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The ECB's Inflation Objective

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Abstract

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The ECB's objective of medium-term inflation below 2 percent has been portrayed by critics as ambiguous, asymmetric, and excessively stringent. This paper attempts a comprehensive evaluation of the trade-offs for the euro area and finds that: (1) in terms of guiding inflation expectations and policymaking, the current definition has functioned much as would an inflation target centered on 1½-1¾ percent; (2) the absence of a specific (point) target for medium-term inflation has encumbered the communication of monetary policy; and (3) a target toward the upper end of the ECB's price-stability range would seem, at least with the current membership of EMU, to strike a judicious balance between the benefits of price stability, on the one hand, and the need to assist relative price and wage adjustment across EMU and safeguard against deflation, on the other hand.

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I. INTRODUCTION

European Central Bank (ECB) President Wim Duisenberg announced in December 2002 that the bank would make a serious assessment and evaluation of—not necessarily a change in—its monetary strategy, probably in the course of the first half of 2003. That review is likely to include an assessment of the ECB's inflation objective. The Eurosystem's current definition of price stability—as an annual rate of increase in consumer prices of less than 2 percent, to be maintained over the medium term—has been criticized by outside observers on two counts. First, the definition has been portrayed as ambiguous and asymmetric, and less effective as an anchor for inflation expectations than a point inflation target (see, for example, Svensson, 2002). Second, the 2 percent ceiling has been said to be too stringent to allow a smooth functioning of the euro-area economy and allow monetary policy to effectively pursue stabilization objectives in the face of large, adverse shocks (see, for example, Begg and others, 2002).

This paper reviews the ECB's definition of price stability from both angles. The first part of the paper examines whether the ECB's inflation objective is clear and symmetric and, to the extent that it is not, the paper discusses the relative costs and benefits of the current definition versus definitions with increased specificity.

The second part of the paper examines the factors determining “the optimal rate of inflation” in the euro area. It reviews the benefits of price stability, including the reduction in the distortionary effects of inflation on savings and investment in non-indexed tax systems. It then goes on to evaluate arguments for maintaining a small positive inflation rate in the context of the euro area, of which there are essentially three. *First*, due to various biases in the measurement of inflation, “true” inflation is likely to be lower than indicated by official price indices. *Second*, a small positive inflation rate may facilitate relative price and wage adjustment in an economy with downward nominal rigidities, that is, when there is resistance to price and, especially, wage cuts. In the case of the euro area, this issue has a particular dimension in that inflation may vary across member countries owing to the gradual convergence in price levels, as well as the occasional need for relative wage adjustment among Economic and Monetary Union (EMU) members in response to country-specific shocks. *Third*, the closer the inflation goal is to zero, the higher the risk that monetary policy could be constrained by the inability of nominal interest rates to fall below zero if and when the economy is hit by severe shocks.

The paper concludes that there would likely be benefits from adopting a point target for medium-term inflation, especially in terms of communication, but that the arguments are more finely balanced than has been admitted by some, and any potential gains would need to be weighed against the potential credibility cost of changing the objective. As for the level of inflation, a target toward the upper end of the ECB's price-stability range (2 percent) would seem, at least with the current membership of EMU, to strike a judicious balance between reaping the benefits of price stability and allowing scope for inflation to assist relative price and wage adjustment across EMU and safeguard against deflation.

II. ON THE CLARITY AND SYMMETRY OF THE ECB'S INFLATION OBJECTIVE

A. The ECB's Objective of Price Stability and How It Compares with Others

The Treaty on European Union established “price stability” as the primary objective of the European System of Central Banks (ESCB). As a secondary objective, the ESCB is required to support the general economic policies of the euro area with a view to contributing, *inter alia*, to high levels of employment and sustainable growth. Lawmakers refrained from specifying the price-stability objective in operational terms or from delegating the authority to do so to any particular body. Consequently, it has been up to the ECB itself to decide whether to provide a quantitative definition of price stability and what such a definition should be. The treaty mandate and the definition of price stability adopted by the ECB are laid out in Box 1.

On the one hand, in providing a definition of price stability, the ECB has specified its medium-term inflation objective in more precise terms than some other central banks, such as the U.S. Federal Reserve or the Bank of Japan, which do not offer quantitative definitions of their targets. The reasons for doing so were several: the European Union (EU) treaty's emphasis on price stability made it natural to provide a definition that could guide policymaking, anchor inflation expectations, reinforce accountability, and facilitate the public's understanding of the aims and constraints of monetary policy. Moreover, a quantitative definition was seen as helpful in establishing the anti-inflation credentials of a new institution with literally no track record of its own.

On the other hand, the definition of price stability provides a less clear-cut demarcation of the ECB's inflation preferences than would an inflation target *per se*, for the following reasons:

- A definition of price stability is not the same as an inflation target or range. It does not follow from the definition of price stability that the ECB is indifferent between all inflation rates in the 0-2 percent range, or that it aims for the mid-point of that range; indeed, as we shall see below there are reasons to believe—and financial market participants appear to believe—that the ECB generally prefers medium-term inflation rates in the upper half of that range;
- The ECB has noted that there might be measurement bias in the monetary union inflation index, and officials have occasionally interpreted the definition of price stability as $x-2$ percent, where x is measurement bias; however, this makes the lower bound for measured inflation uncertain (and potentially time-varying);
- The “medium-term” horizon over which price stability is to be maintained is not specified.

Box 1. Price Stability: The ECB's Definition and Its Antecedents

The Treaty on European Union states the objectives of the ECB in the following terms:

"The primary objective of the ESCB is to maintain price stability. Without prejudice to the objective of price stability the ESCB shall support the general economic policies of the Community with a view to contributing to the achievement of...a harmonious and balanced development of economic activities, sustainable and non-inflationary growth, ...[and] a high level of employment..." (Treaty on European Union, Articles 2 and 105).

The lexicographic ordering of objectives is not necessarily a reflection of legislators' and society's view of their relative importance. Rather, it reflects a consensus view of what monetary policy can be expected to deliver (low inflation) and what it cannot be expected to provide (full employment). The belief is also that central banks charged with delivering price stability are best placed to contribute effectively to output stability.

Taking its cue from the experience and practices of a number of participating central banks, as well as from the EU Council's prescription in successive Broad Economic Policy Guidelines, the ECB adopted the following definition:

"Price stability shall be defined as a year-on-year increase in the Harmonized Index of Consumer Prices (HICP) for the euro area of below 2 percent." Price stability according to this definition "is to be maintained over the medium term."

The ECB has since noted that the use of the word "increase" implied that deflation would not be deemed consistent with price stability.

The ECB also noted that there might be measurement bias in the HICP, and that this bias might vary over time. *"Therefore, the definition has avoided explicitly embodying specific estimates of the HICP measurement bias, while allowing for such bias by not setting the lower bound for measured price level increases at zero."* Informally, ECB officials have, on occasion, interpreted the definition to mean measured inflation rates in the range $[x-2]$ percent, where x is the (unknown) inflation measurement bias.

The most important antecedents to this definition were the practices of a number of EU central banks prior to EMU. The Bundesbank used a 2 percent "price norm" or "medium-term price assumption" in its calculation of target money growth for a number of years. During 1997 and 1998, this was lowered to 1.5–2 percent. Other participating central banks had also adopted inflation norms not exceeding 2 percent.

Language adopted by the Council of Ministers of Economic and Financial Affairs in the 1995 Broad Economic Policy Guidelines was also seen by the ECB to specify 2 percent as the maximum inflation rate compatible with price stability (see Issing and others, 2001, p. 71.)

By way of comparison, some inflation-targeting central banks have adopted point targets—for example, 2 percent in Canada and Sweden and 2.5 percent in the United Kingdom²—while others have adopted target ranges (e.g., 2-3 percent in Australia and 1-3 percent in New Zealand, recently changed from 0-3 percent). For those that have adopted ranges, the lower bound is explicit, and the mid-point of the range is generally understood to represent the preferred inflation outcome.

The policy horizon for most inflation-targeting central banks is specified at 1½-2 years, consistent with the lags with which monetary policy affects inflation and with the dying out of temporary and erratic price level shocks. An exception is Australia, where the target is to be achieved over an unspecified business cycle, and the Bank of New Zealand recently changed its horizon from 12 months to “the medium term.” The trend among both policymakers and academics has been to see real world inflation targeting as “flexible” rather than “strict” inflation targeting (in the terminology of Svensson, 1999). Flexible inflation targeting means that the central bank does not focus exclusively on the inflation forecast at some point in time but also has concern for the stability of the real economy. Among other things, this implies that inflation-targeting central banks aim to meet the inflation target further in the future when a large shock has moved inflation away from target.

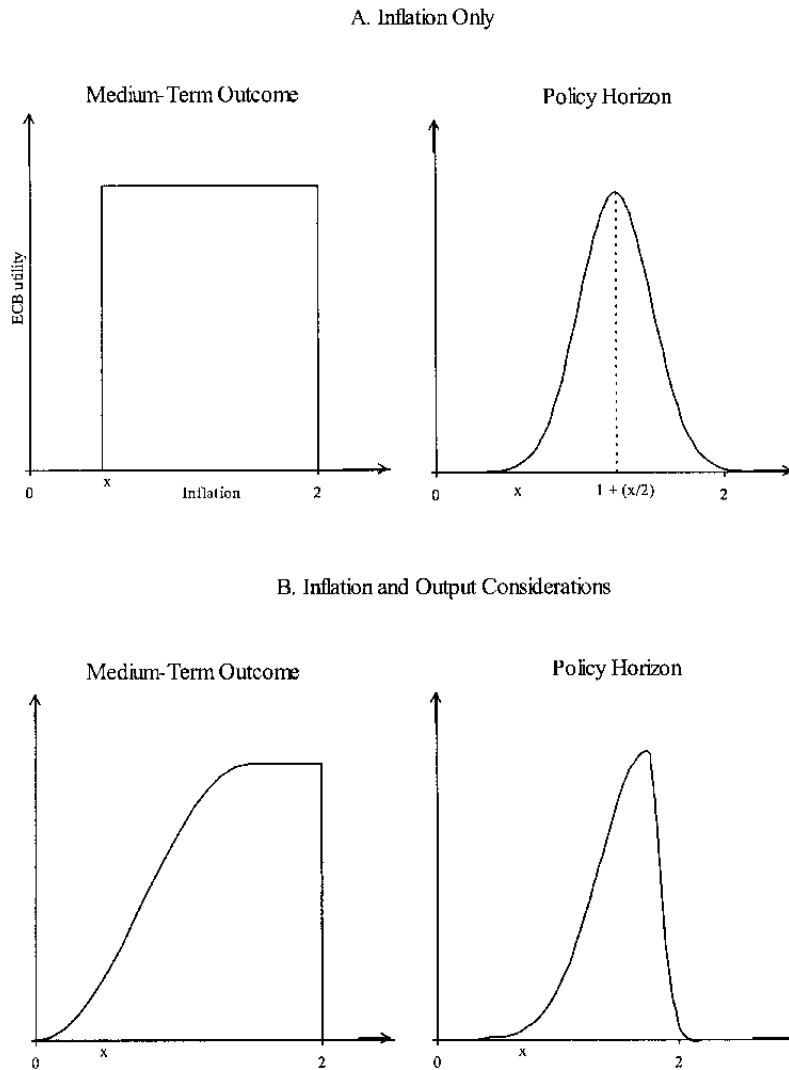
B. Interpretations of the ECB’s Price-Stability Objective

Observers have spent a fair amount of energy trying to deduce from the ECB’s definition of price stability, as well as from ECB communications and actions, what level of inflation the ECB may “really” be targeting. Svensson, 1999, pointed out that the ECB’s calculation of its reference value for M3 growth seemed consistent with inflation in the 1-2 percent range, the mid-point of which is 1½ percent. Statements by ECB Board Member Otmar Issing at the 2002 ECB Watcher’s Conference brought some clarification by recognizing that a small positive rate of inflation, “say between 1 and 2 percent” would significantly reduce the risks of getting trapped in a deflationary spiral, and stressing the need for vigilance were inflation to fall below 1 percent.

Some stylized considerations may illustrate the extent to which the ECB’s target is symmetric and well defined. The top half of Figure 1 represents the ECB’s utility function in inflation if and when the bank is indifferent between any medium-term inflation outcome in the price stability range ($x-2$ percent, where x is measurement bias, or possibly 1 percent). The bank will be indifferent between these outcomes if there is no trade-off between inflation and the level or variability of output (Section IV discusses issues such as the zero interest rate floor and relative price and wage adjustment that may introduce such trade-offs at low inflation). At the relevant policy horizon, and assuming for illustrative purposes that the

² The United Kingdom’s target is specified in terms of the retail price index (RPIX). Given methodological differences between this index and the EU-harmonized index of consumer prices (HICP), the target for RPIX may, on average over time, correspond to 2 percent (or less) for the United Kingdom HICP.

Figure 1. Interpretations of the ECB's Inflation Objective



uncertainty surrounding the central inflation projection is symmetric, the bank's inflation target would be the mid-point of the x -2 percent range.

The lower half of Figure 1 depicts the situation if and when the bank perceives a trade-off between inflation and the level or variability of output (e.g., if a small positive inflation rate facilitates relative price and wage adjustment, or if keeping some distance to zero inflation reduces the risk of deflation). Given the secondary objective of the ECB, the utility function would be tilted towards the upper end of the range defined as price stability. Over the policy horizon, a risk-conscious Governing Council would want to maintain a safety margin by aiming for an inflation forecast slightly below 2 percent.

Thus, although the definition of price stability may be symmetric in a formal sense (0-2 percent, or 1-2 percent), these factors imply some (modest) degree of ambiguity and asymmetry in practice.

Loosely speaking, people who assume the ECB is targeting 2 percent will find that the bank is more focused on inflation risks and slower to reduce rates when price pressures abate than their priors would indicate, while people who assume the ECB is targeting 1.5 percent may quite possibly get the opposite impression.

C. Reasons for Not Being (Even) More Precise

There may be good reasons for not adopting an overly precise inflation target and policy horizon: after all, inflation-targeting is not “the only game in town.” Essentially, four arguments have been forwarded by ECB officials for not providing an (even) more precise definition of the ECB’s objective:

- 1) The economics profession has not come to an agreement on the optimal rate of inflation. In the words of Issing and others. “*Both theoretical and practical arguments can be made in support of and against an inflation rate exactly equal to zero...or a small, but positive, rate of inflation.... Given this situation, it could appear wise to refrain from the specification of an exact figure*” (Issing and others, 2000, p. 69).
- 2) An inflation forecast cannot incorporate all considerations, including those of a strategic or tactical nature, that the Governing Council may deem important in its policy decisions (Issing, 2002). Partly as a consequence, the ECB’s staff projections for inflation do not have the same dominant status in the policy process, analysis, and communication as for traditional inflation-targeters, and they are not necessarily endorsed by the Governing Council. Among other things, policymakers may wish to take steps to prevent asset price bubbles and financial imbalances from building up, or to avoid financial crises, even when this might conflict with rigid, fixed-horizon inflation targeting (the asset price bubble in Japan in the late 1980s and the recent high-tech bubble in United States emerged alongside low inflation, see e.g., Borio and Lowe, 2002).
- 3) Given that inflation is imperfectly measured and the monetary union price index is still, to some degree, work in progress (see Section IV), a point inflation target would be specified with a higher degree of precision than policymakers could deliver.³
- 4) With respect to the policy horizon, the return to price stability after a shock should be gradual and depend on circumstances. A “*different policy response can be optimal depending on the initial conditions and the source and dimension of the exogenous shocks that cause deviations [of inflation] from the objective.*” (Issing and others, 2000, p. 69).

³ A similar view was espoused by U.S. Fed Chairman Alan Greenspan in 2001: “*When industrial product was the centerpiece of the economy...our overall price indexes served us well...But in our new century...our data—using current techniques—could become increasingly less adequate...a specific numerical inflation target would represent an unhelpful and false sense of precision.*” (quoted in Wynne and Rodriguez-Palenzuela, 2002).

ECB officials have stressed that, on some of these points, similar conclusions appear to have been implicitly drawn by the U.S. Federal Reserve. The Fed has striven to convey its anti-inflationary resolve without providing too precise quantitative definitions, and it retains a significant amount of discretion and policy flexibility in its response to shocks.

Supporters of inflation targeting would argue that the most important of these points could be accommodated within a “flexible” inflation-targeting framework. In particular, policy could, in certain circumstances, deviate from short-term targets and react to asset price misalignments or financial stability considerations provided this is communicated well (Cecchetti, and others, 2002);⁴ moreover, the speed with which inflation is brought back to target after a shock could vary and depend on output stability considerations (e.g., Svensson 1999). On these points, not only the theory, but also the practice of inflation targeting is moving in the direction of meeting ECB concerns, witness e.g., the debate in the U.K.’s Monetary Policy Committee about the need to forestall overheating in the housing market, and the redefinition of the policy horizon in New Zealand to an unspecified “medium term.”

On a related point, the ECB’s current definition leaves open the possibility that policies may systematically correct past over- or undershootings of the inflation target. (This contrasts with the traditional view of inflation targeting central banks as letting “bygones be bygones.”) Provided the public knows that target overshootings will subsequently be corrected, adverse price shocks may, in theory, be more easily absorbed since expectations of future inflation are lowered at the same time (e.g., Woodford, 1999), and there may be advantages in targeting a price level path (e.g., Svensson, 1999). However, the ECB has not indicated that it follows either of the two approaches.⁵

D. Potential Costs of Ambiguity

Supporters of inflation-targeting point to three potential costs associated with the ambiguity in the ECB’s inflation goal, to do with policy setting, communication, and inflation expectations, respectively:

First, the definition of price stability provides a less clear and less symmetric guide for policymakers than would a point target. Even when policymakers strive to be evenhanded there remains a risk that well-defined transgressions of price stability in the upward direction receive more focused attention than less clearly defined transgressions in the opposite direction.

⁴ The authors stress that their proposal “*may present communication challenges, and it is critically important that policy set to react to asset price misalignments both be explained well and that it is based on a broad consensus.*” (Cecchetti, Genberg, and Wadhvani, 2002).

⁵ The distinction between inflation and price level targeting may be somewhat artificial (King, 1999). Inflation-targeters are ultimately likely to be held accountable against an average outturn for inflation over longer periods, equivalent to targeting a price level path.

Second, the ambiguity may hamper communication and understanding of the ECB's policies. For instance, it is unclear how far below 2 percent prospective inflation would need to move before rates are changed, or whether there is a zone of policy inaction when projected inflation is inside the price stability range.

Third, the ECB's definition arguably provides a less clear guide for inflation expectations than would a point target for inflation. A clear anchor for inflation expectations is important in that it may improve the available trade off between inflation and output variability (Svensson, 1999; for empirical evidence see Laxton and N'Diaye, 2002), and facilitate long-term contracting, saving and investment.

To some extent, these potential costs can be evaluated on the basis of the EMU experience so far. The available evidence is examined below.

E. The Experience of the First Years

Policy setting

The first issue is how the definition of price stability has served in guiding policymaking.

Owing to large and unforeseeable shocks, actual inflation has exceeded 2 percent almost continuously since mid-2000, i.e., for most of the ECB's history. In this perspective, the Eurosystem cannot reasonably be said to have been overly aggressive in pursuing its primary objective to the detriment of other considerations. At the same time, allowing inflation to overshoot its target in the short run was an appropriate response to the sequence of one-off shocks, and at no point did it cause the ECB's anti-inflation credibility to slip (see below on inflation expectations).

With respect to the uncertain lower bound and midpoint of the ECB's objective, Table 1 shows that the year-ahead consensus forecast for inflation on dates when the ECB cut interest rates varied in a narrow band from 1.6 to 1.8 percent. (This result is unaffected if one allows for a one month lag in Consensus forecasts). Thus, the interest rate cuts in early 1999 and in 2001-03 demonstrated that the ECB was concerned about not letting the economy languish with inflation in the lower half of the price stability band.

It is also noteworthy that the midpoints of the ECB staff's inflation projections, published half-yearly since December 2000, have varied in a band of 1.5-1.9 percent (for the last forecast year). Although quarterly profiles are not publicly available, judging from the trend in inflation the forecasts were probably centered on 1½-1¾ percent at the end of the forecast horizon in all cases.

Table 1. Rate Cuts and Forecast Inflation
(percent)

Date	Rate cut	Consensus forecast ¹
Apr-99	0.50	1.6
May-01	0.25	1.8
Aug-01	0.25	1.8
Sep-01	0.50	1.8
Nov-01	0.50	1.7
Dec-02	0.50	1.8
Mar-03	0.25	1.7

¹Year-ahead HICP forecast
Source: Consensus Economics.

In overall terms, therefore, the ECB has so far acted much as one would have expected of an inflation-targeting central bank with a target of 1½-1¾ percent.⁶

Communication and the public's understanding of ECB policies

Research by ECB staff has indicated that financial markets have broadly been able to predict policy decisions since the inception of the EMU (Pérez-Quirós and Sicilia, 2002). Work done at the IMF has confirmed that the overall predictability of ECB actions has been high and broadly comparable to that of the Bank of England and the U.S. Federal Reserve (Ross, 2002). Given that the ECB is a relatively young institution, this is no small achievement. The latter work also found, however, that while ECB rate *hikes* were generally well predicted (and perhaps better than for the others), the markets have had more difficulty in fully and correctly anticipating ECB rate *cuts* in terms of either timing or magnitude.

While financial markets' ability to predict policy decisions on the day before they are made is not the most important measure of the public's understanding of monetary policies, wider communication issues have been brought out in surveys of financial market participants. Such surveys and other reviews have pointed to occasional difficulties for outside observers in linking ECB policy decisions to the bank's two-pillar monetary strategy (see e.g. Begg and others, 2002, Callow 2001). Similar views have been prominent in the financial press, e.g.: “[while] most ECB watchers would find little cause for complaint in the bank's steering of interest rates...the bank's communication skills, by contrast, are widely viewed as a weak spot....Part of the reason for the 'communications gap' may lie in the complexity of the bank's monetary policy strategy” (T. Barber, Financial Times, September 6, 2001).

Although several factors may have frustrated the communication of ECB policies particularly during rate-cutting cycles—including hard-to-interpret signals from the ECB's monetary pillar, a consensual approach to decision making, and the ECB's need to demonstrate independence from political influences—the lack of a well-defined lower bound or midpoint for the inflation objective clearly complicated matters. It may also have nourished views such as “the ECB [cares] more about inflationary pressures than deflationary pressures,” and “an asymmetric inflation regime restricts a central bank's ability to take stimulus measures when growth flags” (P. Lamy and J. Pisani-Ferry, quoted by Reuters, March 8, 2002). Whatever the merit of such views, outside observers have found it difficult to know just how far below 2 percent medium-term inflation prospects would have to fall for rates to be cut, or how the emphasis might shift to output stabilization when price stability was secured.

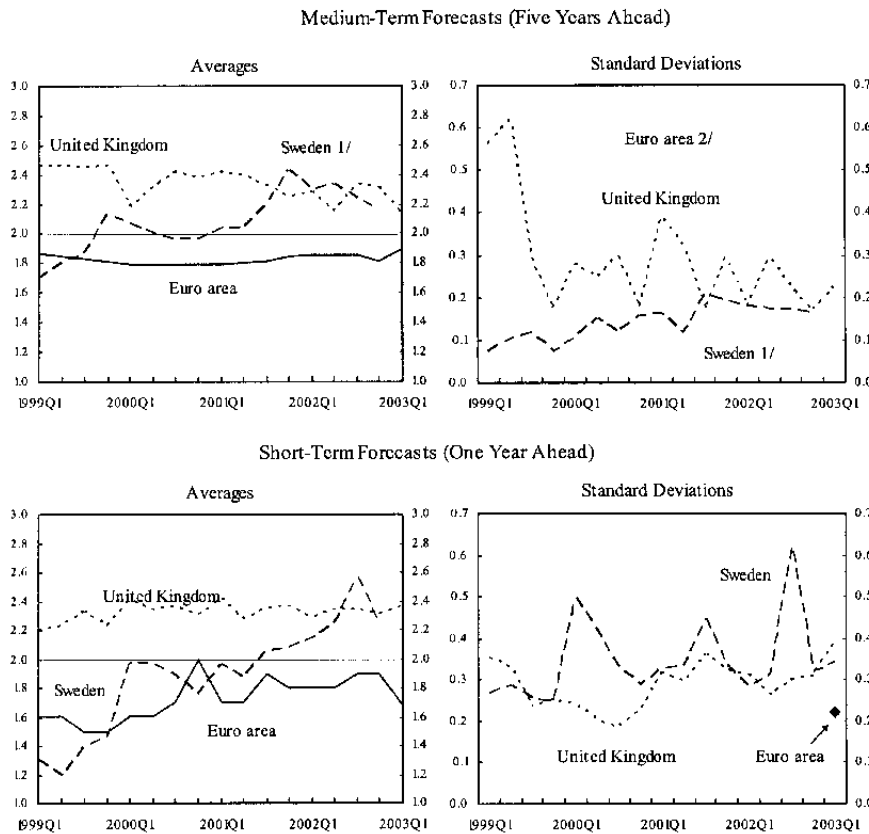
⁶ Several rate cuts were perceived by a vocal section of market participants to have come only when there was a very high degree of assurance that cuts were appropriate. This would be consistent with the observation that most rate cuts, when they came, were of 50 basis points rather than 25 basis points. The lack of a specific target for inflation may have contributed to any such pattern.

Inflation expectations

Surveys of professional forecasters provide a convenient tool to assess the level, stability, and dispersion of inflation expectations among informed observers. The ECB Survey of Professional Forecasters shows that expectations at the 5-year horizon have remained firmly pinned down at 1.8-1.9 percent since the inception of EMU (Figure 2). Comparable surveys are shown for two prominent European inflation targeters, namely the United Kingdom (H.M. Treasury surveys of professional forecasters) and Sweden (surveys kindly provided by the Riksbank). Over time, inflation expectations in the euro area have been as stable, if not more so, than for the two others. Medium-term inflation projections in the United Kingdom have drifted down from around 2.5 percent (the Bank of England target) to 2.2 percent—but any judgment about how expectations have been anchored by central bank targets may be hampered by shifting expectations that the U.K. or Sweden might join EMU and thus abandon their current targets within the forecast horizon.

Short-term inflation projections have been less stable in the euro area than in the U.K., perhaps reflecting differences in the extent to which their central banks target short-term inflation. Presumably, however, the time variation for the euro area (and Sweden) to a large extent reflects the impact of large and unusual shocks to oil prices, food prices, and exchange rates since 1999. Currently, the variation in consensus forecasts for inflation in the euro area (available only since early 2003) is low in comparison to others.

Figure 2. Inflation Expectations in Surveys of Professional Forecasters

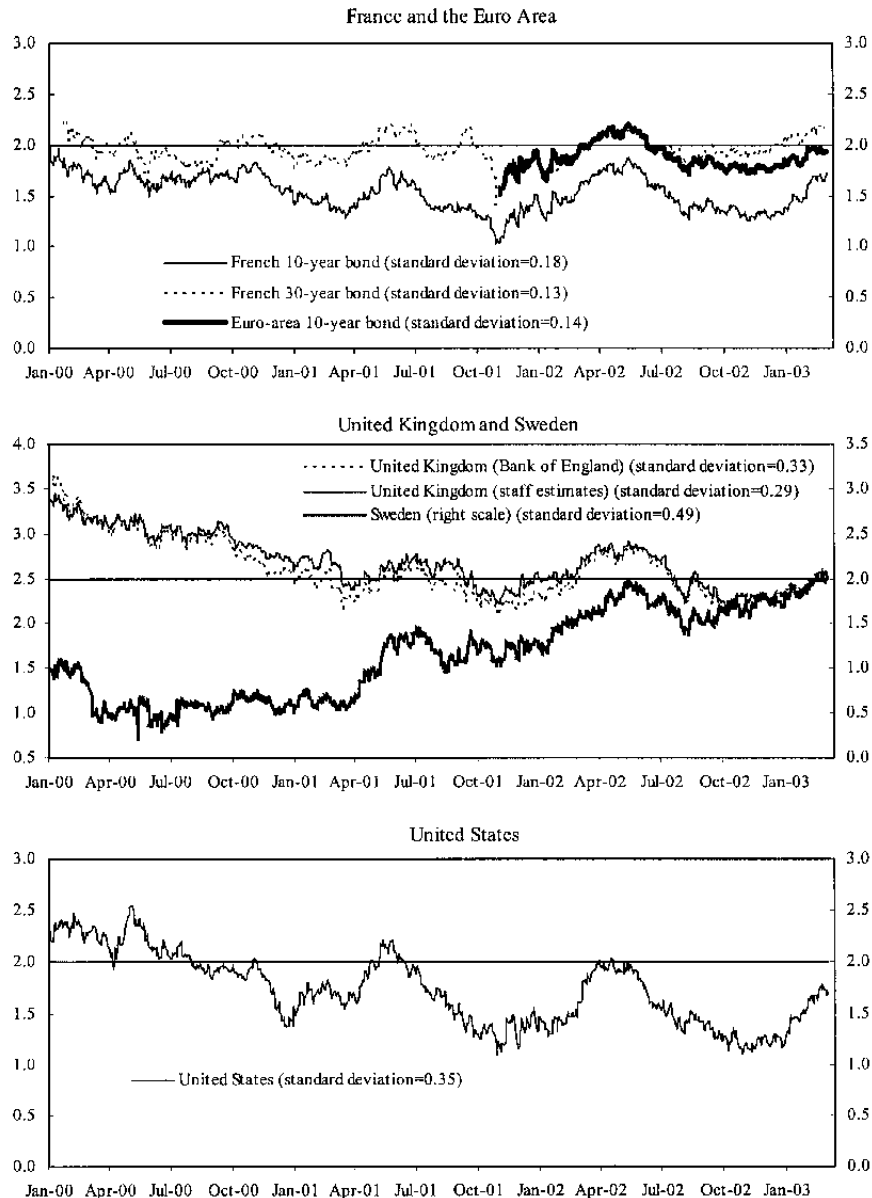


Sources: ECB Survey of Professional Forecasters; Sweden's Riksbank; H.M. Treasury; Consensus Forecasts.
 1/ Average excludes purchasing managers; standard deviation across means of five groups of forecasters.
 2/ Details of ECB surveys withheld for reasons of confidentiality.

Ten-year “breakeven” inflation rates derived from index-linked and nominal bonds confirm that inflation expectations in the euro area have generally stayed close to but below 2 percent (Figure 3, top panel) (unfortunately, such measures may be distorted by liquidity, tax, and inflation risk premia, and do not necessarily provide a precise guide to long-term inflation expectations). A comparison with other countries suggest that break-even inflation expectations have been more stable—exhibiting a lower standard deviation and maximum swings—in the euro area than elsewhere.

All told, inflation expectations have been at least as stable and well anchored in the euro area as in other countries, including ones with point inflation targets. If, however, the ECB was aiming for 1½ percent inflation, as suggested by some, expectations have been less firmly on target than might have been the case.

Figure 3. Break-Even Inflation Rates in Selected Countries



Sources: Bloomberg; Bank of England.

III. BENEFITS OF PRICE STABILITY

We next turn to the issues involved in defining an appropriate or “optimal” rate of inflation over the medium term. Choosing a target rate of inflation involves difficult trade-offs between the “sand” and “grease” effects of inflation on the workings of the price mechanism, capital taxation, and the dangers of hitting the zero-interest-rate floor for monetary policy. Moreover, official inflation measures likely overstate “true” inflation by an unknown amount. Against this background, countries that have adopted explicit inflation targets have generally opted for small but positive inflation rates.⁷ The remainder of this paper considers the relevant trade-offs from the vantage point of the euro area. The analysis is based on the premise that there are significant advantages of maintaining stable and low inflation (“low” taken to mean inflation rates below, say, 3 percent). It is traditionally assumed that the price mechanism works best at low inflation, thereby promoting a more efficient allocation of resources and higher output, and the long-run Phillips curve is taken to be vertical for higher inflation rates. Following a long line of research which established that double-digit rates of inflation reduce economic growth (e.g., Fischer, 1993; Barro, 1995; Sarel, 1996), a study by Andres and Hernando (1999) found that even moderate inflation had a negative effect on output by reducing investment and the efficiency with which factor inputs are used. However, since very few data points in the sample had inflation rates below 3 percent, the results could say little about inflation rates below that level.

Some of the most important benefits of low inflation have more to do with the *stability* of the inflation rate rather than the *level* of inflation *per se*. This holds notably with respect to the anchoring of inflation expectations and the functioning of the price mechanism. There is little to suggest that inflation would be more variable and that price and wage setters would be more liable to confuse general price movements with relative price changes if the inflation target was set at, say, 2 percent rather than 1 percent. Indeed, such confusion might be more likely if the inflation target is unclearly defined or so low that inflation is neglected by near-rational economic agents (Akerlof and others, 2002). By the same token, the macroeconomic benefits of a better anchoring of inflation expectations at low inflation stem from the priority accorded to price stability and the central bank’s anti-inflation credentials (including its independence) rather than from the precise level of the target.

Other traditional benefits of price stability—in terms of “shoe leather” and price adjustment (menu) costs—seem likely to vary only trivially among inflation rates inside or close to the ECB’s definition of price stability.

A key benefit of price stability stems from the interaction of inflation with nominal tax systems, notably through taxation and tax deductibility of the inflation-compensating part of

⁷ As argued in King (1999) the targets chosen by most inflation-targeting central banks are not very different from what has been suggested by prominent researchers. For instance, Summers (1991) concluded that “the optimal rate of inflation is surely positive, perhaps as high as 2 or 3 percent,” while Krugman (1999) argued that the United States and Europe should set a target rate of “at least 2 percent.”

nominal returns on capital and interest expenditure. In most countries, this interaction means that higher inflation weakens incentives to save and induces overinvestment in housing. In this case, reducing inflation would produce a permanent welfare gain through a better allocation of resources. Feldstein (1997) found that the gain from price stability associated with the tax-inflation interaction might be very large in the U.S.: going from 2 percent inflation to zero inflation would permanently raise welfare by an amount equal to about 1 percent of real GDP.

In a set of papers collected in Feldstein (1999) similar methods were applied to Germany, Spain, and the United Kingdom. In the case of Germany, Tödter and Ziebarth (1999) found that the gain from reducing inflation by 2 percentage points was equivalent to a perpetuity of 1.4 percent of GDP. The gain is somewhat larger than for the United States primarily because of the higher marginal rate of tax in Germany. For Spain, Dolado et al. 1999 found an even larger gain (1.7 percent of GDP), principally because of the higher distortions in favor of housing demand. On the other hand, Bakhshi and others, 1999 found a much smaller gain in the case of Britain (0.2 percent of GDP), reflecting the ways in which U.K. taxpayers can reduce the tax on investment income and the limited tax advantage of home mortgages. Britain indexes capital gains for inflation and provides more opportunities for individuals to save in untaxed forms than do the other countries examined.

If these numbers are applied in an approximate fashion to the euro area, the perpetual gain from reducing inflation from, say, 2 to 1.5 percent comes out roughly at $\frac{1}{4}$ percent of GDP, the present value of which is 8 percent of GDP (discounted at a 3 percent real interest rate).

A natural response to the said distortion would be to change tax laws, and the incentive to do so would be considerable if the potential gains were as large as claimed. Feldstein (1997) lists some legal and administrative reasons why comprehensive tax indexing is, in his view, unlikely to be enacted and notes that full indexing has not been adopted by any major industrial country. On the other hand, the estimate for Britain suggests that changes in tax laws have the potential to massively reduce the distortions. Besides, various doubts have been raised about the magnitude of the estimated benefits, and it has been argued that there may be a political economy equilibrium that determines the rate of capital income taxation and housing subsidization (Fischer, 1999). A reduction in effective capital taxation or mortgage subsidization induced by lower inflation could lead to offsetting changes in explicit tax rates on capital income and mortgage deductibility.

At any rate, the benefits of zero inflation need to be weighed against possible downsides of keeping inflation rates too close to that level. We turn next to the possible motives for maintaining a small positive inflation rate.

IV. BENEFITS OF SMALL POSITIVE INFLATION RATES

Maintaining a small positive inflation rate might be preferable to zero inflation on three principal counts. *First*, official measures of inflation likely overstate true inflation; *second*, inflation may help relative price and wage adjustment when the economy is beset by downward nominal rigidities; and *third*, countercyclical monetary policy action risks being constrained by the zero floor if inflation and nominal interest rates are kept too low in a

steady state. In the euro area, these issues are complicated by the fact that trend inflation may vary across countries and real exchange rates may need to adjust to country-specific shocks. Following a brief review of inflation measurement biases, this part draws together the empirical evidence on the likely divergence in trend inflation across EMU as a prelude to the analysis of relative price and wage adjustment. The last section examines the implications of the zero interest rate floor at low inflation rates.

A. Allowing for Biases in Inflation Measurement

In the wake of the influential 1996 Boskin report on measurement biases in the U.S. CPI, several studies tried to estimate the inflation measurement bias in European indices. These studies generally found that the bias was lower than the Boskin estimates owing to a smaller “substitution bias” (Table 2). Lower substitution bias was due to more frequent updating of the weights and differences in the detailed index calculation methods used.

Compared to the wealth of detailed price studies available for the U.S., however, the European results were based on incomplete evidence as regards the “quality bias” which may arise from the inadequate adjustment of prices to take account of quality improvements. Even the Boskin report’s estimates were subject to a large margin of uncertainty since quality biases are by nature hard to quantify. (As statisticians like to point out: if quality improvements were readily quantifiable, the indices would already be adjusted.) The less widespread use of hedonic price measures in Europe suggests that the quality bias could be higher than in the U.S. For example, the U.S. series for “personal computers and peripheral equipment” show a much more rapid price decline (roughly –30 percent per year since the introduction of hedonic prices in January 1998) than the euro area series for “information processing equipment” (–13 percent per year, and –20 percent in France which uses hedonic pricing; the series has a weight of only 0.3 percent in the index).

Table 2. Estimates of the Measurement Bias (percent)

	Total	Range
Germany	0.75	0.5–1.5
France 1/	-	> 0.1–0.25
United Kingdom	-	0.35–0.8
United States 2/	1.1	0.8–1.6
Canada	0.5	-

Sources: Boskin, 1996; Cunningham, 1996; Hoffman, 1998; Lequiller, 1997; and Crawford, 1998.

1/ Does not include 'quality bias.'

2/ Recent methodological changes have reduced the bias since Boskin's estimate.

On the other hand, the euro-area HICP does not presently include owner-occupied housing (an omission which is likely to reduce any upward bias), and recent research has found examples of potential *downward* biases in inflation measures, e.g. related to difficulties in separating changes in “fashion” from quality (see references in Wynne and Rodriguez-Palenzuela, 2002). A recent ECB working paper concluded that “there is very little scientific basis for putting a point estimate on the likely magnitude on the overall bias in the HICP.” (Wynne and Rodriguez-Palenzuela, 2002). The paper also noted that the HICPs are work in progress, so measurement biases may change over time. Owner-occupied housing may be included in the HICP at some point and progress in harmonizing methods of quality adjustment across EU countries could also induce changes in the overall bias.

Even if a numerical assessment of the bias in the HICP remains elusive, however, a qualitative comparison with the well-researched CPI in the United States—on the basis of the

studies of national CPIs quoted above and given that the national HICPs and CPIs mostly share the same detailed price information—would suggest that substitution biases are likely to be substantially lower than was the case for the U.S. CPI when the Boskin report was issued, while quality and possibly new product biases are likely to be at least as high in the euro-area as in the U.S. owing to the less extensive use of hedonic measures. In sum, measurement error may well account for a notable fraction of observed euro-area inflation.

B. Allowing for Cross-Country Variation in Inflation

We next attempt to judge the potential dispersion in trend inflation across EMU members owing to prospective price convergence. If some countries were to experience inflation rates significantly below average, the smooth adjustment of relative wages and prices within and across countries might be stifled. The scope for steady-state inflation differences in EMU is assessed on the basis of three complementary approaches: applications of the Balassa-Samuelson model; examination of long-period real exchange rate trends; and an assessment of the likely pace of convergence in absolute price levels across EMU countries.

Balassa-Samuelson effects in EMU

The Balassa-Samuelson model explains real exchange rate movements in terms of sectoral productivity growth differentials, and rests on two principal components. First, the relative price of nontradables relative to tradables in each country reflects relative productivity in the traded and non-traded goods sectors. Second, the model assumes that purchasing power parity (PPP) holds for traded goods (in the long run). In EMU, this implies that tradables price increases are equal across countries, but that slower productivity growth makes for more rapid increases in unit labor costs and prices in the non-tradables sector. National inflation differences will thus be determined by the cross-country variation in the sectoral productivity differentials and the weights of nontradables in national price indices.

Table 3 summarizes the results of several recent studies, realigned for comparability on an average trend inflation in the euro area of 1.5 percent, and assuming that sectoral productivity differentials observed in the past will continue in the future. The results vary considerably depending on the sample, data, and methodology employed, and the most recent additions to the

Table 3. Steady-State Inflation Rates Implied by Balassa-Samuelson Effects
(aligned to average Euro area inflation of 1.5 percent).

	Average of all columns	Calculations based on:						HICP Proxy
		Alberola and Tyrväinen (1998)		Canzoneri et.al. (1998)		De Grauwe et.al. (2000)	Sinn and Reuter (2000)	
Sample		1975-95	1985-95	1973-91	1973-97	1971-95	1987-95	1995-2001
		Value-added deflators						CPI
Austria	1.6	1.3	1.0	1.7	1.3	2.0	2.0	2.0
Belgium	2.0	2.6	2.2	2.9	2.1	1.6	1.4	1.5
Finland	1.8	1.9	1.0	1.5	2.1	0.9	3.3	1.8
France	1.5	1.2	1.1	1.6	1.9	1.1	1.9	1.4
Germany	0.8	0.8	0.8	0.5	0.5	1.2	0.6	1.4
Greece	3.5	-	-	-	-	-	4.7	2.2
Ireland	2.9	-	-	-	-	-	2.9	2.9
Italy	2.0	1.9	1.9	2.5	2.3	1.9	2.1	1.4
Netherlands	1.7	1.8	1.6			1.5	2.0	1.8
Portugal	1.7	-	-	-	-	1.6	1.4	2.2
Spain	2.1	2.6	3.0	2.0	1.9	1.5	2.1	1.8
Euro area	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Max-Min	2.6	1.8	2.2	2.4	1.8	1.1	4.1	1.5
Dispersion	0.7	0.6	0.8	0.8	0.6	0.4	1.1	0.5

Sources: Author's calculations based on studies listed in the column headings.

literature have significantly inflated the margin of uncertainty: Reuter and Sinn (2000) provide much larger estimates of the dispersion than previous studies, while the opposite is the case for De Grauwe and Skudelny (2000).

Taken at face value, the results suggest that steady-state inflation in Germany could be significantly below the euro area average, and perhaps below 1 percent if the ECB aims for 1.5 percent for the aggregate. Catching-up countries generally would register higher-than-average inflation rates although the results are less unequivocal in this respect than one might have expected. Most of the remaining countries would be close to the average.

Also of interest are the underlying differences across sectors. The average productivity growth differential between the tradables and nontradables sectors in the euro area has been $1\frac{3}{4}$ percent per year, and the average inflation rate for nontradables have exceeded that of tradables by the same amount. Given their respective weights in GDP, average trend inflation of 1.5 percent in the euro area would imply trend inflation for tradables as low as 0.3 percent, and 2.0 percent for services (value-added deflators). (The trend inflation for goods retail prices would be around $\frac{3}{4}$ percent owing to the retail and distribution components of their final sales prices.)

Despite its intellectual attraction, the Balassa-Samuelson model has not received unequivocal backing in the empirical literature. Most studies do find that relative prices generally reflect relative labor productivities in the long run (and in some empirical applications, relative wages), but the evidence on purchasing power parity in traded goods is less favorable (see Canzoneri et al., 1999). As to whether the Balassa-Samuelson model or PPP for broad price measures provides the best description of long-run real exchange rate movements, Rogoff, 1996 concluded that:

“Overall, there is substantial empirical support for the Balassa-Samuelson hypothesis, especially in comparisons between very poor and very rich countries, and in time series data for a select number of countries, including especially Japan. Whether [it] is of broader importance in explaining real exchange rates across industrialized countries is a matter of some debate. We have already seen that a substantial body of evidence suggests that across industrialized countries, there is long-run convergence to PPP, the Balassa-Samuelson effect notwithstanding” (Rogoff, 1996, p. 662).

There are several reasons to believe that the above quantifications of the Balassa-Samuelson effect may overestimate the extent of likely inflation divergences in EMU:

- Fast productivity growth in the traded-goods sectors in catching-up countries owes, at least in part, to rising capital-labor ratios. Consequently, total costs per unit and thus prices may diverge less between sectors than unit labor costs alone would indicate.⁸

⁸ In theory, the Balassa-Samuelson effect is driven by sectoral differences in TFP growth (see e.g. the presentation in Froot and Rogoff, 1995). However, most empirical applications focus on labor productivity. An exception is Swagel (2003).

- The value-added deflator in the tradables sector may not be an adequate measure of the price of domestically produced tradables; in fact, input-output data show that domestic nontraded goods sectors provide substantial inputs to the tradables sector.
- Different sector productivity trends, owed in part to shifts in the composition of labor (e.g. towards low-skill and part-time employment in services), which may equally affect average sector wages. Such composition changes would have little impact on unit labor costs and relative prices. (Alberola and Tyrväinen, 1998, are among the few to control for sectoral wage differences).

The HICP proxy in the right-hand column of Table 3 is calculated by assuming that the trend differential between industrial goods (excluding energy) and services in each country's HICP remains constant going forward. This simple proxy is relatively immune to the criticisms above since it relies directly on observed inflation differentials, not productivity differentials, and because PPP may be a more appropriate assumption for the consumer basket of tradables (which includes a mix of foreign and domestic goods) than the value-added deflator (which covers only domestic goods). This proxy shows an inflation range in EMU from 1.4 percent in France and Germany to 2.9 percent in Ireland.

Extrapolating past real exchange rate trends

If money is neutral in the long run, real exchange rates movements should ultimately be determined by factors in the real economy. Consequently, the fact that EMU countries used to have separate currencies should not be a prime determinant of past long-period real exchange rate trends, and the latter may therefore provide pointers to what could be in store in EMU. This approach imposes much less structure than the Balassa-Samuelson model, and largely leaves open the question of what factors explained past trends. At one level this is an advantage because it allows for an unrestricted array of determinants of real exchange rate

Figure 4. Euro Countries: Consumer Prices Relative to Germany, 1960–2001

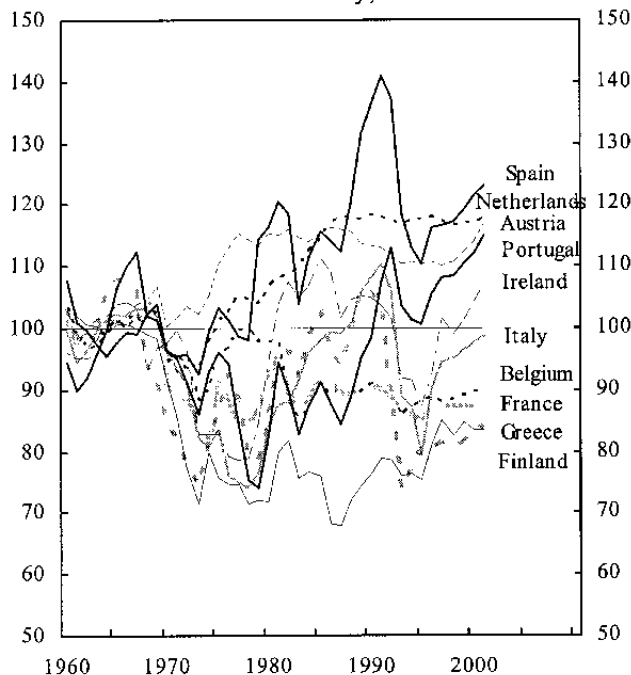


Table 4. Steady-State Inflation Based on Extrapolation of Real Exchange Rate Trends

	Consumer prices 1/			GDP deflator
	1961 –2001	1975 –2001	1985 –2001	1975 –2001
Austria	1.9	2.1	1.9	1.7
Belgium	1.2	1.2	1.1	1.5
Finland	1.0	1.4	1.2	0.3
France	1.1	1.3	1.1	1.1
Germany	1.5	1.4	1.3	1.5
Greece	0.9	1.1	1.7	2.1
Ireland	1.6	1.7	2.3	1.3
Italy	1.5	1.5	2.0	1.6
Luxembourg	1.1	1.4	1.5	1.9
Netherlands	2.0	1.9	1.5	1.6
Portugal	1.7	2.0	2.0	3.0
Spain	2.2	2.2	2.0	1.9
Euro area	1.5	1.5	1.5	1.5
Max-min	1.4	1.1	1.2	2.7
Dispersion	0.5	0.4	0.4	0.6

Sources: EU Commission; and author's calculations.

1/ Deflator of private consumption.

movements. At another level it is a drawback, because in the absence of specific hypotheses of what drives real exchange rates, it is hard to assess whether and to what extent they are likely to continue in EMU.

Figure 4 shows the movements in EMU countries' price levels relative to Germany since 1960 when measured in common currency; and Table 4 shows implied steady state inflation rates in EMU based on extrapolations of past relative price adjustments.

These calculations suggest that the scope for inflation differentials in EMU is smaller than Balassa-Samuelson calculations imply (especially bearing in mind the absence of data for Portugal, Ireland, and Greece in most studies reported in Table 3). Nonetheless, they do not rule out that trend inflation could be as low as 1 percent in one or more countries if the euro area average were to be maintained at 1.5 percent.

Convergence in absolute price levels

However, income convergence has progressed across the EU during recent decades and real exchange rate appreciation for lower-income countries may therefore be smaller going forward than in historical samples.

Absolute price levels vary across the EU in a manner that relates fairly closely to relative living standards (Figure 5). The correlation coefficient between absolute 1999 price levels and per capita income is 0.68. Correcting for differences in indirect taxes the correlation was 0.83 in a recent year for which price data excluding taxes are available.

Table 5 breaks down the overall price levels in terms of six goods and services categories. As is evident from column 1, the price levels of "core goods" (which excludes food, alcohol and tobacco) are very similar across EMU, indicating highly integrated markets: the only significant outliers are geographically isolated Finland and Greece. The degree of price

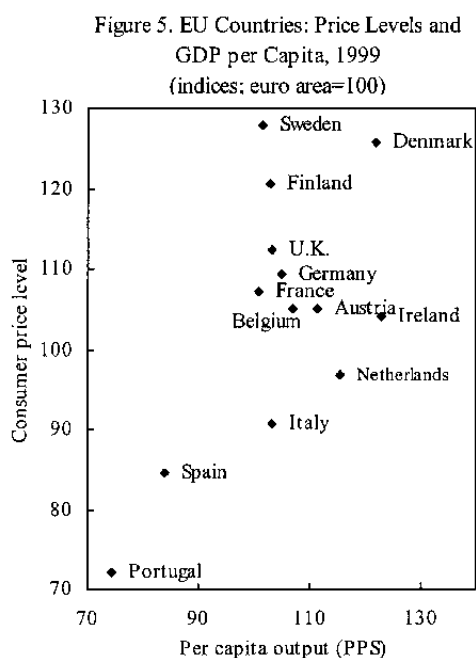


Table 5. EU Countries: Price Levels Compared (1999; index EU12=100)

	Goods			Services		
	Core goods 1/	Food, tobacco	Energy	Core services 2/	Communica-tions	Rents
Austria	99	104	102	107	128	81
Belgium	100	101	95	102	113	87
Finland	117	109	83	102	85	93
France	106	110	103	107	96	101
Germany	99	102	108	109	111	112
Greece	108	88	65	52	72	60
Ireland	99	97	86	89	108	65
Italy	97	102	96	85	87	54
Netherland	97	94	91	94	89	104
Portugal	97	80	102	64	103	31
Spain	95	83	74	83	83	57
Euro area	100	100	100	100	100	100
Denmark	124	134	155	112	79	84
Sweden	105	114	94	121	94	105
U.K.	94	101	87	103	105	78

Sources: Dresdner Kleinwort Benson, 1999; Eurostat; and author's calculations.

convergence appears almost surprisingly large, given the relatively high share in retail prices of domestic inputs (retail, distribution, and indirect taxes). However, cheaper labor and land inputs in the distribution sectors of lower-income countries are seemingly off-set by lower efficiency, possibly related to high numbers of small-scale outlets. Moreover, cross-border shopping provides for arbitrage at the retail level, particularly among neighboring countries (although prices do vary considerably for many individual subcomponents of “core goods”).

By contrast, services prices vary widely across countries, and there is a clear tendency for prices to be lower in the relatively poorer countries. The prospective convergence in price levels as these economies catch up with the more advanced economies will necessarily imply divergence in inflation rates. Another way of expressing the same point is that convergence on absolute PPP necessitates temporary deviations from relative PPP.

Table 6 provides some illustrative calculations of how average inflation rates might differ across the euro area over the next 10-20 years, depending on how fast the remaining differences in price levels are reduced. This exercise should be taken with a grain of salt—for instance, it is possible that geographically remote Finland could maintain high indirect taxes and retail prices despite intensified pressures for harmonization. Nonetheless, the results are broadly corroborative of the previous approach and lends support to the notion that trend inflation rates could vary from around 1¼ percent in Germany and France to 2-3¼ percent in Portugal, Greece, and Spain.

For a broad sample of countries, Barro and Sala-i-Martin (1995) estimate that relative differences in per capita incomes are reduced on average by 3 percent per annum. Using different estimation methods, Björkstén (2000) finds convergence to be more rapid. Applying the range of estimates in the EU context implies that lower income Portugal and Greece should enjoy productivity growth of about 1-1½ percent higher per year than the highest income countries, in which case the half-life of remaining output (and price level) differences would be 15-20 years.

Experience from actual monetary unions may also shed light on the issue of inflation differences in EMU. In the monetary union between Ireland and the U.K.—countries with a considerable disparity in economic development—the average difference in annual inflation was a moderate 0.4 percentage points between 1950 and 1978. Between Luxembourg and Belgium, there was no difference on average over the 1950-2001 period.

Implications of enlargement

Any enlargement of EMU to include wealthy EU members Denmark, Sweden, and the United Kingdom seems unlikely to broaden the scope for inflation divergence significantly, although pressures for absolute price convergence could keep inflation below average in

**Table 6. Steady-State Inflation Rates
Based on Convergence in Price Levels
(Aligned to 1.5 percent for the euro area)**

	Half-Life (years)		
	10	15	20
Austria	1.3	1.3	1.4
Belgium	1.3	1.3	1.4
Finland	0.6	0.9	1.1
France	1.2	1.3	1.3
Germany	1.1	1.2	1.3
Greece	2.6	2.2	2.0
Ireland	1.3	1.4	1.4
Italy	2.0	1.8	1.7
Netherlands	1.7	1.6	1.6
Portugal	3.3	2.7	2.4
Spain	2.4	2.1	1.9
Euro area	1.5	1.5	1.5
Max-min	2.7	1.8	1.3
St.dev.	0.8	0.5	0.4

Sources: Eurostat; and author's calculations.

high-price Sweden and Denmark. However, the EU is set to be enlarged with 10 Eastern European countries as well as Cyprus and Malta. Turkey has also applied for membership. Those countries that are ready to join can accede by 2004, and several others are expected to follow not long thereafter. Some seem keen on joining EMU at the earliest opportunity, which could be by 2006/2007 provided they fulfill the treaty's convergence criteria.

In 1998, the combined GDP of the EU applicant countries amounted to no more than 9 percent of euro area GDP, less than Spain alone (Björkstén, 2000). One might therefore surmise that the effect of above-average inflation in the newcomers would have a limited effect on the aggregate. The results in Reuter and Sinn, 2000 imply that 1.5 percent steady state inflation in an enlarged euro area of 21 countries (namely the current 15 EU members plus Poland, Hungary, the Czech Republic, Estonia, Slovenia, and Turkey, but omitting Cyprus, Bulgaria, Romania, Lithuania, Latvia, Malta, and the Slovak Republic due to lack of data) would require a reduction in trend inflation for the existing euro area countries of 0.2 percentage points. While the calculations are based on very short samples, the implied steady state inflation rates for most newcomers would be in the range of 3-4½ percent, which is consistent with the estimates in Halpern and Wyplosz (2001). The latter conclude that inflation rates in Poland, Hungary, the Czech Republic, Slovenia, Latvia, and Romania could be some 3 percent above that in the euro area.

However, as real convergence progresses, the weight in the euro aggregates of accession countries would converge on their share in the euro area population, which could be as high as one-third of an enlarged euro area. To be sure, the speed of convergence and size of the inflation differential would decrease as states neared the advanced-country technology frontier. Björkstén (2000) conducted a simulation in which he assumed: (1) 13 applicant countries joining EMU within 15 years; (2) average real GDP growth of 2 percent in wealthier countries, (3) average real growth of 5 percent per year in accession countries until 2010, subsiding thereafter, and (4) average inflation of 5 percent until 2010, 4 percent during 2010-15, and 3 percent thereafter. If the accession countries all joined the euro, the current members would be obliged to maintain average annual inflation levels below 1¼ percent in order to keep area-wide inflation below 2 percent (and below ¾ percent to keep the area-wide rate below 1.5 percent). After 20 years of convergence, per capita GDP in accession countries would still only be about two-thirds of the euro area average, so price convergence could go on for some time after that, even if at a reduced pace.

The prospect of enlargement strongly underscores the need for the Eurosystem's target for inflation to allow scope for variation in trend inflation across countries.⁹ Variation in trend inflation rates—while probably not as large with the current country composition as suggested by applications of the Balassa-Samuelson model—may affect the smooth functioning of EMU if nominal rigidities hamper price and wage adjustment at near-zero inflation. It is to this issue that we turn next.

⁹ It also implies that early EMU participation would make it difficult for low-income countries to maintain domestic price stability and sustainable inflation convergence as required by the EU treaty.

C. Inflation as a Lubricant in Price and Wage Adjustment

The idea that a moderate level of inflation may “grease the wheels” of relative price and wage adjustment in an economy where agents are averse to nominal wage or price cuts was revived in the 1990s as inflation rates returned to low levels.¹⁰ Downward rigidities may stem from elements of money illusion, entrenched perceptions about “fairness,” and employer concerns about the impact of wage cuts on worker morale. A seminal paper by Akerlof, Dickens, and Perry (1996) argued that steady-state unemployment (in the U.S.) would be higher at rates of inflation below 3 percent, and especially below 2 percent. On the other hand, the coexistence of low inflation and falling NAIRUs in a number of industrialized economies in the 1990s—including the U.S., the U.K., and several euro countries—suggests that the reduction in inflation to roughly 2 percent has not (at least so far) had any detrimental impact on the smooth functioning of labor markets. The issue is briefly explored below for product markets, and at greater length for wages.

Product markets

Evidence from euro-area price indices suggests nominal price cuts are not as uncommon as is often believed. For instance, the fraction of the euro area HICP that displayed negative year-on-year inflation rates in March 2002 (when headline inflation was 2.5 percent) was 11 percent. In December 1998, when inflation was 0.8 percent, one-fifth of all categories exhibited negative inflation.

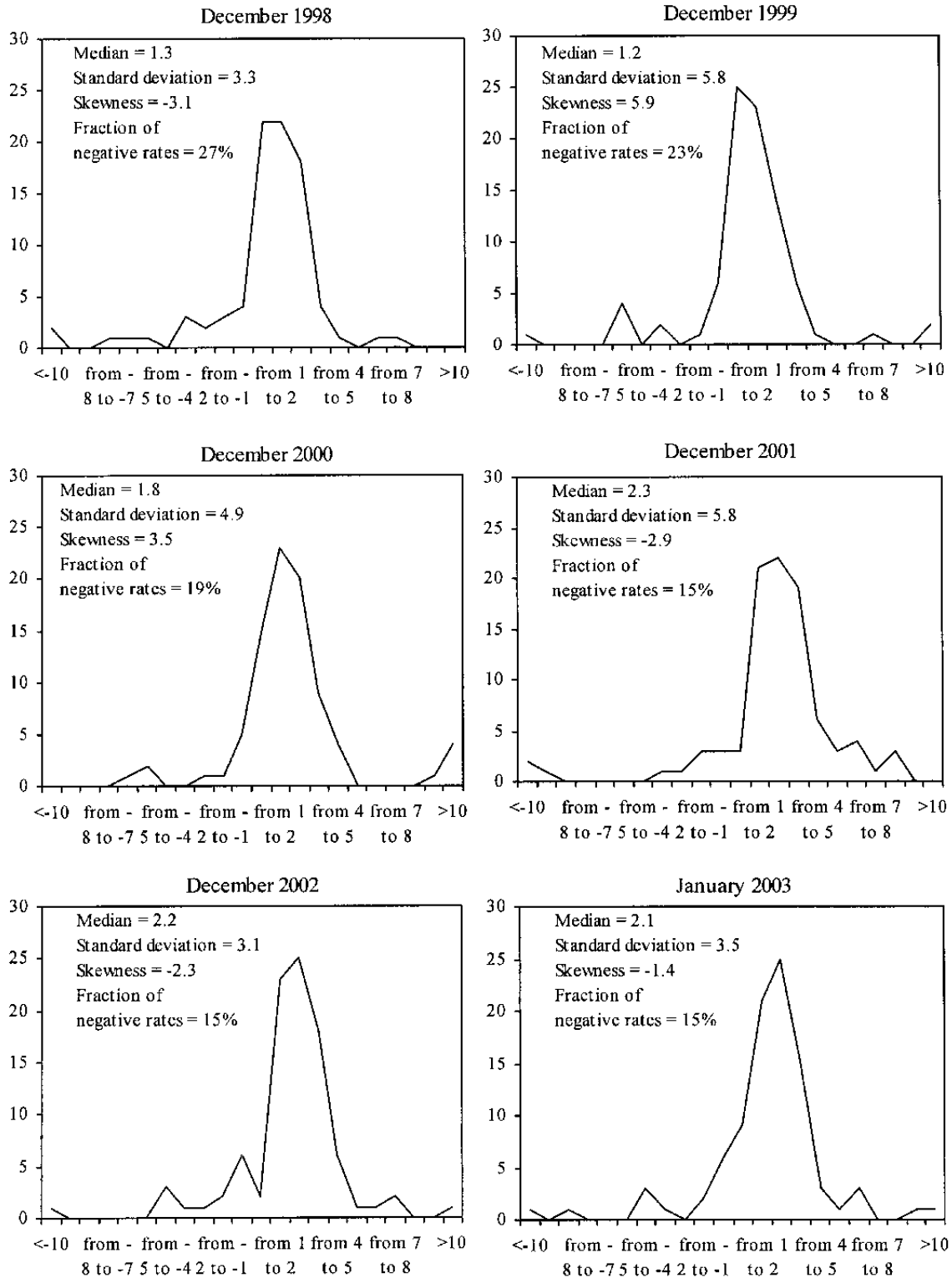
If goods and services markets were characterized by downward nominal rigidities, one would expect the distribution of price changes to alter shape and exhibit more zero changes as the inflation rate falls. Figure 6 shows the distribution of year-on-year price changes in the HICP at six discrete points in time, and reveals no obvious signs that the distribution is affected by the median inflation rate. Figure 7 charts the median and the skewness of the distribution since 1990 (upper panel), and a cross-plot of the median vs. skewness (lower panel). There is little to suggest that lower inflation in the euro area has affected the skewness of the distribution, as would have been expected in the presence of downward rigidities, at least for observed median inflation rates down to 1¼ percent. (Similar conclusions were reached for the United Kingdom by Yates, 1998, and King, 1999).

Labor markets: downward nominal wage rigidity

While not conclusive, the cumulated evidence on downward nominal wage rigidities points to such rigidities being quite pervasive in the primary sector of the labor market in industrial countries, in the sense that cuts in base pay for given worker effort are much more rare than if there were no nominal rigidity (Box 2). Out of concern for worker morale, wage cuts are enacted almost exclusively in conditions of severe distress (Bewley, 1999). At the same time, however, variations in hours worked and bonuses provide substantial flexibility in companies

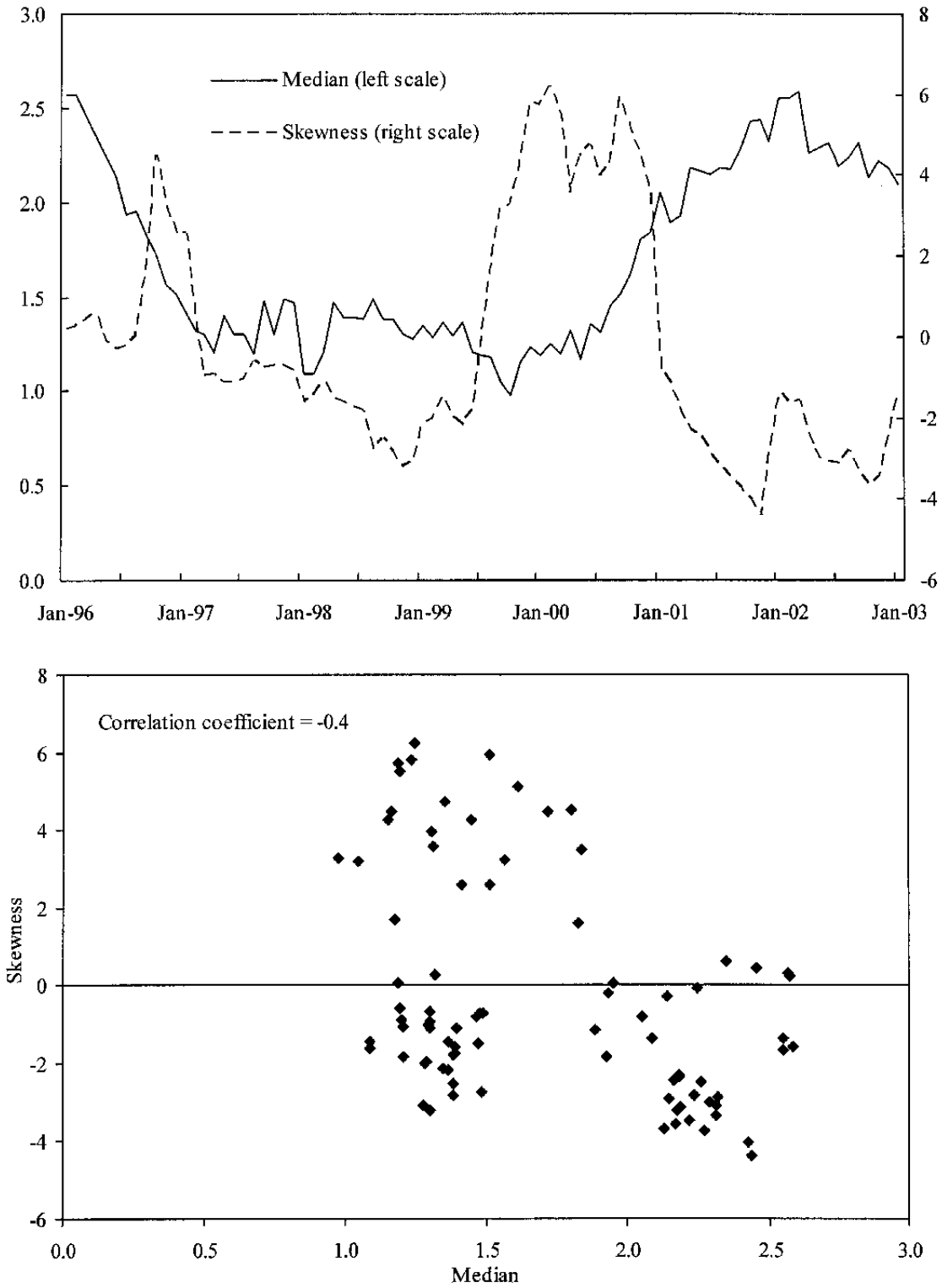
¹⁰ The issue goes back at least as far as Keynes’ (1936) “general theory,” and was prominent in James Tobin’s 1971 address to the American Economic Association.

Figure 6. Euro Area: Distribution of Annual Price Changes Among CPI Components



Sources: Eurostat; and IMF staff estimates.

Figure 7. Euro Area: Median and Skewness of the Distribution of Price Changes



Source: Eurostat.

wage bills. Moreover, the secondary sector of the labor market, where turnover is high and part-time and temporary jobs are common, exhibit much more flexibility in nominal wages than does the primary sector (Bewley, 1999).

Much less is known about the effects of downward nominal wage rigidity for aggregate employment and wage outcomes. Akerlof, Dickens, and Perry 1996 used a simulation model of the U.S. economy—in which a random distribution of wage changes across employers was truncated so that firms cut back employment instead of cutting wages for workers whose marginal revenue product had fallen—to argue that steady-state unemployment is higher at very low rates of inflation. Their results suggest that average inflation of 2 percent in the U.S. would result in a permanent increase in unemployment of around 0.2 percentage points compared to the natural rate of unemployment obtaining at inflation rates of 3 percent or more. An inflation target of 1 percent would add an additional ½ percentage point to the steady-state unemployment rate.¹¹ On the other hand, Groshen and Schweitzer 1999—who take account not only of inflation’s “grease” effects in aiding relative wage adjustment but also its “sand effects” in distorting price signals—found little or no increase in unemployment at low inflation rates. Using a high-quality establishment data set they found that modest inflation has a positive but small and statistically insignificant impact on the labor market, but that sand effects exceed grease effects at inflation rates over 5 percent.

In judging the importance of this issue for the euro area, questions arise as to the extent to which U.S. considerations apply to Europe, given the very different labor market institutions in place there. It is widely accepted that *real*, not nominal, wages are more rigid in Europe than in the United States, even if such rigidities relaxed in the 1990s. In the euro area, there is little to suggest that wages adjust quickly to local or occupational supply and demand conditions in the manner of the U.S. labor market (see, e.g., Prasad, 1999 on “the unbearable stability of the German wage structure”). If relative wage rigidity largely reflects wage-setting institutions and the impact of government regulations, inflation is unlikely to do much to speed up wage adjustment.

Moreover, bearing in mind the effects of productivity growth, relative wage growth can vary significantly across workers even at low inflation rates. If average long-term hourly wage growth in the area was 3-4 percent, consistent with average hourly productivity growth of 1½-2 percent and trend inflation at 1½-2 percent, relative wages across occupations could in principle vary to the tune of, say, 6-8 percent a year, if some workers got zero increases, and others were at the top of a broadly symmetric distribution (adapted from Svensson, 2000). Considering how slowly the wage structure in most European countries has responded to differences in unemployment rates across skill levels and regions, inflation rates toward the upper end of the ECB’s objective would not seem to constitute an obstacle to efficient

¹¹ In a later paper, Akerlof, Dickens, and Perry, 2000, argued that unemployment might be *lower* at very low inflation than at higher inflation rates because some agents are fooled by a small positive inflation to offer more labor than they would in the absence of money illusion. That equilibrium would not, however, be optimal and probably not sustainable.

Box 2. Evidence on Downward Nominal Wage Rigidities

The clearest evidence of downward wage rigidities comes from studies that rely on firm-specific, contract, or interview data and focus on base pay rates in the primary sector of the labor market. Using *firm-specific data*, Wilson 1999 found 0.1 percent and 0.0 percent of jobstayers suffered wage cuts in two large U.S. service sector firms; Fehr and Goette 2000 found wage cuts in 1.7 percent and 0.4 percent of cases in two large Swiss firms; and Altonji and Devereux, 1999 found that only 0.5 percent of salaried workers and 2.5 percent of hourly workers received wage reductions in a large U.S. financial corporation, almost all of which were associated with changes in part time/full time status or performance-related incentives. There is no guarantee that these firms are representative, but the presumption that they may well be so is bolstered by extensive *interview studies of employers* (notably Bewley, 1999, but also Shafir, Diamond, and Tversky, 1997; Blinder and Don Choi, 1990; Agell and Lundborg, 1995) which without exception confirm that wage cuts are uncommon. Bewley, however, reports that wage flexibility is much more pronounced in the secondary sector of the labor market for part-time and temporary jobs. Finally, Akerlof, and others, 1996 found negative pay changes in about 2 percent of cases in *telephone surveys*, and Fortin, 1996 and others confirm that negotiated wage cuts are rare in *contract settlements*.

A growing number of papers have examined the existence of downward nominal wage rigidities using *household panel data* (including for the U.S. Kahn, 1997 and Card and Hyslop, 1996; for the U.K. Smith, 2000; and for Germany Decressin and Decressin, 2002) or *employer-supplied data* (e.g. Groshen and Schweitzer, 1999 and Lebow and others, 1999 for U.S. establishment data; Nickell and Quintini, 2001 for the U.K.; and Beissinger and Knoppik, 2001 for German social security data). These studies generally find some bunching of wage changes around the zero mark for workers who stay in a given job in a manner consistent with downward nominal rigidity. (They also indicate that surprisingly high numbers of wage earners suffer nominal wage cuts in an average year (spanning 15-25 percent of non-job changers) which may owe much to reporting errors as well as to the inclusion of overtime pay, bonuses, and other flexible elements (e.g. night shifts, perks) in the measure of remunerations).¹

For the purposes of this paper, the most important aspect of these studies concerns the tests performed of how the wage change distribution is affected by the level of inflation (as argued in Decressin and Decressin, 2002, reporting error lowers the power of such tests but does not invalidate them). The tests carried out for the euro area's largest economy by Beissinger and Knoppik, 2001 and Decressin and Decressin, 2002 find that the level of inflation affects the distribution of wage changes. The zero mark is binding more often so that real wage adjustments could be hampered in Germany at very low inflation rates. (Similar results were found for the U.K. by Nickell and Quintini; for the U.S., Groshen and Schweitzer, 1999 pinpoint declining grease effects during low inflation periods.) Decressin and Decressin 2002 judge the effect to be too small to make a compelling case for the ECB to adopt a higher inflation target but also note that the presence of a nominal rigidity at the zero mark for base wages suggests pushing inflation much below 2 percent could bear risks. Based on similar analyses Beissinger and Knoppik suggest the ECB should aim at the upper bound of its target.

¹ For the United States, there is direct evidence of reporting errors: a validation study of the Panel Study of Income Dynamics (PSID) suggested only 44.2 percent of respondents reported their wage correctly, and the standard deviation between the log wages of the survey responses and the actual wages (as measured by establishment data) was 16.7 percent (discussed in Akerlof and others, 1996, p. 13). In a similar vein, Shea 1997 noted that in a sample of workers of which only 1.3 percent received actual wage cuts, 21 percent reported cuts in the household survey.

relative wage changes within countries. This view is in line with the studies of the interaction of inflation with nominal wage rigidities quoted in Box 2.

Aggregate wage flexibility

An additional dimension arises because of the occasional need for real exchange rate adjustment among EMU countries in response to asymmetric (country-specific) shocks.

The need for cross-country relative wage adjustment will depend on the frequency, nature and size of asymmetric shocks, the occurrence of which is inherently difficult to predict, in part because of the endogenous nature of the optimal currency area criteria (Frankel and Rose 1998; for a review of the literature, see OECD, 1999). The experience of the quasi-monetary union between Germany, Austria, and the Netherlands since the early 1980s suggests that considerable movements in relative wage levels, unit labor costs, and prices may continue even among highly integrated economies (Figure 8). It also shows that such adjustments have indeed been able to take place in a low-inflation regime.

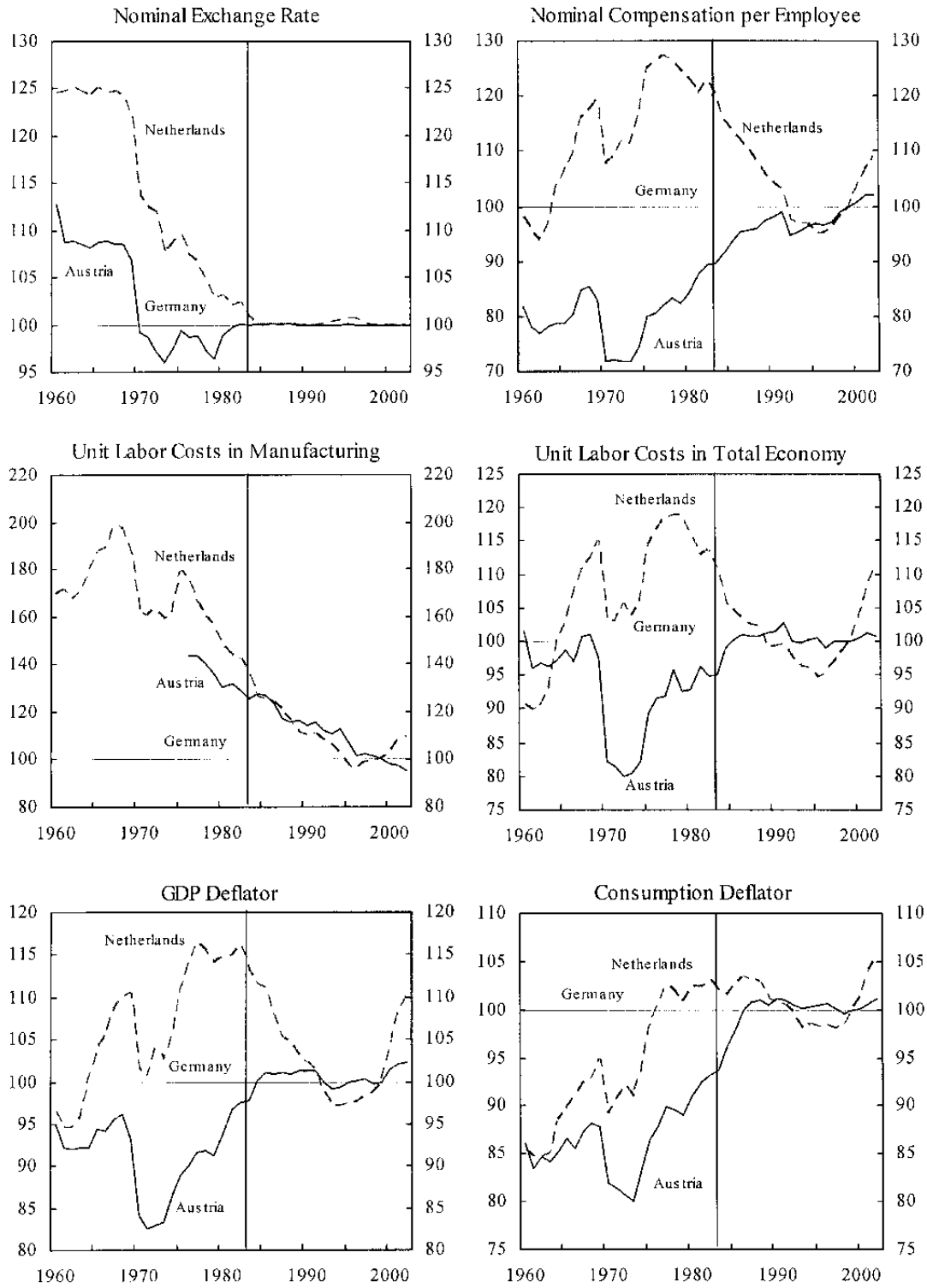
Downward nominal wage rigidities may give rise to *non-linearities* in the short-run Phillips curve at near-zero inflation, whereby the aggregate wage responds less to a negative shock to labor demand—because the downward rigidity binds for a larger fraction of workers—than to a positive shock of equal magnitude.¹² By the same token, the *slope* of the Phillips curve becomes flatter at near-zero inflation (in both directions), implying that a larger shift in unemployment is needed to produce a given change in the rate of wage inflation. Price rigidities of a different type—namely those owing to “menu costs” or staggered contracts—may equally flatten the slope of the short-run output inflation trade off because of less frequent price adjustments in a low inflation regime (Ball, Mankiw, and Romer, 1988).¹³

The weight of the evidence is suggestive of non-linearities in the Phillips curve although there are also findings to the contrary (e.g., Clark and others, 1996; Laxton and others, 1997; Turner, 1995). Pyyhtiä, 1999 found evidence of nonlinearity and concluded that the disinflationary impact of a negative output gap was small and not always significant in many euro countries. According to his results, the Phillips curve is especially asymmetric in Germany, Italy, Spain, the Netherlands, and Finland. However, almost all available studies have included countries or periods characterized by well above zero inflation, and they provide little or no evidence that any non-linearities are related to *nominal* rigidities at low inflation, rather than real ones.

¹² The short-run Phillips curve may be non-linear also at higher inflation rates in the presence of *real* rigidities, e.g., if workers resist reductions in their relative rate of wage increases.

¹³ The existence of multilevel collective bargaining in many European countries (national, regional, sectoral, or firm level) in which each layer needs to justify its existence may create rigidities above the zero mark (Calmfors, 1996).

Figure 8. Germany, Austria, and the Netherlands: Relative Wages and Prices 1/



Sources: European Commission; IMF; and IMF staff calculations.

1/ Indices, expressed in common currency, relative to Germany, 1999=100.

A few empirical studies have focused on the non-linearity and slope of the short-run Phillips curve at low inflation. Ball, Mankiw, and Romer (1988) found a statistically significant negative relationship between average inflation and the slope of the output-inflation trade off in a cross-section of 43 countries. The interpretation of this result is not straightforward, however. Since inflation expectations tend to be less well anchored in countries with high inflation, a given shock to output could affect inflation via shifting expectations, but this could be picked up in estimation as responsiveness to output (i.e., the estimated slope coefficient could be severely biased if inflation expectations are imperfectly measured). On the other hand, Japan's experience from the 1990s may shed further light on the issue. In a study that controlled for nation-wide inflation expectations in a panel study of Japanese regions, Nishizaki and Watanabe, 2000 found that the output-inflation trade off there had become significantly flatter as inflation had fallen near zero.

Even if rigidities put a floor under domestic wage inflation, a country's competitive position may improve inside EMU as long as unit labor costs among the country's EMU partners increase at a faster rate. An example of how this type of process works in practice is given by Germany's adjustment relative to euro-area partners in the first four years of EMU (Table 7). Germany managed to keep annual GDP deflator and unit labor cost growth some 1½ percent below its partners, gaining "competitiveness" to the tune of 6 percent over four years, in an environment of 2 percent area-wide inflation. Manufacturing wages have been rather sticky, but given Germany's long history of low inflation and the intensity with which wage negotiators scrutinize price developments, there seems little *prima facie* reason to believe such stickiness was related to forms of money illusion rather than real rigidities.

Table 7. Relative Wage Adjustment Within EMU, 1999–2002
(annual average growth; percent)

	Germany	Rest of Area	Difference	Euro Area
Compensation 1/	1.8	3.6	1.8	3.0
Unit labor costs	1.2	2.5	1.4	2.1
Hourly wages, industry 2/	3.1	3.6	0.5	3.5
Unit labor costs, industry	-1.2	1.0	2.2	0.3
GDP deflator	1.0	2.4	1.5	2.0
Private consumption deflator	1.5	2.5	1.0	2.2

Sources: European Commission; and IMF staff calculations.

1/ Nominal compensation per employee; total economy.

2/ Hourly compensation in manufacturing.

An illustrative simulation

The interaction of the average inflation target with relative wage adjustments within and across countries in the presence of wage rigidities has been analyzed in a stochastic, multi-sector simulation model by Holden, 2002. The results clearly depend on the calibration of shocks and response parameters for which there is limited hard evidence, and they should be considered merely indicative. In the model, some workers become unemployed when market-clearing real wage adjustments would require a nominal wage cut, thus giving rise to additional unemployment at low inflation rates (although if labor market pressures are sufficient, some wage cuts do take place). The simulation results recaptured in Table 8 indicate little difference between inflation rates of 2 percent and above, but reducing inflation to 1½ percent or below could entail significant costs in this stylized framework.

Table 8. Euro Area: Long-Run Inflation and Unemployment Rates
(percent)

Inflation Target	Unemployment Rate	Proportion of Wage Cuts
0.0	9.5	8.2
0.5	9.3	4.6
1.0	8.6	3.1
1.4	7.8	0.4
1.9	7.1	0.1
2.5	6.9	0.1

Source: Holden, 2002.

Will behavior change in the new regime?

A final issue concerns the extent to which observed behavior during past periods of moderate to high inflation will change in the price stability regime of EMU (cf. the Lucas critique). Mainstream menu-cost theories predict the appearance of downward nominal rigidities at positive inflation that would disappear in a regime of price stability (Ball and Mankiw, 1995). If downward wage rigidity were binding in a low inflation environment, there would be quite strong incentives to get around the restriction by extending bonus and profit-sharing systems, for the benefit of both workers and firms. Nevertheless, one should not take for granted that downward wage flexibility would easily develop. The examples of Switzerland and Japan may be instructive: Fehr and Goette 2000 found a large degree of wage rigidity and no tendency for the proportion of wage cuts to rise in Switzerland even after an extended period (seven years) in which inflation was close to zero and productivity growth low. Nominal wages are currently falling in Japan, but hourly compensation in manufacturing remained basically flat in 1998-2001, after deflation had set in. In the euro area, moreover, the downward rigidity rooted in employers' concerns about worker morale may be reinforced by the existing labor laws governing contract renegotiations and lay-offs (Holden, 2002). Because economies have operated for so long with positive inflation, it would likely take a long time for downward flexibility to develop.

Even if downward flexibility were to develop, falling prices and wages may not necessarily stabilize the economy in the short run (a debate which goes back to Keynes). In a closed-economy context DeLong and Summers, 1986 showed that while lower prices and wages do ultimately increase output, the process of getting there via declining inflation causes the real interest rate to rise, and the latter effect may well swamp the former (in fact, the increasing degree of nominal rigidity in Western economies in the last century coincided with a dramatic decrease in cyclical volatility). In the open and highly integrated economies of EMU, improved competitiveness will strengthen the equilibrating effects of lower relative wages and prices (Box 3), but such processes may still be fairly slow.

The next section examines whether low inflation and interest rates might compromise the ability of central banks to avoid deflation in the face of large, negative shocks.

D. Staying Clear of the Zero Bound on Nominal Interest Rates

A positive rate of steady state inflation may provide a buffer against the risk that countercyclical monetary policy becomes constrained by the zero floor on nominal interest rates or that the economy ends up in a liquidity trap.¹⁴

¹⁴ This proposition was made by Keynes, 1936, and regained prominence in more recent times when taken up by Summers, 1991.

Box 3. Are There Risks of Deflation in Individual Member Countries?

The prospect of low trend inflation in core EMU countries has caused some to ask whether the ECB target is so tight as to raise the risk of countries slipping into deflation (“deflation” taken to mean prolonged negative inflation and weak activity). This box discusses some conceptual issues in the context of a small model of a two-country monetary union (countries h and f). Demand is determined by the real interest rate, the real exchange rate, foreign demand and a shock variable; inflation is determined by a standard Phillips-curve; inflation expectations are governed by past inflation as well as the area-wide target (directly or through its impact on tradables prices across the union); and monetary policy follows a Taylor type rule:

$$\begin{aligned}
 (1) \text{ Aggregate demand:} & \quad y_h = a_1(p_f - p_h) - a_2(i - \pi^e_h) + a_3y_f + a_4z \\
 (2) \text{ Inflation:} & \quad \pi_h = \pi^e_h + b \cdot y_h \\
 (3) \text{ Inflation expectations:} & \quad \pi^e_h = c\pi^*_{mu} + (1-c)\pi_{h,t-1} \\
 (4) \text{ Monetary policy rule:} & \quad i = r_n + \pi_{mu} + d_1y_{mu} + d_2(\pi_{mu} - \pi^*_{mu}) \quad ; \quad i \geq 0
 \end{aligned}$$

where y measures output as deviation from trend; p is the price level; π inflation; i the nominal interest rate; r_n the neutral interest rate; and π^*_{mu} is the monetary union inflation target. The model is closed by similar equations for country f , aggregation (c.g. $\pi_{mu} = w\pi_h + (1-w)\pi_f$), and laws of motion for prices.

Monetary stabilization. As long as area-wide monetary policy is unconstrained by the zero floor—an issue covered in detail in section IV.D—the paths for real variables will be *unaffected by the level of the inflation target* (this result holds in a wide class of models, namely linear ones; for possible modifications, see below.) Simply put, the real and financial sector implications of country h having -1 percent inflation when the area-wide interest rate is, say, 2 percent is similar to country h experiencing 1 percent inflation if and when the policy interest rate is 4 percent. With the same real interest rate, people will tend to postpone purchases, real debt burdens will rise, and bankruptcies ensue to the same extent.

Financial frictions and nominal rigidities. These conclusions could be altered if the model included something special about falling prices. The zero-bound on interest rates aside, the two main candidates for non-linearities are: (i) financial frictions; and (ii) downward nominal rigidities. (Besides, deflation fears, whatever their source, might conceivably become self-fulfilling in a sun-spot equilibrium.) On (i), if a monetary union member is hit by an adverse shock, it may suffer “too high” real rates for its conditions, which may cause falling collateral values. As the collateral loses value, banks—which find it hard to distinguish between good and bad risks—may raise lending rates or call in loans, thereby exacerbating the downturn. If asset prices were forward-looking jump variables, the inflation target would not matter for this process, but with imperfect information and rigid prices (e.g., for physical assets), imbalances could arguably be resolved more quickly at higher inflation. On (ii), downward nominal rigidities play a mixed role. In the first place, they make it less likely that deflation could set in. Moreover, sticky prices would make for a less elevated (short) real interest rate. On the other hand, competitiveness gains would be less quick. Hence, downward rigidities might (possibly) be beneficial in the case of temporary shocks, but they would tend to slow adjustment to permanent shocks.

Equilibrating forces. The model illustrates some important countervailing forces to any country-specific deflationary episode within a monetary union. First, the more actual and expected inflation at home is conditioned by area-wide inflation (notably for tradables), the less likely it is that deflationary expectations could become entrenched. Second, should p_h start to fall, then sooner or later the (positive) real exchange rate effect would dominate the (negative) real interest rate effect. The real exchange rate channel is stronger, the greater the degree of integration and the more sensitive trade and investment are to competitiveness. The latter elasticities are likely to be relatively high inside a monetary union where intra-area real exchange rate changes are highly persistent.

The seriousness of hitting the zero floor hinges importantly on whether monetary policy would retain some potency through unconventional transmission channels, e.g., expansion of the money base through large-scale purchases of longer-term bonds and exchange rate intervention. Prominent U.S. officials and academics have recently argued that monetary policy could retain potency through such measures if and when necessary (e.g., Bernanke, 2002). Moreover, fiscal policy and possible self-equilibrating forces in the economy (the real balance effect, spontaneous exchange rate depreciation) might also play a stabilizing role, although fiscal policy is subject to intertemporal budget constraints and currency movements are not always benign. At any rate, because of the dearth of experience with unconventional monetary policy measures, the uncertainty about how much and how fast they would impact activity is larger than for conventional monetary policy. This uncertainty constitutes an important argument for shunning situations in which unconventional measures would need to be called upon.

Two approaches to studying the potential risk of hitting the zero interest rate constraint are explored in the following: the first is to look at the historical incidence of negative real interest rates; the second is to use stochastic model simulations.

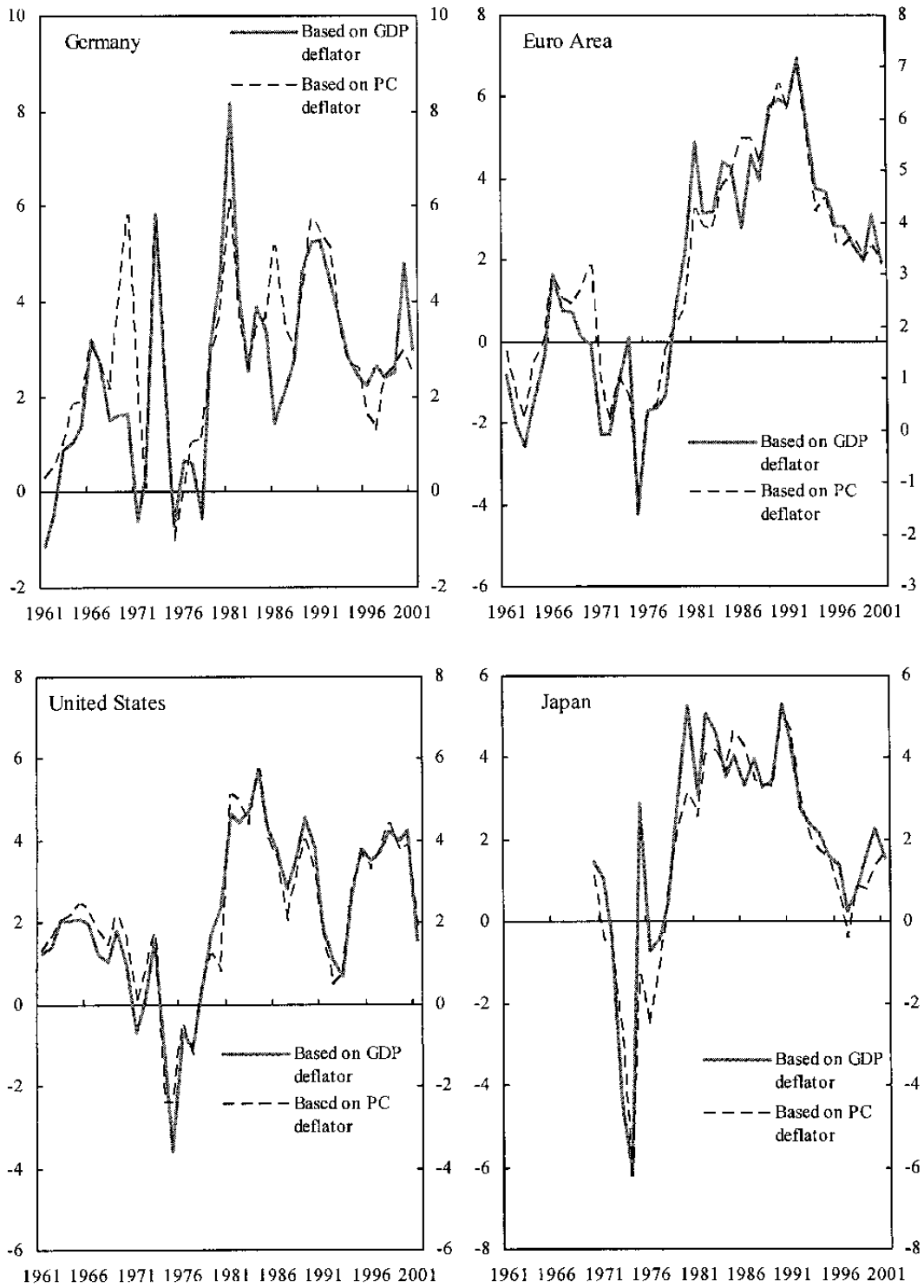
Historical experience of the euro area

Zero *nominal* interest rates have been rare in the industrialized post-war world, with the important exception of Japan since 1998. High inflation in the 1970s and 1980s made the zero floor for nominal rates a faint prospect, and the higher rate of potential growth as well as widespread quantitative limits on credit expansion in the 1950s and 1960s limit the relevance of the experience from those low-inflation decades for today's conditions.

Summers, 1991 reported that *ex post real* interest rates in the United States had been negative about one third of the time since World War II, a policy stance that could be difficult to achieve at near-zero inflation since nominal rates cannot be negative. However, the more relevant concept for assessing the policy stance is the *ex ante* short-term real interest rate (King, 1999). Using one-year-ahead survey expectations and interest rates observed at half-yearly intervals, King found that *ex ante* real interest rates in the U.S. had been negative only in three brief episodes (the second half of 1976 and the first half of 1977, and the first halves of 1980 and of 1993, comprising roughly 5 percent of the observations). In three of those half years the real rate was barely different from zero, while one observation was around $-\frac{1}{2}$ percent. Results for the U.K. show one instance of negative real rates over the same time span, which was, however, quantitatively insignificant.

Figure 10 uses historical IMF forecasts as a proxy for inflation expectations to calculate *ex ante* real short-term interest rates in Germany, France, Italy, and the United States since 1961. On this measure, real *ex ante* interest rates were negative only on few occasions and only when there was a sharp run-up in inflation, especially around the 1974 oil shock. Too low real interest rates on this instance arguably constituted a policy error, which fed subsequent high inflation. On balance, there is little in this experience with inflationary shocks to illuminate the risk that real interest rates may need to become negative in the face of adverse demand shocks.

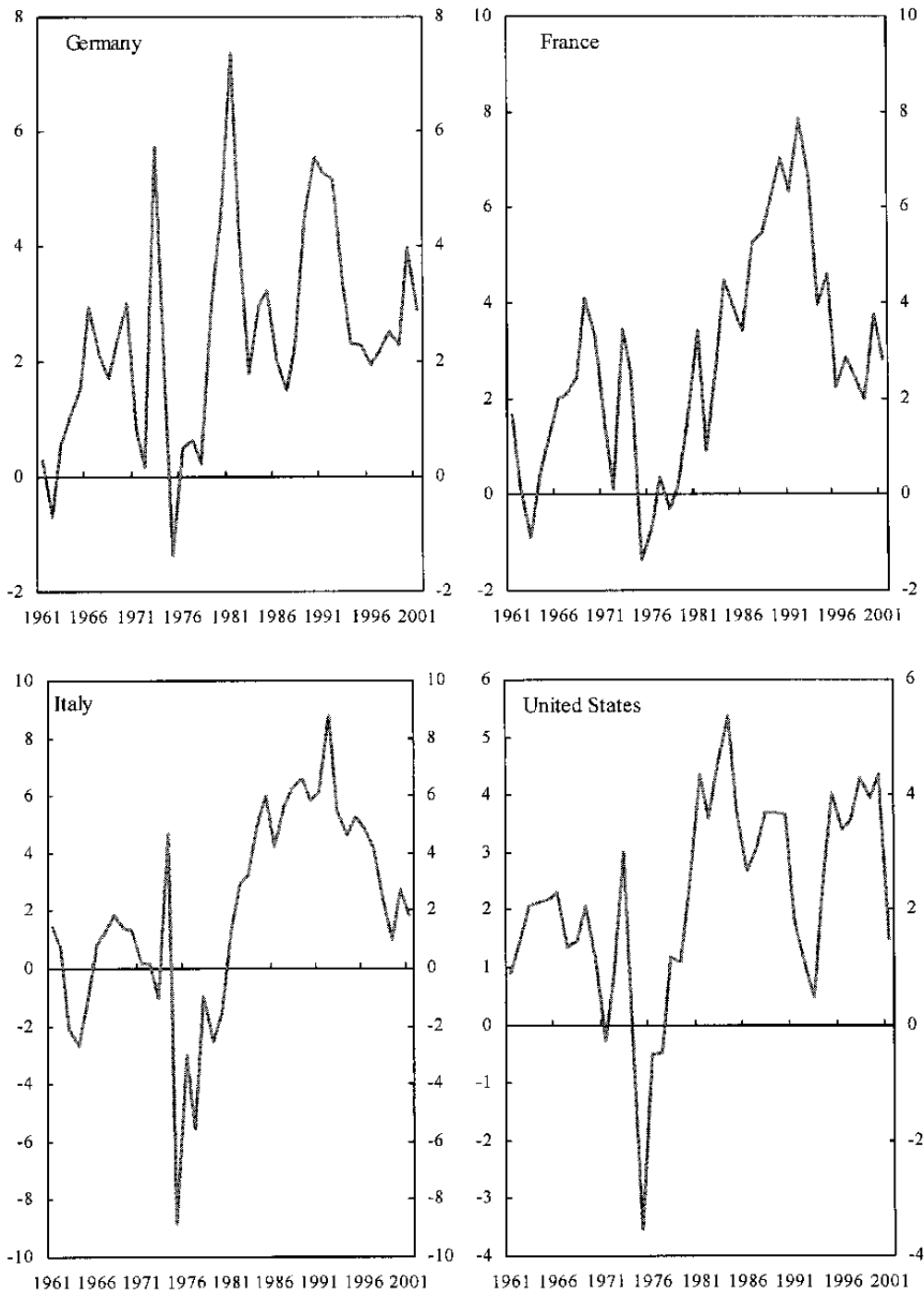
Figure 9. Ex Post Real Short-Term Interest Rates, 1961–2001



Sources: IMF; European Commission.

Note: PC deflator refers to the deflator of private consumption.

Figure 10. Ex Ante Real Short-Term Interest Rates, 1962–2001



Sources: IMF; European Commission.

Note: Inflation expectations are based on May WEO forecasts of the current year change in the GDP deflator. WEO forecasts were not available for the 1960s. For each country, the inflation forecast series over the 1971–2001 was regressed on lagged and actual inflation, and expectations during the 1960s were retroplated by assuming the same degree of foresight then as in 1971–2001.

Simulations of stochastic models

Given the limited relevance of historical experiences for today's environment, recent years have seen a proliferation of studies that explore the zero-bound issue in stochastic model simulations. Most have focused on the United States but qualitative implications may be drawn for other countries. The following surveys the results, first for standard Taylor policy rules and subsequently for alternative (extended) policy rules, and then adds some new evidence based on model simulations for the euro area.

(i) Simulations based on standard Taylor policy rules

Table 9 shows the probability that interest rates might hit the zero bound in three different model applications under different assumptions about the inflation target. The models range from small-scale new open macroeconomics models (Orphanides and Wieland, McCallum) to large-scale models (Reifschneider and Williams) with considerable variation in price and output dynamics and monetary transmission. The shocks and structural features of the models have been calibrated to U.S. rather than euro-area conditions, or, in the case of McCallum 2001, to a more generic "standard" open economy.

The probabilities are not strictly comparable across studies. For instance, the results quoted for Reifschneider and Williams, 1999 refer to the percent of time that the policy interest rate falls to zero in the simulations, whereas McCallum's results refer to the number of quarters in which the nominal interest rate is negative in his model. By allowing negative interest rates the latter approach tends to underestimate the severity of the zero bound.

There is considerable variation in the results. Orphanides and Wieland (the first paper in this line of research) found low probabilities of hitting the zero floor and concluded that *"the consequences of the zero bound are negligible for target inflation rates as low as 2 percent"*

although the constraint produces a *"significant deterioration of the performance of the economy with targets between 0 and 1 percent."*

Their simulation assumes an unusually low level for the neutral interest rate, which presumably biases upward the probability of the constraint becoming binding. On the other hand, their model generates unusually low variability of output and inflation, which has the opposite effect.¹⁵ Reifschneider and

Table 9. Probability That Interest Rates Become Zero Assuming Policy Follows a Standard Taylor Rule

	Inflation target			
	0.5	1	1.5	2
Orphanides and Wieland, 1998 1/	6	2	1	0
Reifschneider and Williams, 1999 2/	11	9	7	5
McCallum, 2001 3/	-	-	11	8

Note: some entries have been interpolated from neighboring observations.

1/ Small calibrated U.S. model, and a neutral real rate of 1 percent.

2/ FRB/US model, assuming a neutral real rate of 2.5 percent.

3/ Small calibrated model, and a neutral real rate of 2.5 percent.

¹⁵ The standard deviations of the quarterly output gap and inflation generated by their model under the Taylor rule (ignoring the zero bound) are 1.0 and 0.7 percent, respectively. By way of comparison, the realized standard deviation of the euro-area output gap is 1.6 percent in quarterly IMF data (1980Q1-2001Q4), and 1.4 percent in annual data (1980-2001). It is highly probable that inflation variability will be lower in the EMU regime than in the past.

Williams' results for the U.S. (using the Federal Reserve Board's FRB/US model) are broadly similar to the results for Japan in Hunt and Laxton, 2001, using the IMF's Multimod.¹⁶

The likelihood of hitting the zero target is not equivalent to the probability of ending up in a deflationary spiral, in which falling prices produce higher real rates which further depress demand and exacerbate negative price pressure. The probability of deflationary spirals is a good deal lower, cf. below. However, whenever the constraint becomes binding there is some loss of output and inflation stabilization.

(ii) Extended Taylor rules

The literature has explored modifications to the policy rule which might reduce the likelihood of hitting the zero bound and generally help output and inflation stabilization. Modifications include variations on the parameters in the Taylor rule; addition of the lagged interest rate to the rule (policy inertia); asymmetric responses where rates are lowered more aggressively if inflation nears zero; and inclusion of price level objectives in the rule.

Some representative results are reported in Table 10. Relative to the standard Taylor rule, the model simulations do not unanimously point to higher or lower risk of hitting the zero floor—in some cases a more “aggressive” policy rule implies greater interest rate volatility and thus more frequent cases when the zero floor is binding, while in others more active policy has a preventive effect and leads to a fall in the risk of zero interest rates (cf. also Rotemberg and Woodford, 1999; Batini and Haldane, 1999; and Levin, Wieland, and Williams, 1999). Vinals, 2000 represents an outlier in showing zero probabilities of hitting the zero floor even at very low inflation rates. One reason is that his calibration entails a volatility of detrended euro area output of 0.45 percent, which is low relative to the U.S. using the same methods (0.80 percent), and relative to other studies (cf. footnote 15).

Table 10. Probability That Interest Rates Become Zero Assuming Policy Follows a Modified Taylor Rule

	Inflation target			
	0.5	1	1.5	2
Orphanides and Wieland, 1998 1/	23	9	6	2½
Reifschneider and Williams, 1999 2/	13	9	6	4
McCallum, 2001 3/	6	4	3	2
Vinals, 2000 4/	0	0	0	0

Note: some entries have been interpolated from neighboring observations.

1/ Small calibrated U.S. model, and a neutral real rate of 1 percent.

2/ FRB/US model, assuming a neutral real rate of 2.5 percent.

3/ Small calibrated model, and a neutral real rate of 2.5 percent.

4/ Small calibrated euro area model, and a neutral rate of 3 percent.

¹⁶ Reifschneider and Williams increase the actual target rates of inflation that appear in the policy rule to compensate for the decline in average inflation outcomes that will otherwise arise in the face of the zero bound constraint. For example, to achieve an average outcome of 0.0 percent inflation, the actual target rate for inflation in the policy rule is 0.7 percent.

The simulations sometimes rely on assumptions that may be difficult to achieve in practice. For instance, although adding an element of price level targeting may be helpful for countries that have fallen in a deflationary spiral because it raises inflation expectations, the central bank may find it difficult to convince the public of its ability to deliver on its promise, as well as its willingness to endure higher inflation after the economy escapes the trap.

Implications for the euro area

The relevance of the zero bound issue for the euro area depends in part on the comparative features of the euro area economy with respect to:

- ***The neutral rate:*** the higher the steady state real interest rate in the economy, the lower the probability of the zero interest rate floor becoming binding. The equilibrium real interest rate is primarily determined by the natural rate of growth (the growth of the labor force and the rate of technical progress), and the propensity to save, which in turn hinges on the rate of time preference, the risk aversion of economic agents, government finances, and tax distortions. With global capital mobility providing an equalizing force across countries, the neutral rate in the euro area is likely to be similar to that of other industrialized countries, even if the area's comparatively modest potential output growth rates might suggest that the neutral rate is lower than, e.g., in the United States.¹⁷
- ***Inflation inertia*** can cut both ways.¹⁸ With high inflation inertia, real shocks initially dislocate inflation less, but then the real economy needs to be shifted more to restore inflation to target. In the case of price shocks, the real economy needs to be shifted more to stabilize inflation. Historically, the euro area exhibited comparatively high inflation persistence, in part because of the interaction of oil price shocks with wage indexation and low real wage flexibility, and in part because of monetary policies (in the 1970s and early 1980s) that allowed inflation to become ingrained in expectations. Recent experience suggests inflation inertia has declined in the area but still remains higher than, e.g., in the United States.

The likelihood of the zero constraint becoming binding depends also on the frequency, severity, and duration of the shocks hitting the economy; structural features of the economy including its openness and the monetary transmission mechanism; expectations formation; and the responses of the monetary authority before the zero bound becomes binding (for a wide-ranging survey, see Yates, 2002).

¹⁷ Estimates of potential growth in the euro area are 2-2.5 percent (ECB), and 2.2-2.4 percent (IMF, OECD, and European Commission). In a dynamically efficient economy, the neutral interest rate is higher than potential growth in steady state, although it might be lower or higher during transitions from one steady state to another.

¹⁸ Here, inflation inertia denotes the weight on past inflation relative to forward-looking (model-consistent) inflation in determining near-term inflation expectations.

To explore the issue further, stochastic simulations were run with the euro-area block of IMF's Multimod. Based on a neutral interest rate of 2.7 percent, the results are reported in Table 10 under the assumption that inflation persistence and price shocks remain in line with historical experience. Policy follows an optimal rule which responds more strongly to inflation and output gaps than a simple Taylor rule, and includes an asymmetric objective not to let the price level fall. This approach minimizes the probability of the zero interest rate floor becoming binding in the simulations.

The probabilities of the zero interest rate floor becoming binding are in line with the majority of those reported in Tables 9 and 10. Table 11 also reports the simulated probabilities of falling into a deflationary trap over the course of a 100-year period if the economy is subjected to shocks similar to those that occurred during the 1980s and 1990s (here, a deflationary trap is a situation in which the model does not solve, so that monetary policy

acting through the interest rate channel alone cannot restore the economy to equilibrium; see Hunt and Laxton, 2001 for details of the methodology). The probabilities assume a perfectly credible commitment to generate future inflation under the optimal policy rule.

Table 11. Euro Area: Impact of Average Inflation Target on Probabilities of Zero Interest Rates and Deflation 1/

	Inflation target			
	½	1	1½	2
<i>Optimal policy rule</i>				
Probability of zero interest rates	16	11	9	3
Probability of a deflationary spiral 2/	10	4	3	0

1/ Based on Multimod simulations and neutral real rate of 2.7 percent.

2/ Actual probabilities may be lower, e.g. if "unconventional" monetary policy measures are considered; see main text for details.

The simulated probabilities should probably be seen as *upper limits* on the risks of deflation for two reasons:

- **“Unconventional” monetary policy:** the key assumption that monetary policy becomes ineffective at the zero interest rate floor does not take account of non-conventional policy measures, as described above (see Bernanke, 2002; and e.g. Svensson, 2001 on “A Foolproof Way of Escaping From a Liquidity Trap.”). One could well argue that the probabilities measure the chances that unconventional policies might be called upon rather than the risk of deflationary spirals per se.
- **Regime change:** the persistence in the inflation process as well as the standard deviation of price shocks seems likely to have declined in line with structural reforms enacted in the euro area in the 1990s and, especially, the regime shift to EMU which anchors inflation expectations much more firmly than used to be the case. In this perspective, the probabilities of being caught in a deflationary spiral have probably decreased for each level of the inflation target.

Although the simulated probabilities of deflationary traps are clearly model- and parameter-specific, the cumulated evidence suggests that the risk of the zero interest rate floor becoming binding would be non-negligible if trend inflation rates were maintained significantly below 2 percent. Moreover, even if the probability of entering a deflationary spiral may not be great, Japan's experience is a sobering reminder that the ability of policy to escape the spiral could be limited. In this connection, prevention is easier than cure and a high premium should be put on avoiding deflationary traps in the first place.

V. CONCLUSION

The Eurosystem has chosen to provide a definition of its price stability objective which is more specific than some central banks, such as the U.S. Federal Reserve and the Bank of Japan, but less specific than traditional inflation-targeting central banks. The criticism of the Eurosystem's target definition for being ambiguous and asymmetric has come primarily from those who favor inflation targeting over other monetary strategies. (See Subsections II.A and II.B)

There are potentially good reasons for not switching to full-fledged inflation targeting. An inflation forecast for a given horizon cannot plausibly summarize all information relevant for policy in all situations, including considerations of financial stability and asset-price misalignments. And the horizon over which inflation is brought back to target after a shock should optimally depend on the nature and size of the shock. On these points, however, both the theory and practice of inflation targeting has moved in the direction of alleviating ECB concerns about full-fledged inflation targeting. (Subsection II.C)

The paper reviewed some potential costs and benefits of the current definition of the objective versus a point target for inflation, and found (Subsections II.D and II.E) that:

- *Policymaking* appears so far to have been very much in line with how an inflation-targeting central bank with a target of 1½ to 1¾ percent would have behaved;
- *Difficulties in communicating* policy in the first years of EMU are partly rooted in the current specification of the objective; communication would remain a challenge under flexible inflation targeting, however, at least if and when the bank wanted to deviate from its target at short horizons for the types of reasons mentioned above; and
- *Inflation expectations* in the euro area have been firmly anchored at around 1.8-1.9 percent over the medium term, consistent with the definition of price stability. Expectations have been as stable over time, if not more so, than for inflation-targeting central banks, and the dispersion of inflation expectations appears to have been no greater than in other cases examined.

In sum, the differences between the ECB's current goal specification and those of inflation-targeting central banks are probably less important, and the relative merits more finely balanced, than has been acknowledged by many observers. Moreover, any potential gains from changing the goal specification would need to be weighed against the possible credibility costs of doing so.

While neither this paper nor the economics profession more broadly has come to a firm conclusion concerning the "optimal level of inflation" in the euro area (or elsewhere), the same holds true for other issues—for example, monetary transmission—on which the practice of monetary policy nevertheless requires policymakers to take a stance. While based on the premise that price stability brings great benefits (Section III), the paper examined various arguments for maintaining inflation somewhat above zero and found that:

- *Inflation measurement bias* in the harmonized European price indices, while inherently unknowable, may account for a nonnegligible fraction of observed inflation. The bias appears to be smaller than in some other cases—for example, the Bank of England’s RPIX inflation target of 2.5 percent may well correspond to inflation of 2 percent or less in terms of the U.K. HICP. Formula biases are likely to be smaller than the widely quoted Boskin estimate for the U.S. CPI, but other elements of measurement bias appear likely to be at least as high as in the United States. (Section IV.A)
- *Balassa-Samuelson and price convergence* processes are liable to cause long-lasting differences in trend inflation across EMU members. The analysis suggests that such differences are likely to be smaller than indicated by most estimates of the Balassa-Samuelson model, but high-income countries could still experience trend inflation at $\frac{1}{4}$ - $\frac{1}{2}$ percentage points below the euro average, while catching-up countries could be up to 1-1½ percentage points above it. Moreover, such differences would become more pronounced in future if the EMU were enlarged to include countries with significantly lower GDP per head than current members. All else equal, this suggests that the inflation target should not be lower in the diverse euro area than for individual countries that have adopted inflation targets. (Subsection IV.B)
- *Downward nominal wage rigidities* appear quite prominent and could restrain or delay relative wage adjustment across occupations and regions within countries, as well as across countries in response to asymmetric shocks. Inflation may also distort price signals in the labor market, however, and there is little firm evidence to suggest that the upper limit of the ECB’s definition of price stability is too strict to allow such processes to play out. Illustrative simulations suggest that the potential costs increase as the target is lowered below 2 percent. (Section IV.C)
- The *zero-interest rate floor* under nominal interest rates may constrain monetary policy effectiveness if the economy is threatened by deflation; the evidence presented here suggests that the risks of monetary policy being constrained by the zero-interest rate floor are minor for inflation targets down to 2 percent and possibly lower when inflation expectations are well anchored by the central bank target, whereas they increase progressively for targets too close to zero. Although monetary policy may also act through unconventional channels, experience from around the world suggests that prevention is far easier than cure, and uncertainty argues for a risk-averse approach. (Subsection IV.D)

Whereas the benefits of driving inflation significantly below 2 percent seem either small (for example, lower shoe-leather costs) or better dealt with through other means (for example, tax reform), the potential costs would appear to rise progressively for rates significantly below 2 percent. Bearing in mind that, at the margin, the potential costs of setting the inflation target too low seem more severe than those of setting it too high, caution would argue against the former. The analysis suggests that an inflation target toward the upper end of the ECB’s price-stability range would, at least with the current membership of EMU, strike a judicious balance between reaping the benefits of price stability and allowing inflation to “lubricate the wheels” of price and wage adjustment and safeguard against deflation.

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