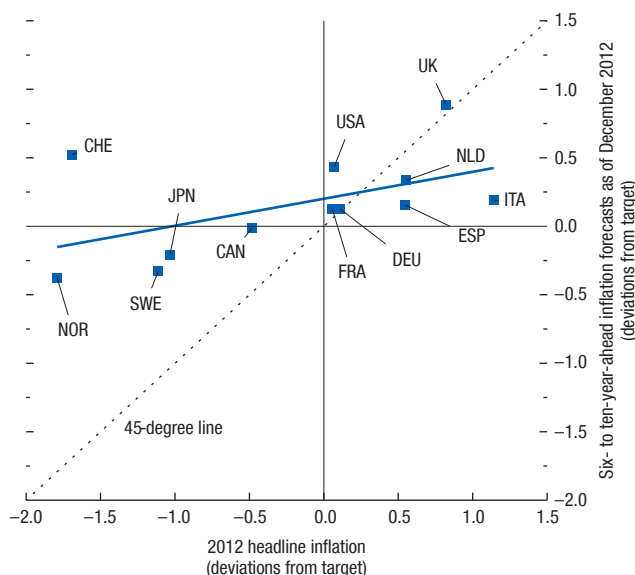

Sources: Haver Analytics; Organization for Economic Cooperation and Development; and IMF staff calculations.
Note: OECD = Organization for Economic Cooperation and Development; WEO = *World Economic Outlook.*

[2]Despite its apparent simplicity, this framework is surprisingly rich and is the workhorse for most work in this area. It can incorporate additional influences, such as import price effects and asset price effects. A number of these elements are introduced in the econometrics below. For a fuller treatment of the New Keynesian theory, see Woodford (2003) and Galí (2008).

[3]The magnitude of the estimates cannot be directly compared across these measures. For example, as documented in Abel and Bernanke (2005), it is fairly standard to assume that output gaps are approximately twice the size of unemployment gaps based on Okun's law.

Figure 3.3. Current Headline Inflation Compared with Expectations

Long-term inflation expectations have remained very close to central banks' targets. This is true even in countries where 2012 inflation was significantly above or below target.

Sources: *Consensus Forecasts;* Organization for Economic Cooperation and Development; and IMF staff calculations.
Note: CAN = Canada; CHE = Switzerland; DEU = Germany; ESP = Spain; FRA = France; ITA = Italy; JPN = Japan; NLD = Netherlands; NOR = Norway; SWE = Sweden; UK = United Kingdom; USA = United States.

unemployment from its precrisis average and OECD estimates of cyclical unemployment, defined as the gap between current unemployment and the nonaccelerating inflation rate of unemployment (NAIRU). This suggests that a considerable share of the increase in unemployment during the Great Recession was cyclical.

A second critical element in exploring recent inflation dynamics is the anchoring of inflation expectations. Figure 3.3 compares long-term inflation expectations with 2012 inflation rates in advanced economies as deviations from central banks' inflation targets.[4] Although current and expected inflation are positively correlated, the low regression slope suggests that expectations are strongly anchored to the central banks' inflation targets rather than being particularly affected by current inflation levels. Indeed, despite wide variations in actual inflation, long-term inflation expectations remain close to targets. This was the case even for Japan, where expectations remained close to the 1 percent target announced in February 2012 despite a prolonged period of deflation.

To further explore the extent to which institutional and behavioral changes in central banks have helped anchor inflation expectations, we estimate the degree of anchoring over time using the following simple regression:

$$\bar{\pi}_t^e - \pi^* = \alpha + \beta(\pi_t - \pi^*) + \varepsilon_t, \quad (3.2)$$

in which $\bar{\pi}_t^e$ is the long-term inflation expectation at a given time, π_t is the inflation rate when inflation expectations are collected, and π^* is the central bank's target level of inflation.

Inflation expectations that are strongly anchored to the inflation target should result in estimates for both α and β that are close to zero. A zero β coefficient implies that expectations are not influenced by the contemporaneous level of inflation, and a zero α means that the inflation expectations are centered at the target level. We ran the regression for 12 advanced economies over five-year rolling windows since 1990, reflecting the available data. The cross-country average

[4]The target is the rate announced by the central bank or the simple average of the announced range (Canada 2 percent, Norway 2.5 percent, Sweden 2 percent, Switzerland 1 percent, and United Kingdom 2 percent). A target of 1.9 percent is used for the countries in the euro area, given that the European Central Bank (ECB) defines price stability as an increase in inflation below, but close to, 2 percent. We use 1 percent for Japan, consistent with the announcement by the Bank of Japan on February 14, 2012. A target of 2 percent was introduced on January 22, 2013. Finally, we use 2 percent for the United States, the rate announced by the Federal Reserve on January 25, 2012.

of the estimates for α and β and the cross-country range of estimated coefficients are plotted in Figure 3.4. The estimates for both coefficients are clearly declining and are currently very close to zero. Inflation expectations have become much more anchored around targets during the past two decades.

Finally, we consider the evidence on the relationship between the level of inflation and the responsiveness of inflation to economic slack. Figure 3.5 shows the relationship between cyclical unemployment and the level of inflation. The figure shows the cross-country means of inflation and cyclical unemployment at quarterly frequencies since 1975, with fitted regression lines during several periods.[5] Broadly speaking, inflation was high in the late 1970s and early 1980s, when the relationship between inflation and unemployment appears relatively steep; it was more muted between 1985 and 1994, when many economies experienced disinflation as central banks started establishing the current targeting regimes; and it was particularly flat after 1995, a period of stable inflation around 2 percent.

This preliminary evidence suggests that economic slack persists and that the recent stability of inflation is indicative of greater anchoring of expectations and a more muted relationship between economic slack and inflation. This, however, is only a tentative observation. To test the robustness and plausibility of this possibility we make use of a formal econometric model.

Econometric Results

Although an initial look at the data suggested some possible explanations for the recent experience—a muted relationship between inflation and unemployment and better anchoring of expectations—they are only tentative and partial. This section examines these explanations to see whether they continue to hold within a formal econometric framework. This approach allows us to find the interpretation of the data that is both internally consistent and statistically most likely.

Based on the framework set out in equation (3.1), we estimate the following unemployment-based Phillips curve:

$$\pi_t = (1 - \vartheta)\pi_{t-1} + \vartheta\pi_t^e - \kappa\hat{u}_t + \gamma\pi_t^m + \varepsilon_t, \qquad (3.3)$$

[5] Cyclical unemployment is computed by subtracting the OECD estimates of the NAIRU from the unemployment rate. The NAIRU is the rate of structural unemployment consistent with no inflation pressure. Because the NAIRU estimates are available only at annual frequencies, we use linear interpolation to generate quarterly values.

Figure 3.4. Rolling Regressions of Inflation Expectations over Actual Inflation
*(Net of inflation target)*

Inflation expectations are now better anchored to targets and respond less to actual changes in inflation. This is shown below in rolling regressions of inflation expectations over actual inflation in deviations from central banks' targets, which reveal that both the intercept α and the slope β have moved closer to zero.
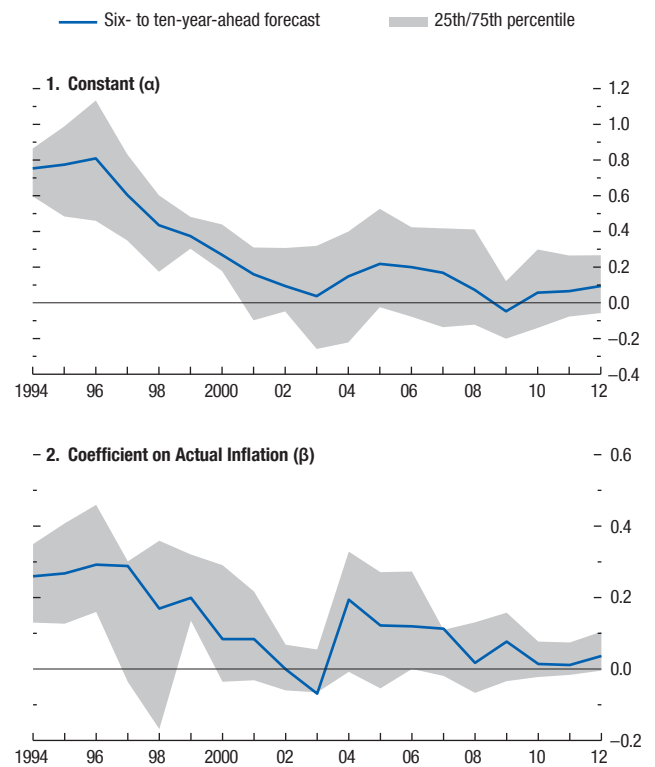
Sources: *Consensus Forecasts;* Organization for Economic Cooperation and Development; and IMF staff calculations.

Figure 3.5. Inflation and Cyclical Unemployment
(Percent; average across advanced economies)

From its peak in the 1970s, the average level of inflation has fallen as a result of central banks' disinflationary policies. What is also noticeable is that the relationship between cyclical unemployment and inflation appears to have moderated as the level has fallen.
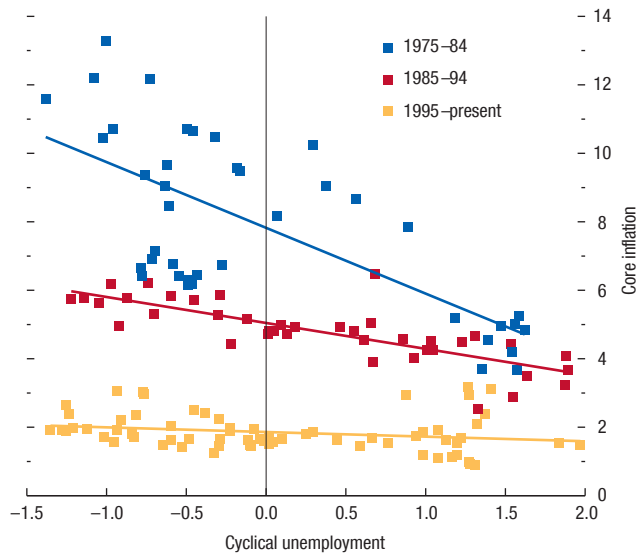
Sources: Organization for Economic Cooperation and Development; and IMF staff calculations.
Note: Each square represents the average across advanced economies of inflation and cyclical unemployment in one quarter.

in which π_t is headline consumer price index inflation, π_t^e is long-term inflation expectations, $\hat{u}_t$ is cyclical unemployment, and π_t^m is inflation in the relative price of imports. Relative to the basic specification in equation (3.1), the estimated equation incorporates two new features that allow for a better characterization of the inflation process. First, we introduce lagged inflation, π_{t-1}, to allow for some inflation persistence. The idea is that when people set wages and prices, they may be incorporating both their expectations about future inflation and the latest actual inflation rate. The parameter ϑ determines the balance between these two factors. Second, we introduce the import price inflation term, π_t^m, for two reasons. First, headline inflation is used to estimate the regression because historical core inflation data are generally not available. But because headline inflation includes many short-term fluctuations caused by commodity price volatility and because commodities are traded internationally, the import price term allows us to capture many of these fluctuations. Second, incorporating import price effects allows us to investigate the contention that globalization makes inflation more dependent on global factors (captured through the import price term) than on domestic factors. The regression equation also allows for transitory shocks; ε_t, which captures fluctuations in inflation that may be driven by temporary supply factors. Furthermore, supply shocks, for example linked to swings in oil prices, are captured by the import inflation term, π_t^m, as well as by changes in the NAIRU that the model internally estimates given constraints we impose on how volatile this term can be. Cyclical unemployment, $\hat{u}_t$, is then derived by subtracting from the unemployment data the estimates of the NAIRU. Asset price effects on inflation are also captured by this term to the extent that they affect aggregate demand. Appendix 3.1 provides technical details of the model.

An important feature of the estimation is that we allow for time variation in all the parameters: ϑ, γ, and κ.[6] This is essential for assessing whether the economy of today differs from the economy of the past. An increase in ϑ implies that current inflation has become more anchored to long-term expectations and is less influenced by past inflation. Given that long-term

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[6]In the past, most work has assumed either that the slope of the Phillips curve was constant over the estimation period or that it was nonlinear in ways that linked the slope to the level of inflation. Our approach encompasses both possibilities without imposing them.

inflation expectations are now more stable than in the past (see Figure 3.4), a higher ϑ would also imply that inflation has become less persistent. Time variation in γ allows for the possibility that inflation is now more dependent on global developments, perhaps because of globalization. Finally, time variation in the parameter κ makes it possible to directly test the hypothesis suggested in Figure 3.5 that the relationship between inflation and unemployment may have become more muted—that is, that the Phillips curve is flatter.

We estimate the model for all advanced economies for which data are available, which produces estimates for 21 countries, usually starting in the 1960s. The results are remarkably consistent across countries (Figure 3.6) and tell a story that confirms the preliminary results:

- *Unemployment gaps have opened in many countries.* Figure 3.6, panel 1, confirms the findings reported in Figure 3.2 that there are unemployment gaps in almost all the countries in the data set. Furthermore, because a number of countries have very large unemployment gaps, the distribution is skewed and the average is above the median.

- *The responsiveness of inflation to unemployment has been gradually declining over the past several decades.* Figure 3.6, panel 2, shows that κ has decreased (that is, the average slope of the Phillips curve has flattened). The interquartile range also demonstrates that this decline occurred throughout the advanced economies in the data set. Furthermore, in results not reported here, there is a correlation between the level of inflation and the slope, as suggested by Figure 3.5. However, the degree of potential nonlinearity is very modest at the rates of inflation observed over the past few decades. We consider some of the implications of a flatter Phillips curve for policy in Box 3.1.

- *The relationship between current and past inflation has weakened over time.* Figure 3.6, panel 3, shows that θ has increased since the 1970s, which means that the persistence of inflation has declined such that deviations of inflation expectations from its long-term trend are more short lived relative to the 1970s—in short, inflation has become more "anchored." Once again, this is a change that has occurred throughout advanced economies.

- *At the aggregate level, the contribution of global inflation to country-specific inflation shows no clear trend.* While we find that, for a number of individual countries, the imported inflation parameter has

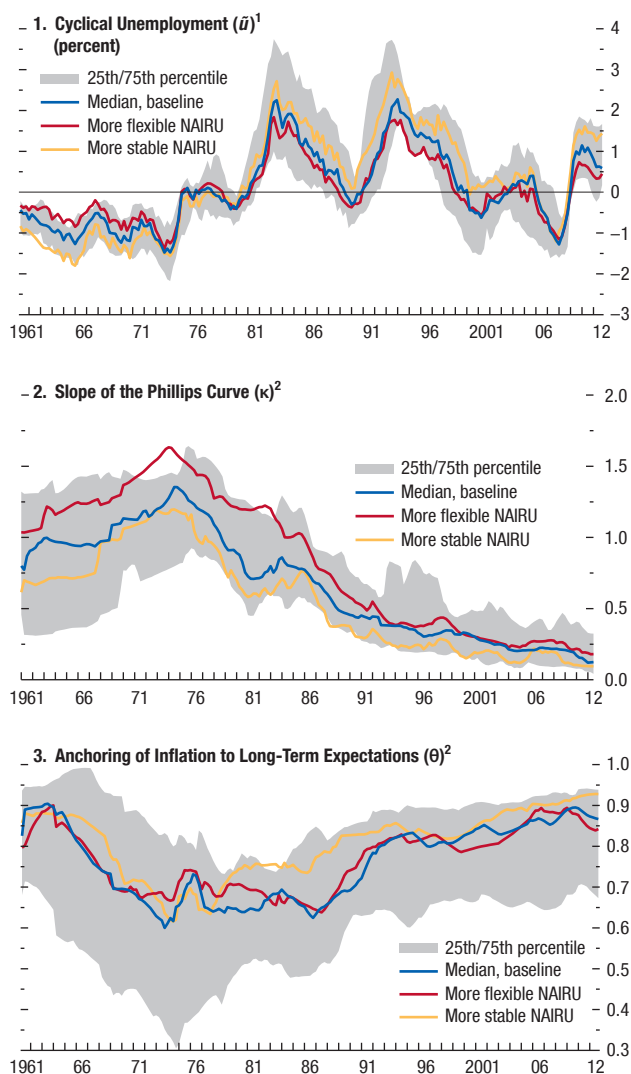**Figure 3.6. Changes in the Inflation Process**

The recent rise in cyclical unemployment is similar to that in previous recessions, although the starting position was lower and there is a significant dispersion across countries. There has been a decline in the responsiveness of inflation to unemployment —that is, the slope of the Phillips curve—and a rise in the anchoring to long-term inflation expectations since the 1970s. There is no clear trend in the importance of import price inflation.
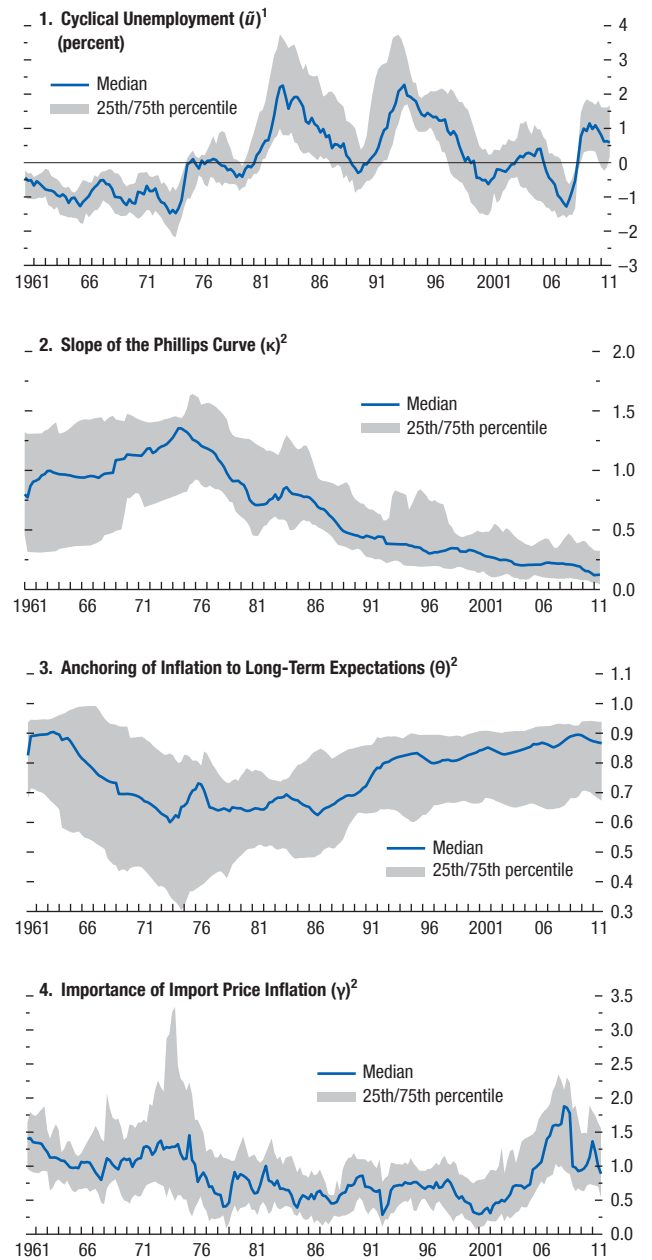
Sources: Board of Governors of the Federal Reserve System; *Consensus Forecasts;* Organization for Economic Cooperation and Development; and IMF staff calculations.
Note: Country sample includes Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and United States.
[1]Unemployment rate minus model-generated estimates of the nonaccelerating inflation rate of unemployment.
[2]See equation (3.3) in the text.

Figure 3.7. Robustness to Alternative Estimates of the NAIRU

Changes to the assumption about the flexibility of the NAIRU leave the core findings unchanged—inflation expectations are more anchored and the Phillips curve is flatter.

1. Cyclical Unemployment ($\bar{u}$)[1]
(percent)

- 25th/75th percentile
- Median, baseline
- More flexible NAIRU
- More stable NAIRU

2. Slope of the Phillips Curve (κ)[2]

- 25th/75th percentile
- Median, baseline
- More flexible NAIRU
- More stable NAIRU

3. Anchoring of Inflation to Long-Term Expectations (θ)[2]

- 25th/75th percentile
- Median, baseline
- More flexible NAIRU
- More stable NAIRU

Sources: Board of Governors of the Federal Reserve System; *Consensus Forecasts;* Organization for Economic Cooperation and Development; and IMF staff calculations.
Note: NAIRU = nonaccelerating inflation rate of unemployment. Country sample includes Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and United States.
[1]Unemployment rate minus model-generated estimates of the NAIRU.
[2]See equation (3.3) in the text.

increased over time, which is consistent with greater import penetration associated with globalization, there is no clear trend in the median (Figure 3.6, panel 4).

These findings are also consistent with much of the earlier research. First, many researchers find evidence that, since the mid-1990s, inflation has become better anchored around long-term expectations, which themselves have become more stable.[7] It is natural to associate this with the simultaneous trends toward more central bank independence and the adoption of inflation-targeting regimes across advanced economies. Second, the observed flattening of the Phillips curve as inflation rates declined is consistent with evidence that there is downward nominal wage rigidity—that is, people are very resistant to nominal wage reductions (Yellen, 2012).

The flattening of the Phillips curve at low levels of inflation may also reflect the fact that there are costs associated with adjusting nominal prices that lead firms to change prices less frequently when inflation is lower (Ball, Mankiw, and Romer, 1988). Cross-country evidence compiled by Klenow and Malin (2010) confirms that firms do change prices less frequently when inflation is lower. As to whether globalization has affected the slope of the Phillips curve, consonant with our findings on the import price parameter, the evidence so far is either inconclusive or negative (Ball, 2006; Gaiotti, 2010).

Importantly, the flattening of the Phillips curves is robust to alternative specifications of the NAIRU. In the estimation procedure, we assume a certain flexibility in the NAIRU, which affects the size of unemployment gaps over time. It is possible that the implied estimates of the unemployment gap are wrong even though they match well with the alternative measures presented in Figure 3.2. To allow for this possibility we test specifications in which the NAIRU is more flexible and more stable than in the baseline. Figure 3.7 shows that this assumption does not materially affect the key findings. Regardless of one's view of the flexibility of the NAIRU and thus the current size of the output gap, the slope of the Phillips curve has fallen over time, and the slope is currently very flat.

These results are, of course, subject to the usual caveats that accompany any econometric work. It is possible that particular variations in the framework,

[7]See, for example, Stock and Watson (2007) and Kuttner and Robinson (2010).

data, or estimation technique could affect the results. Tests of a number of variations in the framework, data, and estimation method yielded results that were broadly unchanged. Nevertheless, the more compelling argument in favor of these results is that they agree both with the descriptive data and with earlier results on individual aspects of the model. That is, the accumulation of evidence points in the same direction—namely, that inflation has been more stable than in the past both because it has become better anchored to stable long-term expectations and because the relationship between inflation and unemployment is much more muted.

To illustrate this finding, Figure 3.8 shows actual inflation in the United States during the Great Recession compared with two predictions. The first prediction (yellow line) uses the latest parameter estimates of the econometric model with a flat Phillips curve and well-anchored inflation. The second path (red line) uses the parameters from the 1970s, when the slope of the Phillips curve was higher and expectations were less well anchored, which predicts deflation following the Great Recession. The absence of deflation can be explained by the changes in the economy and in institutions since the 1970s.

How Much Should We Worry about Inflation?

If the inflation stability during the Great Recession reflects a flat Phillips curve and the anchoring of inflation expectations, there seems little risk of strong inflation pressure during the ongoing recovery. However, there is a risk that inflation could become much more sensitive to output gaps during future periods of expansion. For example, there could be nonlinearities in the Phillips curve: the slope of the curve could be flat when the economy faces cyclical unemployment but steep if unemployment falls below the NAIRU. This concern becomes particularly salient if estimates that suggest there are now large output gaps and high cyclical unemployment (see Figure 3.2) turn out to be wrong. For example, it may be that slower productivity growth and yet-unrecognized structural changes have lowered potential output and raised the NAIRU—just as during the 1970s.

In this respect, there are useful lessons from the experiences of several countries during the early 2000s, when unemployment was below the NAIRU for an extended period but inflation and inflation expectations remained remarkably stable (Figure 3.9). These phenomena were particularly evident in several euro

Figure 3.8. Actual and Predicted Inflation in the United States
*(Percent, year over year)*

If inflation in the U.S. economy behaved as it did during the 1970s, the United States would have experienced significant deflation starting in 2010. The fact that it did not is evidence that the behavior of inflation and its reaction to economic slack have changed. Inflation is now much more stable than in the past. (The large fall in inflation in 2009 reflects the commodity price swing that affected headline inflation in most economies at that time. The contribution from economic slack was relatively minor.)
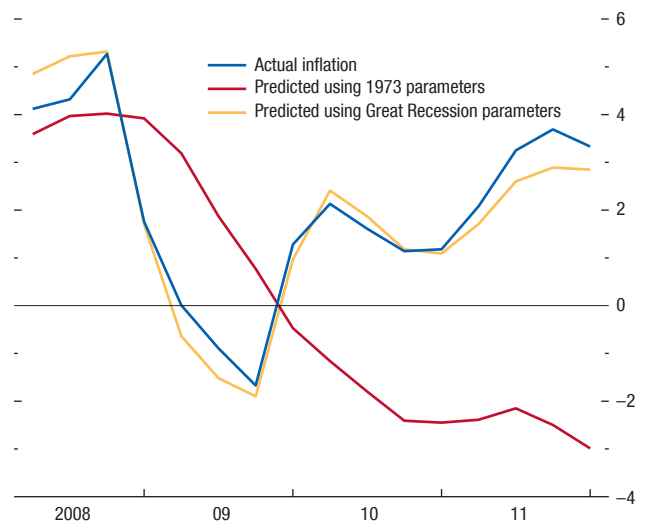
Sources: Board of Governors of the Federal Reserve System; Organization for Economic Cooperation and Development; and IMF staff calculations.

Figure 3.9. Unemployment and Inflation in Selected Economies
(Percent)

Despite unemployment below the NAIRU for about a decade, inflation and inflation expectations remained remarkably stable and well anchored in Ireland, Spain, and the United Kingdom.
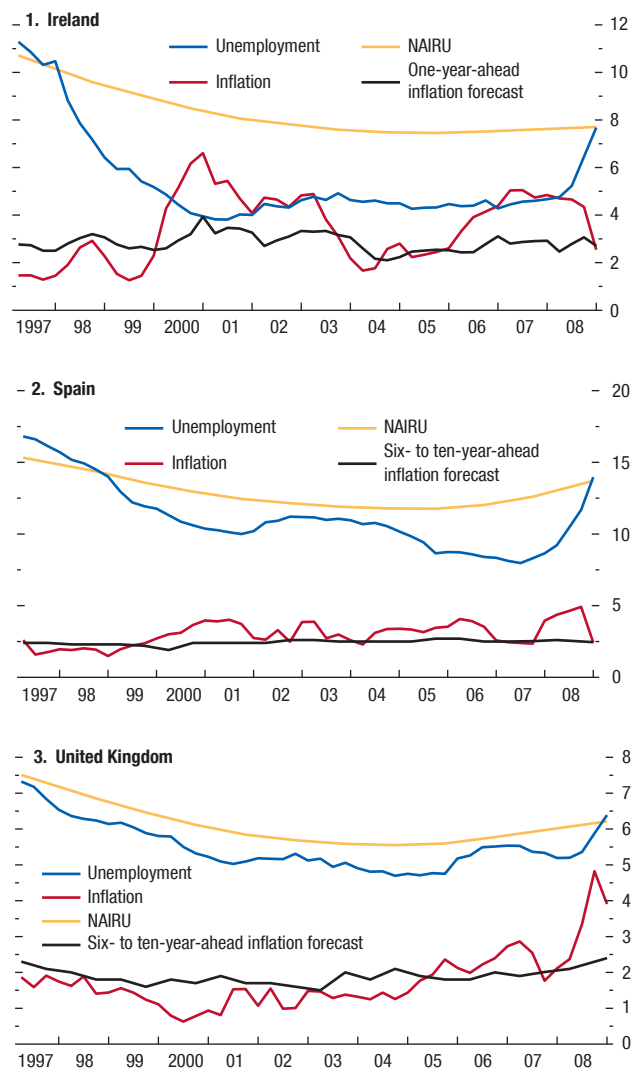
Sources: *Consensus Forecasts;* Organization for Economic Cooperation and Development; and IMF staff calculations.
Note: NAIRU = nonaccelerating inflation rate of unemployment (from Organization for Economic Cooperation and Development).

area countries that entered the monetary union and became subject to ECB monetary policies that were too loose for their particular circumstances. Emblematic cases are Ireland and Spain (Figure 3.9, panels 1 and 2). Despite large reductions in unemployment fueled by inappropriately loose monetary policies, inflation did not rise nearly as much as the experience of the 1970s would suggest.[8] This pattern was not confined to the euro area. The United Kingdom had a similar experience during this period (Figure 3.9, panel 3). Although there was less overheating, there was the same combination of modest inflation pressure and a sustained period of tight capacity. These cases clearly demonstrate that flat Phillips curves are just as applicable to periods of strong growth as to recessions and are readily observable in the economic experiences of the past decade.[9]

An important implication of a flat Phillips curve under both positive and negative unemployment gaps is that the precise determination of the current degree of economic slack is not that important in terms of the consequences for inflation. It is notoriously difficult to estimate potential output and employment in real time. Therefore, even though the indicators presented in Figure 3.2 and our own econometric estimates all suggest continuing slack, we cannot rule out the possibility that advanced economies are much closer to potential. But even in this case, the experiences of the early 2000s suggest that the monetary stimulus in the pipeline is unlikely to generate high inflation because the Phillips curve is likely to remain flat.

Given that the risks from movement along a flat Phillips curve seem modest—and that most economies are still operating with significant output gaps—the greatest risk for inflation, just as in the 1970s, is the possibility that expectations will become disanchored. Even though long-term expectations are currently close to targets and well anchored, our estimates show that

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[8]For example, contemporary analysis of the Spanish economy acknowledged that the monetary policies, set as they were for the whole of the euro area, were inappropriate for Spain. This can be seen, for example, in the IMF Article IV report from 2001: "Even before the November 8 cut in interest rates, monetary conditions were easier than justified from a purely Spanish perspective, the authorities noted." (IMF, 2002)

[9]As mentioned in the discussion of the results, we find some evidence that the slope of the Phillips curve is higher at higher levels of inflation. If we restrict the model such that the slope of the Phillips curve is related to the level of inflation, we find that the nonlinearity is very modest—that is, the slope does not rise appreciably at moderate inflation levels.

the behavior of inflation has changed in the past and may change again in the future.

To assess the risk that inflation expectations will disanchor, we look back to the 1970s—the last time they did. In particular, we contrast the experiences of the United States and Germany. In the 1970s both countries experienced rising unemployment as the rapid growth of the immediate postwar period slowed and the world economy suffered from oil shocks. However, even though inflation kept increasing in the United States, it remained remarkably well anchored in Germany (Figure 3.10). Comparing these two cases yields valuable insights about the factors that can guard against a possible disanchoring today.

Anchoring and Disanchoring in the 1970s

United States: Disanchoring of inflation expectations

U.S. economic policy after World War II was shaped against the vivid memory of the Great Depression. High unemployment and deflation were more feared than inflation. In this climate, inflation pressure built up gradually as policy targeted a "natural rate" of unemployment of about 4 percent—a level achieved only briefly in the late 1960s and today recognized as too low.[10]
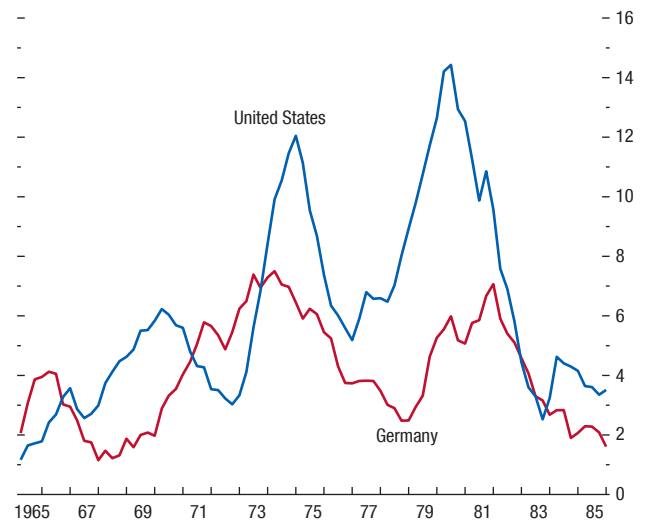
This gradual buildup in inflation has been linked to several factors. First, there was limited under-standing of how to effectively control inflation. The economic approach was initially shaped by simple Keynesian models and the idea of a stable trade-off between unemployment and inflation. Furthermore, some believed that inflation could be managed through wage and price controls, and these were, in fact, used sporadically during the 1970s, including two complete wage and price freezes under President Richard Nixon.[11] One consequence was that there was less use of more effective monetary tools. Second, as Orphanides (2002) argues, there was a mispercep-tion about the sustainable rate of unemployment

Figure 3.10. Headline Inflation in the United States and Germany
(Percent)

Despite facing similar shocks during the 1970s, Germany ended the decade with much lower inflation than the United States. This largely reflects the countries' differing approaches to monetary policy.

Source: Organization for Economic Cooperation and Development.

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[10]Meltzer (2009, p. 2) summarizes it thus: "The principal monetary and financial legacies of the Great Depression were a highly regulated financial system and the Employment Act of 1946, which evolved into a commitment by the government and the Federal Reserve to maintain economic conditions consistent with full employment. The Employment Act was not explicit about full employment and even less explicit about inflation. For much too long, the Federal Reserve and the administration considered a 4 percent unemployment rate to be the equilibrium rate. The Great Inflation changed that."

[11]See, for example, Nelson (2005), who discusses the cases of Australia, Canada, and New Zealand.

and, more generally, the size of the output gap. These errors spurred policies that, in hindsight, were too stimulative.

Another important contributor to the disanchoring of inflation expectations in the United States during the 1970s was the lack of independence of the Federal Reserve (Fed), which stemmed from the lack of social consensus on the appropriate objectives for monetary policy. The Fed's lack of independence and its deference to political interests are evident in Arthur Burns's 1979 Per Jacobsson lecture in which he looked back over his experiences as chairman of the Fed:

> Viewed in the abstract, the Federal Reserve System had the power to abort the inflation at its incipient stage fifteen years ago or at any later point, and it has the power to end it today… It did not do so because the Federal Reserve was itself caught up in the philosophic and political currents that were transforming American life and culture… If the Federal Reserve then sought to create a monetary environment that fell seriously short of accommodating the upward pressures on prices that were being released or reinforced by government action, severe difficulties could be quickly produced in the economy. Not only that, the Federal Reserve would be frustrating the will of Congress to which it was responsible. (Burns, 1979, pp. 15–16)

Throughout this period, increases in inflation and inflation expectations were not reversed and were effectively condoned.[12] Indeed, there was a sense of fatalism about increased inflation. This is expressed by President Jimmy Carter in 1978:

> The human tragedy and waste of resources associated with policies of slow growth are intolerable, and the impact of such policies on the current inflation is very small. (*Economic Report of the President*, 1978, p. 17)[13]

Inflation was finally brought down only when the de facto independence of the Fed was established with the appointment of Paul Volcker in 1979, who made it clear to President Carter that he was "mainly concerned that the president not be under any misunderstanding about my own concern about the importance of an independent central bank and the need for tighter money…" (Volcker and Gyohten, 1992, p. 164). This development reflected a social and political evolution that ranked inflation as a more important

problem than unemployment only toward the end of the 1970s and not at the beginning of the decade.

Germany: Institutional independence and anchoring

German economic policy in the post–World War II era was shaped against the vivid memory of the hyperinflation of the 1920s and the monetary reform of 1948 that wiped out savings. Inflation was feared more than anything else. The Bundesbank, set up as an independent institution by the war powers, fought to maintain this independence in the mid-1950s, when the governing law was rewritten. As reported in 1957:

> President Vocke had incurred the Chancellor's wrath because he pursued a monetary policy that paid scant attention to Konrad Adenauer's amateurish ideas and politically dictated wishes… On such occasions Vocke demonstrated that the Chancellor's power ceased to apply at the gates of the central bank. (*Der Spiegel*, July 17, 1957, pp. 18–20)

Public support for an independent, inflation-fighting central bank ensured that the Bundesbank emerged from this political fight with legal and, more important, practical independence. It wasn't until the end of the 1970s that the United States developed a social aversion to high inflation; Germans required no such persuasion.

However, the Bretton Woods fixed exchange rate system meant that the Bundesbank was constrained in its implementation of monetary policy. The upshot was that Germany ended up importing inflation from the United States throughout the late 1960s and early 1970s (see Figure 3.10). When it regained its independence in 1973 with the abandonment of the Bretton Woods system, the Bundesbank strengthened its reputation for independence and anti-inflation credibility. Its first step was to quickly raise interest rates to about 7 percent. It also looked for ways to anchor expectations. In 1974 it introduced a system of monetary targeting. Moreover, the Bundesbank made pronouncements about the level of "unavoidable inflation," which were gradually ratcheted down, as an additional way to communicate its objectives and manage expectations. Bundesbank Chief Economist Helmut Schlesinger explained the purpose of the targets in 1979:

> But as the monetary target tends to act as a signpost the pressure to exercise cost and price discipline is likely to grow. Indeed, experience even permits the conclusion that the formulation of this target helped bring about a "social consensus" among all groups… (Schlesinger, 1979, p. 308)

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[12]See Levin and Taylor (2010) for a more extensive discussion of this point.

[13]Available at www.presidency.ucsb.edu/economic_reports/1978.pdf.

This framework was, in many ways, the precursor to the "flexible inflation targeting" practiced today by central banks. The ECB's current 2 percent target for inflation descends from the Bundesbank's concept of "unavoidable inflation."

The Bundesbank's success, however, was not based on it being infallible. Its success in hitting the monetary targets was limited—the authorities overshot their point target before moving to a target range in 1979, which it still struggled to hit. Moreover, as demonstrated by Gerberding, Seitz, and Worms (2005), the Bundesbank overestimated the output gap—just as U.S. authorities did. In 1975, the bank calculated the output gap at about 9 percent, whereas ex post estimates put it closer to 1 percent. These overestimations were persistent from 1974 until the mid-1980s.

Nor was the Bundesbank's success based on its being, in the words of Bank of England Governor Mervyn King, an "inflation nutter." The bank did not behave as if it had an inflation-only target but also placed weight on the output gap and cyclical developments.[14] For example, a recession in 1975 led the Bundesbank to so fear weak growth and undershooting its newly introduced monetary targets that it engaged in what is now known as quantitative easing. In a move that stirred considerable controversy, the bank bought government bonds on the secondary market totaling about 4 percent of the outstanding stock, or 1 percent of GDP. More explicitly, in its 1976 and 1977 annual reports the Bundesbank indicated that its goal was "strong economic growth and a further containment of inflation."

During this period, and in common with the Fed, the Bundesbank was also pressured to place greater weight on reducing unemployment. Helmut Schmidt, the minister for economics and finance, famously declared in 1972 that "5 percent inflation is easier to bear than 5 percent unemployment." In addition, as in the United States, government concerns over rising unemployment meant that fiscal policy was relatively loose in the 1970s, with the government running a deficit from 1974 on. The pressure can be seen, for example, in a *Der Spiegel* cover in 1975 that asked, "1.3 million unemployed: Is the Bundesbank to blame?"

[14]Both Clarida and Gertler (1997) and Gerberding, Seitz, and Worms (2005) estimate policy reaction functions for the Bundesbank and conclude that it placed significant weight on short-term objectives such as output stabilization.

Given these "errors" and concerns about unemployment, it may seem surprising that the Bundesbank managed to bring down inflation in the challenging environment of the 1970s. But it did. Through the use of explicit monetary and inflation targets, the authorities managed to anchor expectations. As a truly independent central bank with the flexibility to do what it judged best to achieve its mandate, the Bundesbank outstripped its peers.

Case Study Analysis

The large increase in inflation and the disanchoring of inflation expectations in the United States have been attributed to a variety of factors. Although we cannot rule out the possibility that other factors, including some not mentioned above—such as labor and product market differences—may have contributed to the different inflation dynamics in Germany and the United States, we focus on two that are particularly relevant today. First, the increase in unemployment was for some time erroneously interpreted as cyclical, thus requiring fiscal and monetary support. Second, the Fed was strongly influenced by political pressures to address increasing unemployment. As a result the Fed was reluctant to tighten policies enough to reduce inflation both because it overestimated the amount of economic slack and because such tightening would have involved "unacceptably" high unemployment. As a consequence, inflation expectations were gradually but inexorably disanchored, which eventually led to the stagflation that is a lasting symbol of those times.

The relative importance of these two elements in explaining the disanchoring of expectations is illuminated by a comparison with Germany. The Bundesbank shared many similarities with the Fed: both overestimated the size of the output gap, interpreting the increase in unemployment as mostly cyclical, and both operated within a political context that placed great weight on unemployment. What set them apart was their degree of actual independence. Unlike the Fed, the Bundesbank enjoyed a broad social consensus regarding its primary task of ensuring the stability of the currency.

This independence was reflected in the framework adopted by the Bundesbank, which allowed it to preserve its independence and keep expectations stable without excess tightening. As the case reveals, the Bundesbank's success was not linked to meticulously meeting the monetary targets, which it actually missed

throughout the 1970s, or to focusing on inflation with no regard for output developments. Rather the Bundesbank's success was a reflection of the robust framework it developed, which allowed it to keep longer-term inflation expectations anchored while flexibly responding to shorter-term output shocks.[15] The importance of operational independence has been emphasized in a large body of literature (such as Alesina and Summers, 1993) and is also underscored by the experience of the Fed: once the Fed was free to focus on inflation under chairman Volcker, it also achieved lower inflation and, after a painful recession, lower unemployment.

These experiences offer several valuable lessons for today. First, the similarities between the Bundesbank's approach then and the "flexible inflation targeting" framework used by many central banks today suggest that mistaken estimates of current economic slack seem unlikely, by themselves, to generate a sharp rise in inflation or in inflation expectations. Both the Fed and the Bundesbank overestimated the output gap, but inflation remained under control in Germany while it rose dramatically in the United States. Although it is hard to be definitive, a crucial difference was that the Bundesbank had the operational independence to credibly commit to taking action if inflation was projected to drift away from target. In the United States, the Fed effectively condoned increases in inflation and inflation expectations and thereby ratified them.

Conclusions

The data and case studies presented here suggest some important conclusions. First, the Phillips curve is considerably flatter today than in the past, and the inflation consequences of changes in economic slack are therefore much smaller. Second, inflation expectations are much better anchored now than in the past. Together, these two factors largely explain why the declines in inflation during the Great Recession were small. It also follows that these small declines are consistent with continued economic slack in most advanced economies.

An important policy conclusion is that, as long as inflation expectations remain firmly anchored, fears about high inflation should not prevent monetary authorities from pursuing highly accommodative monetary policy. Indeed the combination of a relatively flat

Phillips curve and strongly anchored inflation expectations implies that any temporary overstimulation of the economy—perhaps stemming from misperception about the size of output gaps—is likely to have only small effects on inflation.

There are two important caveats. First, moderate inflation could induce complacency—and complacency would be a mistake. Although consumer price inflation was well contained in the first decade of the 2000s, many economies experienced rampant asset price inflation, most notably in residential housing. These housing bubbles helped destabilize the global financial system and contributed to the subsequent recession. Therefore, low consumer price inflation does not necessarily equate with a lack of economic imbalances. Policymakers must be alert to signs of growing imbalances and respond with appropriate policies. Furthermore, as discussed in Box 3.1, the muted relationship between inflation and output raises particular challenges for monetary policymaking for which there are no clear solutions.

Second, the comparison of the U.S. and German experiences in the 1970s should serve as an important reminder about the inflation risks arising from political pressure and limited central bank independence. Although a flatter Phillips curve can mitigate the inflationary effects of expansion, history clearly demonstrates the risks associated with curtailing appropriate monetary tightening in response to persistently rising inflation. The end result can be the disanchoring of inflation expectations and stagflation.

In the wake of the Great Recession, there is political urgency to reduce unemployment, as during the 1970s. In addition, the unprecedented growth in central bank balance sheets has been suggested as a possible vector through which central bank independence could be undermined during the recovery.[16] For example, capital losses on large bond holdings could expose central banks to political pressure. Similarly, there are concerns that the stimulative effects of unconventional monetary policies may gather momentum as the recovery strengthens, and these policies may be hard to reverse. We do not analyze these issues here (see Chapter 1). Instead, what our analysis underscores is that, whatever the source, limits on central banks' independence and operational restrictions that limit their flexibility in

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[15]This conclusion is very much in line with the findings of Beyer and others (2009).

[16]See the April 2013 *Global Financial Stability Report* for a discussion of the potential financial stability risks of such actions, which are not addressed here.

responding to evolving challenges can cause problems and must be avoided.

In short, the dog did not bark because the combination of anchored expectations and credible central banks has made inflation move much more slowly than caricatures from the 1970s might suggest—inflation has been muzzled. And, provided central banks remain free to respond appropriately, the dog is likely to remain so.

Appendix 3.1. Econometric Model

An unemployment-based Phillips curve is estimated that allows for time-varying parameters. The Phillips curve is:

$$\pi_t = \theta_t \,\bar{\pi}_t + (1 - \theta_t)\pi_{t-1}^4 - \kappa_t(u_t - u_t^*) + \gamma_t \,\hat{\pi}_t^m + \varepsilon_t^\pi, \tag{3.4}$$

in which π_t is headline consumer price index (CPI) inflation, $\bar{\pi}_t$ is long-term inflation expectations, π_{t-1}^4 is year-over-year headline CPI inflation (lagged one quarter), θ_t is a time-varying parameter, u_t is the unemployment rate, u_t^* is the nonaccelerating inflation rate of unemployment (NAIRU), $\hat{\pi}_t^m$ is inflation in the relative price of imports (deviation from average), and ε_t^π is a cost-push shock. The unemployment gap and the NAIRU are assumed to evolve as follows:

$$(u_t - u_t^*) = \rho(u_{t-1} - u_{t-1}^*) + \varepsilon_t^{(u-u^*)},$$

with

$$u_t^* = u_{t-1}^* + \varepsilon_t^{u^*}. \tag{3.5}$$

The parameters $(\kappa_t, \gamma_t, \theta_t)$ are assumed to be constrained random walks (κ_t and $\gamma_t \geq 0$ and $0 \leq \theta_t \leq 1$), and ρ is assumed to be constant ($0 \leq \rho \leq 1$).

The data are measured at a quarterly frequency and are seasonally adjusted. The relative price of imports is the import-price deflator relative to the GDP deflator. All inflation rates are annualized. Where possible, inflation data have been adjusted for changes in indirect taxes. Sample periods vary across countries, depending on data availability, with most data beginning in the early 1960s. Long-term inflation expectations are six- to ten-year-ahead inflation forecasts from Consensus Economics.[17]

The parameters and shock variances are estimated with maximum likelihood using a constrained, nonlinear Kalman filter. The parameters are initialized using estimates from 10-year rolling regressions using nonlinear least squares, subject to the same constraints described above and with the NAIRU assumed to be fixed in each rolling window. For each country, the variance of demand shocks $\varepsilon_t^{(u-u^*)}$ relative to NAIRU shocks $\varepsilon_t^{u^*}$ is calibrated.

In addition to the robustness check discussed in the main text, the baseline results were found to be qualitatively similar if different estimation methods are used. Various approaches were examined, including rolling regressions (with a variety of rolling-window sizes) and regressions with deterministic trends in the parameters. Likewise, the results are robust to changing the assumptions relating to the stability of long-term inflation expectations.

[17]Long-term inflation expectations for the United States are sourced from the Federal Reserve Board. If data are missing, long-term inflation expectations are estimated using a model similar to that used by Stock and Watson (2007).

Box 3.1. Does Inflation Targeting Still Make Sense with a Flatter Phillips Curve?

This box considers some of the possible implications of a flatter Phillips curve for the conduct of monetary policy. It does not, however, suggest particular solutions—its purpose is merely to review some of the issues currently under debate.

Over the past couple of decades, many central banks have adopted inflation targeting or similar frameworks. These decades, at least until the Great Recession, were also some of the least troubled from a macroeconomic point of view, with stable economic growth and lengthy expansions. Indeed, some have linked the Great Moderation with improvements to monetary policymaking over this period.[1] And the acceptability of these frameworks by the public was certainly helped by their seeming ability to deliver stable inflation, low unemployment, and stable output growth. The Great Recession changed all that.

There are suggestions that, particularly in the current economic circumstances, inflation-targeting frameworks may be less than optimal. Wren-Lewis (2013) suggests that the combination of a flatter Phillips curve and persistent shocks to inflation that are unrelated to domestic cyclical conditions means that central banks may end up stabilizing inflation at the cost of economic growth. For example, central banks may cease providing stimulus to an economy that is experiencing high inflation due to exchange rate effects or commodity price cycles, even though unemployment remains high and there are large amounts of economic slack. Analogously, stabilizing inflation may involve much larger swings in economic activity than in the past because the flatter Phillips curve means central banks must effect larger changes in economic slack to obtain a given change in inflation. These considerations suggest a need to reconsider how monetary policy can best contribute to general economic welfare under the circumstances now facing advanced economies.

Any such reconsideration should, however, clearly recognize that the stability of inflation and the anchoring of expectations are essential in order to avoid repeating the experiences of the 1970s. The key issue is whether there is a need to modify the monetary policy framework to ensure that stabilizing inflation is more consistent with stabilizing output.

Various central banks have already adopted "flexible inflation-targeting" regimes that give weight to output stabilization if it is not in conflict with their inflation targets. For example, inflation is allowed to deviate from the target for extended periods if it results from external or tax shocks. To the extent that such shocks are now more important relative to domestic cyclical conditions, extra flexibility may be appropriate. For example, in countries with considerable economic slack, the central bank can react less aggressively than in the past when inflation fluctuates above the target, provided expectations remain anchored.

Another approach is to focus on inflation measures other than the consumer price index that respond more closely to domestic cyclical conditions. For example, targets could be defined in terms of the rate of increase in labor earnings net of productivity gains. Monetary policy would thus be tightened when abnormal increases in wages signal bottlenecks in the labor market. Another suggestion is to give asset price inflation more prominence in monetary policymaking, given the large asset price rises that occurred during the first decade of the 2000s and their role in the financial crisis. However, Bernanke and Gertler (2000) point out the unintended consequences that can attend such an approach.

A more far-reaching approach would complement the inflation target with an explicit mandate to stabilize output. In this dual-mandate framework, central banks' decisions would be based not only on their views about inflation, but also on direct measures of output and unemployment gaps. Central banks would thus have more discretion to allow inflation fluctuations if addressing them would exacerbate cyclical downturns. There is some debate about whether such a dual mandate is compatible with inflation targeting. Bullard (2012) argues that the two are compatible and that differences amount only to the relative weight that is placed on inflation and output fluctuations.

Central banks are already making use of whatever flexibility they have in responding to the unprecedented circumstances following the Great Recession. However, changes in the behavior of inflation and profound challenges in the aftermath of the Great Recession may mean there is need for even greater flexibility. As such, it is worth thinking about whether improvements can be made to frameworks in light of the changed circumstances.

The authors of this box are Damiano Sandri and John Simon.
[1]See Bernanke (2004) or Blanchard and Simon (2001).

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