Securing the Peace after a Truce in the War on Inflation

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Central bankers in the major industrial economies have come close to securing the peace, or in some cases, have secured it in the battle against inflation, hostilities that lasted almost as long as the Cold War. It is important to remember that this battle has been a good fight: both the theory and the empirics reviewed in this paper support the central tenet of central banking that lower inflation supports faster economic growth. However, the observation that low inflation is associated with a macroeconomic benefit does not imply that disinflation should be pursued without limit. A particularly compelling argument in the body of work on the optimal inflation rate is the view that price deflation, or even very low inflation, may pose unacceptable macroeconomic risks given the lower bound of nominal interest rates of zero. Empirical work in this paper suggests that the zero bound is not an artifact of theoreticians but a palpable reality. That said, the perils of the zero bound to nominal interest rates may be seen as less threatening if a central bank is willing to be both aggressive in providing policy accommodation when the economy may be nearing the zero bound and flexible in using the available tools of policy.

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I. Introduction

In the war against inflation, in hostilities that have lasted almost as long as the Cold War, central bankers in the major industrial economies have come close to securing the peace or, in some cases, have already done so. In most major countries, consumer price inflation has fallen to around 2 percent, about one-third the pace of 20 years ago (Table 1). The prevailing inflation rate of the past 10 years in the United States, about 2.25 percent, was last routinely achieved in the 1950s. And the deflation of the past five years in Japan implies that the current level of consumer prices is now the same as in 1995. In this fight, as in the Cold War, considerable resources were devoted to the effort, and there were no decisive victories but rather a slow grinding down of the enemy as the advantages of the alternative regime became increasingly obvious.

Military history counsels two lessons for securing the peace after a long war. First, do not underestimate the resilience of the old foe. Central banks should view subdued inflation as merely a temporary truce rather a final victory. Such watchfulness and responsiveness is important, because inflation can be kept low only as long as a nation's citizenry rightly believes that their central bank will not tolerate its resurgence. Second, shift at least some resources to position yourself to tackle the next possible enemy. If inflation is low and not thought likely to rise appreciably, central banks should focus at least some attention on understanding how to deal with adverse shocks given low inflation. These two lessons combine to a simple aphorism for the conduct of monetary policy: lock in the gains from the last battle and prepare for the next.

This paper will expand on the aphorism by discussing three lines of argument.

First, the battle against inflation has been a good fight. A changeable price level clouds household and firm decision making and exacerbates distortions in the tax system, pulling economic activity below its maximum sustainable level and possibly impairing the expansion of its potential. After presenting the arguments from the theoretical literature in Section II, I examine the data for 178 countries over the past quarter-century in Section III and find that they appear consistent with a decidedly negative effect of inflation on real economic growth. Moreover, this effect is robust across econometric techniques. Thus, over time much could be lost by a failure to secure the current low inflation.

Table 1 Average Consumer Price Inflation

Percent, annual rate over the period

	1980–84	1985–89	1990–94	1995–99	2000–04
Canada	8.7	4.3	2.8	1.6	2.4
France	11.1	3.6	2.6	1.3	1.8
Germany	4.6	1.3	3.7	1.1	1.2
Italy	16.6	6.2	5.4	3.0	2.5
Japan	3.9	1.1	2.0	0.4	–0.7
United Kingdom	9.4	4.7	5.0	2.7	2.3
United States	7.5	3.6	3.6	2.3	2.2

Source: International Monetary Fund, *World Economic Outlook* (April 2004).

Second, the observation that low inflation is associated with a macroeconomic benefit does not imply that disinflation should be pursued without limit—the subject of Section IV. In particular, the empirical evidence of the way a modern economy performs in deflation is scant. Brief episodes of deflation have occurred in the past quarter-century, but they have been the exception, not the rule. A particularly compelling argument in the body of work on the optimal inflation rate is that price deflation, or even very low inflation, may pose unacceptable macroeconomic risks given the lower bound of nominal interest rates of zero. In particular, a prevailing expectation of either low inflation or declines in the general price level limits how far the central bank can push down the real short-term interest rate. That may lead to output losses, on average, if because of occasional adverse shocks to aggregate demand a very low—perhaps negative—real interest rate is needed to encourage spending. Regression evidence presented on the Japanese and U.S. economies over the past 30 years, including estimates of expected real short-term interest rates and their relation to the output gap, suggests that the full employment of resources required low real short-term interest rates in more than a few years.

Thus, central bankers face a difficult trade-off in choosing their long-run inflation objective. Low inflation fosters economic growth and keeps distortions to a minimum. But too low an inflation goal—particularly if it allows veering into deflation at times—may threaten the attainment of maximum sustainable employment by raising the lower bound on real interest rates.

A third objective of this paper, as laid out in Section V, is to show that the perils of the zero bound to nominal interest rates may be seen as less threatening if a central bank is willing both to be aggressive in providing policy accommodation when the economy may be nearing the zero bound and to be flexible in using the available tools of policy. In particular, policymakers may have scope to be explicit about their outlook for the economy and expectations for the likely path of policy to ensure that investors' expectations are correctly aligned. *In extremis*, central banks may need to resort to more direct attempts to influence market yields through outright purchases of securities, perhaps in large volume. In any circumstance, it is important that the public understand that the central bank has the tools—and the willingness to use them—to prevent doubts by households' and firms' doubts about economic prospects from becoming self-reinforcing.

The entire discussion reflects my own views, which are not necessarily shared by others within the Federal Reserve System.

II. Why Should Inflation Be Kept Low?

Many elegant theoretical models support the routine assertion of central bankers that keeping inflation low in the long run generates many benefits. Some of these benefits are that a low inflation rate allows firms to avoid costs associated with changing the prices of the goods and services they sell, permits potential purchasers to detect relative price changes more easily, reduces the cost associated with holding money balances (thereby cutting down on transactions costs), and vitiates nominal distortions in the tax code. As opposed to these benefits, some analysts argue that a bit of inflation enables

relative prices to adjust without imposing the burden on reluctant workers to have their nominal wages decline. Inflation may also look attractive if there is a concern that the zero lower bound to nominal interest rates imposes an unattractively high lower limit on real interest rates. And concerns about the seigniorage from money creation, especially in developing economies, may raise the attractiveness of inflation. These arguments can be treated in order of their implication for how low inflation should go.

A. Lowering Transactions Costs

The central bank is a zero-cost provider of a useful resource. That is, money balances in the hands of the public may reduce the cost of transacting, aid firms in producing, and make households feel better off.[1] A central bank could maximize welfare by satiating the demand for money balances and subsequently maintaining money growth in a manner so that the public willingly holds that high level of balances. This is the Friedman rule, which calls for steady contractions in the nominal money stock so that prices decline at the rate equal to the rate of time preference, thereby ensuring that the nominal short-term interest rate equals zero and the public demands a level of real balances at the satiation point.[2] Thus, deflation is to be welcomed, not feared, because agents will no longer devote resources in an effort to conserve their holdings of something that the central bank can provide at zero cost.

B. Saving Menu Costs and Reducing Distortions

An economy may have mechanisms—including institutional strictures or governmental distortions—that require the expending of resources when nominal prices change. Canonical examples include menu costs that require a firm to devote some resources to changing prices, search costs as households have to distinguish between changes in the general price level (whether up or down) and changes in relative prices, and distortions in the tax system in which the real burden of a tax changes with the nominal price level.[3] Because of such resource costs, policymakers may be inclined not to go as far as the Friedman rule—and impose the burden on the private sector in responding to a changing (that is, falling) general price level—especially if they think that the welfare benefit of increasing real balances to the satiation point is modest. In general, such mechanisms add to the attractiveness of achieving price stability—a zero inflation rate—because at that point none of these resource costs are incurred.[4]

C. Offsetting Downward Rigidities

An older argument emphasized concerns about a potential asymmetry in price setting.[5] In particular, in their wage-setting behavior, workers may have an element of money illusion or view norms of fairness and relative performance as especially

1. More formally, real money balances may enter the budget constraint by influencing transactions costs, the firm production function, and household welfare. Feenstra (1986) discusses the equivalences among these approaches.
2. As discussed in Friedman (1969).
3. Menu costs are discussed by Mankiw (1985), search costs are the key feature of Lucas's island parable (Lucas [1972]), and tax distortions are central to Feldstein's view of the optimal inflation rate (as discussed in Feldstein [1999]).
4. Of course, in a heterogeneous economy facing many shocks, relative prices may need to change frequently, implying that menu costs would be incurred at a stable general price level and lessening the benefit of low inflation.
5. A modern treatment is provided by Akerlof, Dickens, and Perry (1996).

important. If so, they may respond poorly to wage bargains requiring declines in nominal compensation even if their real wages were actually unchanged or rising because of a falling general price level. Such resistance to price declines poses a barrier that may imply a less-than-full employment of resources, at least for a time, if prices are declining. And the heterogeneity of a modern industrial economy may imply resource losses at positive, but low, inflation rates because of such a barrier. In particular, in a complicated economy with a range of goods and services being produced, some relative prices will be increasing and some decreasing in response to changes in taste and production possibilities. At a zero or low general inflation rate, firms in the sector with declining relative prices would have to cut their nominal prices and possibly the wages of their workers. If such cuts in money terms are resisted, some portion of the work force will have inappropriately high real-wage demands, a situation resolved over time only by less-than-full employment. The logical extension of this argument is that a higher general inflation rate provides cover for reductions in real wages without outright cuts in money wages and, thereby, will be associated with a higher level of resource utilization on average.[6]

D. Providing Insurance against Adverse Outcomes

The practice of modern central banking incorporates an important element of risk management; policy needs to be designed not only to deliver the best possible average performance of the economy but also to minimize the risks of especially adverse outcomes. One concern is that an economy's performance may entail significant and uncertain nonlinearities in regions that are less traveled. As one example, if inflation were allowed to drift up to a high level, household inflation expectations might worsen dramatically and contracts might change to include an element of indexation in a manner that would make checking a further rise in inflation difficult. As another, if aggregate demand softened precipitously in the face of adverse shocks, the associated worsening of household and business confidence and increased fragility of the financial system might exacerbate the downdraft in spending.

One region of potential nonlinearity is mapped out by the zero bound to nominal interest rates.[7] Once the nominal policy rate moves down to zero, the real short-term interest rate equals the negative of the inflation rate expected to prevail. Such a real rate may be too high to ensure the full employment of resources. If it is too high, then the associated output gap will put more downward pressure on inflation and lead households to lower their inflation expectations further, pushing the real rate up and further increasing its spread above its equilibrium level. Unless some other force provides an offsetting impetus—or monetary policy has a means to influence the economy beyond the level of the short-term nominal interest rate (see Section V)—it would be only a matter of time before a deflationary dynamic sets in.[8] To ensure

6. This argument might be particularly telling in a currency union where members exhibited varying degrees of structural flexibility.
7. McCallum (2000) explains why the zero bound binds, and Reifschneider and Williams (2000) and Coenen, Orphanides, and Wieland (2003) discuss its implications for the strategy of monetary policy. Ahearne *et al.* (2002) apply this logic to the Japanese situation.
8. The other force could be exogenous, such as fiscal policy, or endogenous, such as an important role for wealth that ultimately leads to increases in aggregate demand through a Pigou effect.

against such an eventuality, the argument goes, the central bank should set a goal of nonzero inflation in the long run; the higher the goal, the less likely the economy is to enter into the region of suspected nonlinearities.

E. Preserving the Revenue from Money Creation

A particularly relevant argument for a developing or emerging market economy is that money creation represents an important source of revenue. Reducing inflation and forgoing that revenue may prove risky if alternative means of taxation or spending reduction are unavailable, because it will require an increased reliance on debt finance, all else being equal. Finding alternative means of funding may be problematic for countries that have weak institutional structures which make them susceptible to funding difficulties—those that are "debt intolerant" in the phrase of Reinhart, Rogoff, and Savastano (2003).

F. Discussion

These arguments are not competing but rather different possible mechanisms in modern industrial economies that must be weighed in settling on the desired long-run goal for inflation. The analysts who favor a low, potentially negative, number as the appropriate goal tend to stress the inefficiencies associated with the public's economizing on a resource that the central bank can make for free. The difficulty with that argument is that estimates of significant welfare loss associated with achieving the Friedman rule as opposed to, say, a zero inflation rate are hard to come by.[9] An emphasis on menu costs or tax distortions creates a fixed point at zero for the optimal inflation rate that is hard to dislodge, but, again, the quantitative significance of such effects is hard to assess, especially when real shocks require relative prices to adjust fairly frequently. As for a reliance on money illusion or other factors that argue for some inflation "grease" in the price system, the norms representing an obstacle to price declines presumably would change over time as workers saw increases in purchasing power at unchanged or declining money wages. The empirical evidence, at least in the United States, is ambiguous as to whether declines in wages are uncommon (as discussed in Lebow, Saks, and Wilson [2003]). And the risk management approach weighs average economic performance against adversities in the tail of potential outcomes—but the tails of distributions, by definition, are infrequently observed events that make quantification difficult. Emphasis on the revenue from money creation is not particularly to the point of this paper's consideration of industrial economies.

By my reading, the weight of the evidence should incline a central bank to a low, but nonzero, inflation goal. That judgment rests on (1) the view that the welfare gain associated with the Friedman rule as opposed to a small positive inflation rate is modest, (2) the lack of evidence indicating significant menu or distortionary costs, (3) the belief that money illusion is at most transitory and can be ameliorated by explaining the central bank's goal for inflation, and (4) an empirical assessment about the desirability of insurance against the zero bound and the availability of

9. The intuition is that the demand for money balances is not that elastic at the range below zero, implying that not much consumer surplus is lost when moving from a zero nominal interest rate to a nonzero level.

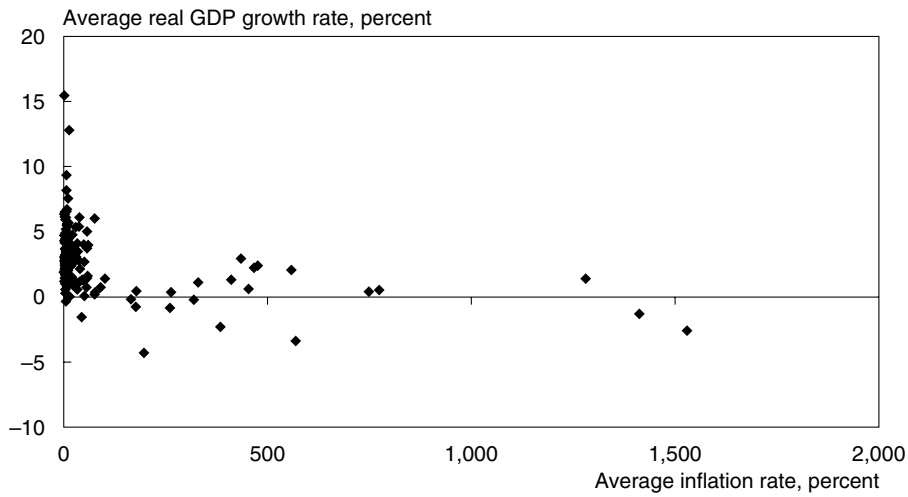
monetary policy tools with uncertain effectiveness in that eventuality. But this matter ultimately is empirical: one must first establish whether output growth and inflation are associated and then address the quantitative significance of the zero bound.

III. Some Evidence on Inflation and Growth

Without question, there has been a considerable volume of work on the correlation between output growth and inflation over time and across countries, as exemplified by Bruno and Easterly (1996) and Barro (1996).[10] A message from this work is that properly identifying the correlation depends critically on including appropriate control variables in the regression. From a central bank's perspective, however, the unconditional correlation may provide important information, in part because inflation may be under policymakers' control in a way that most of the conditioning variables in standard growth regressions are not.

In that regard, the unconditional association shows through in even the simplest representations of the data, as in Figure 1, which plots average inflation rates (along

Figure 1 Inflation and Real GDP Growth, Averages (178 Countries, 1980 to 2004)



OLS estimation: average real GDP growth

	Estimate	Standard error	*t*-statistic
Constant	3.181	0.177	17.953
Average inflation rate	–0.004	0.001	–5.336
R-squared		0.139	
Adjusted R-squared		0.134	

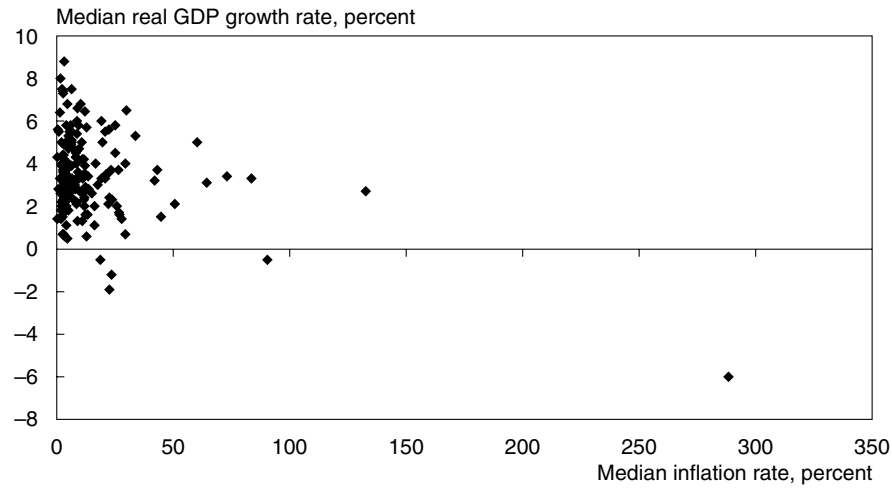
Source: International Monetary Fund, *World Economic Outlook* (April 2004).

10. This pairing of papers highlights the range of views on the subject. The theoretical literature just reviewed is scattered as to whether inflation should be associated with economic welfare or the level or growth rate of output.

the horizontal axis) against the average real GDP growth rate (along the vertical axis) for the 178 countries in the International Monetary Fund's *World Economic Outlook* (WEO) database.[11] These averages are taken from the annual data available for 1980–2004 (with the WEO forecast filling in the observations for the final two years of the sample). A negative association is evident in the data, with a simple regression through those points indicating that a decline of 10 percentage points in the average rate of inflation raises real GDP growth by 0.04 percentage point. Such a decline in inflation may seem outsized relative to the contained performance of price growth of most industrial countries in recent years, but enough observations lie in the right portion of Figure 1 to suggest that high inflation has been a fixture in a significant fraction of the globe. And that a fraction of the world well may have lower economic growth, in part, because of outsized changes in the price level.[12]

Simple averages of inflation and real GDP growth may be influenced by large outliers and an estimation technique, such as ordinary least squares (OLS), that particularly penalizes deviations from the norm. However, as is evident in Figure 2,

Figure 2 Inflation and Real GDP Growth, Medians (178 Countries, 1980 to 2004)



OLS estimation: median real GDP growth

	Estimate	Standard error	*t*-statistic
Constant	3.753	0.149	25.210
Median inflation rate	–0.026	0.005	–5.275
R-squared		0.137	
Adjusted R-squared		0.132	

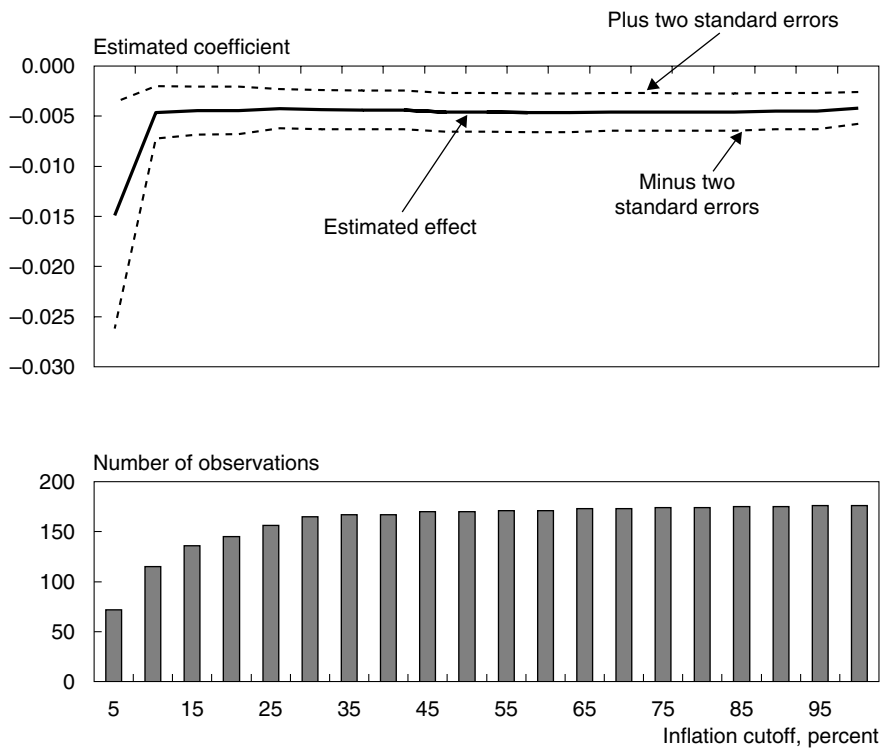
Source: International Monetary Fund, *World Economic Outlook* (April 2004).

11. These data are available at www.inf.org/weo/database/april04.
12. Of course, the causation likely runs both ways. Governments with a collection of poor policies that hinder growth may also be reduced to rely more heavily on the inflation tax. That is, inflation is an indicator of poor macroeconomic performance. Alternatively, a central bank targeting a fixed growth of nominal income in an economy with variable productivity growth would also generate such an association.

the negative association between inflation and output growth holds when medians are used instead of averages. Indeed, reducing the range of variation in the horizontal axis by a factor of five and that of the vertical axis by a factor of two makes the negative relationship between inflation and output growth show through more clearly. By this estimate, a reduction in inflation of 10 percentage points raises output growth by 0.25 percentage point, not a trivial amount economically, especially when compounded over time.

A few outliers of very high inflation rates are evident in this figure, even after a switch to a more robust measure of central tendency. To control for these outliers in a more systematic manner, I carried out regressions of output growth on inflation in which the sample of observations was truncated at median inflation rates ranging from 5 percent to 100 percent, in increments of 5 percentage points. In Figure 3, which reports these regressions, the solid line plots the point estimate as the sample varies; it is surrounded by dashed lines that give a 95th percentile confidence band. Even if

Figure 3 Estimated Effect of Inflation on Growth (As the Sample Varies by the Median Inflation Rate)



Note: The sample of observations on median annual inflation and real GDP for 178 countries is truncated (as shown along the horizontal axis) at median inflation rates ranging from 5 percent to 100 percent.

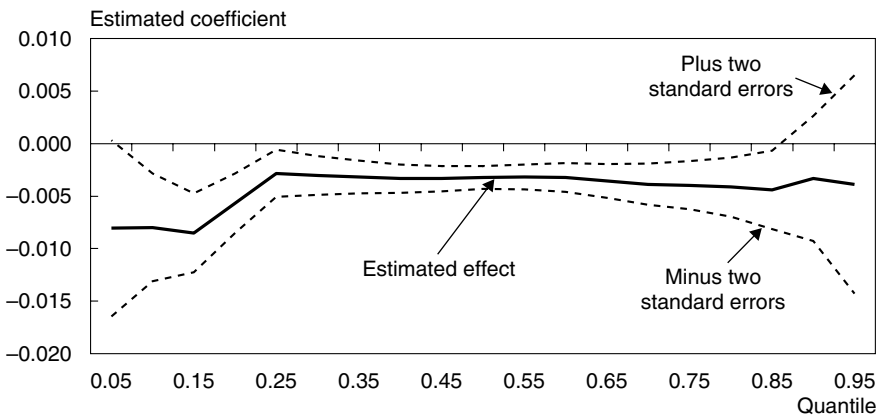
Source: International Monetary Fund, *World Economic Outlook* (April 2004).

the sample is limited to the 70 economies that have a median inflation rate at or below 5 percent, a distinct negative relationship between inflation and economic growth emerges. Adding higher-inflation countries actually lowers the estimated effect, but appreciably narrows the confidence band around those point estimates. Limiting the sample to countries with median inflation rates no higher than 100 percent does trim the size of the estimated effect, but the broad flat range of the estimates suggests that a robust rule of thumb is that a decline of 10 percentage points in inflation raises output growth by about 0.05 percentage point.

Varying the sample size is a crude attempt to control for the heterogeneity of the sample. A more robust way is to fit the relationship to minimize a specific percentile of the distribution of the absolute value of the errors.[13] Figure 4 reports such quantile regressions in which the coefficients are chosen to fit the percentiles ranging from the fifth to the 95th, in increments of 5 percentage points as measured along the horizontal axis. Again, for the broad range of the sample, the estimate effect of inflation on output growth is in the neighborhood of –0.005 and is tightly estimated, except in the attempt to explain the two extreme tails of the distribution of the absolute value of the errors.

To be sure, the estimated effect of inflation on output growth is not large across the range of regressions, particularly from the perspective of the industrial countries, listed in Table 1, that posted declines in inflation on the order of 5 to 10 percentage points. However, the effect differs statistically from zero and would cumulate in a present-value sense to raise wealth and perhaps lessen the need to resort to distortionary policy interventions.

Figure 4 Estimated Effect of Inflation on Growth (Using Quantile Regressions)



Note: Quantile regression estimates in which the objective is to minimize the absolute value of the errors at quantiles ranging (along the horizontal axis) from the fifth percentile to the 95th.

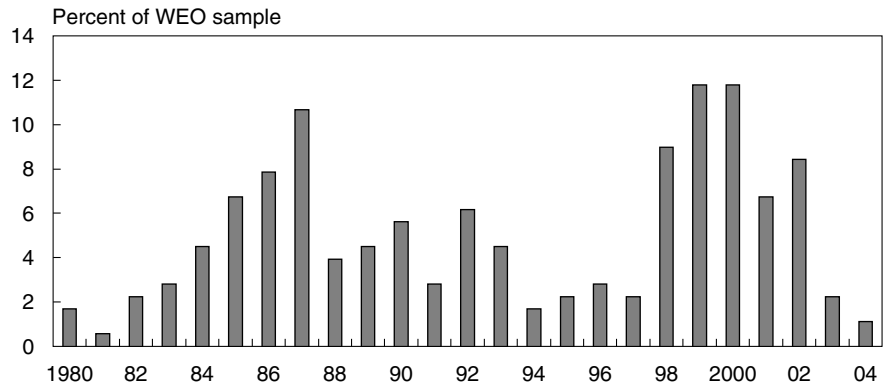
Source: International Monetary Fund, *World Economic Outlook* (April 2004).

13. Fitting the 50th percentile, for instance, is equivalent to the least absolute median estimator. See Koenker and Hallock (2002) for an introduction to quantile regression.

IV. How Can There Be Too Much of a Good Thing?

While the historical record of the past quarter-century supports the contention of central banks that benefits accrue from keeping inflation low, there is a limit to the inferences possible from that data set. In particular, in the WEO sample of 178 economies, no economy posted an average or median inflation rate below zero from 1980 to 2004. Indeed, of the sample only 2.25 percent had medians as low as 1 percent and only 6.75 percent had them as low as 2 percent. That result, however, does not mean that inquiries into an economy's performance in deflation are irrelevant. Again using the WEO data set, Figure 5 documents the results of a simple counting exercise, with each bar recording the number of countries with deflation in any given year. An occasional bout of deflation is not uncommon: in every year since 1980 at least some country had declining prices, and in three years (1987, 1999, and 2000) more than 10 percent of the sample posted price declines.[14] As shown in the note to the figure, 72 economies out of the sample of 178 experienced at least one year of outright deflation since 1980. These calculations, which use measured consumer price inflation, probably overstate actual inflation because of various biases in their construction. If we use the rule-of-thumb bias of 1 percentage point, which seems appropriate in the United States, then 106 countries experienced a decline in prices measured correctly in at least one year.[15]

Figure 5 Fraction of Economies in the WEO Database Experiencing Deflation (By Year, 1980 to 2004)



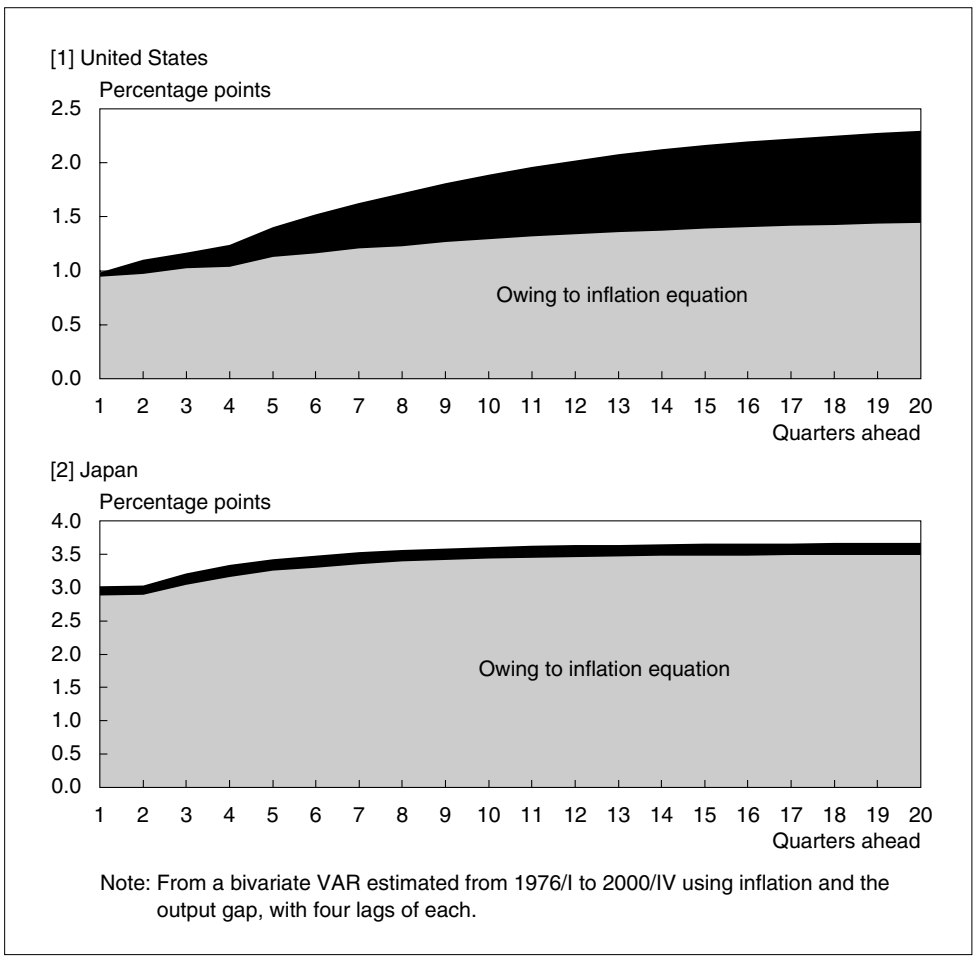
Note: Of the 178 countries in the WEO sample since 1980, 72 experienced at least one year of deflation and 106 experienced at least one year of inflation under 1 percent.

Source: International Monetary Fund, *World Economic Outlook* (April 2004).

14. The bars in this figure seem to track the weighted foreign exchange value of the U.S. dollar, perhaps because the economies keeping their exchange rate unchanged to the dollar receive a deflationary impulse when the U.S. currency is strong.
15. Schultze (2003) provides an update on the biases in major price indexes in the United States.

From a planning perspective, another aspect of the dynamics of inflation in industrial countries is of note. In particular, inflation tends both to be inertial in the short run and unpredictable over longer periods.[16] One way of seeing the latter property is through a simple forecasting exercise. I constructed a measure of the output gap by applying the Hodrick-Prescott (HP) filter to quarterly real GDP in Japan and the United States from 1970 to 2003.[17] I then fit two bivariate vector autoregressions (VARs) in the estimated output gap and inflation (as measured by the logarithmic change in the GDP deflators) using quarterly data from 1976 to 2000 and four lags of each variable. The moving average representation of those VARs produces the striking results evident in Figure 6: in both countries, the standard error of the

Figure 6 Standard Errors of the Forecasts of Inflation



Note: From a bivariate VAR estimated from 1976/I to 2000/IV using inflation and the output gap, with four lags of each.

16. Atkenson and Ohanian (2001) emphasize this point.
17. The results do not depend much on the type of filter used. Because both of these countries had a similar decline in inflation over that period, it seemed reasonable that they both had a positive output gap on average. I adjusted the HP-filtered gaps (which by construction average to zero) so that the sample average could explain the secular decline in inflation on the assumption that the sacrifice rate was four. (That is, an output gap of 4 percent for one year is needed to produce a decline of 1 percentage point in inflation.)

forecast of inflation is quite high to begin with, and it widens as the forecast interval lengthens. A two-year-ahead forecast of inflation has a standard error of 3.5 percentage points in Japan and of 1.75 percentage points in the United States. Moreover, the preponderance of that uncertainty is due to shocks to the inflation equations (the light shaded area) rather than to the gap equations, particularly for Japan.

One consequence of this imprecision is that, even beginning at a moderate rate of inflation, considerable mass may still rest on the possibility that prices could be declining in a few years. Thus, although the empirical record does not provide sufficient examples of sustained deflation to assess if there are systematic effects on output growth, it has enough episodes of deflation and the inflation process is sufficiently unforecastable to suggest that it is important to understand how an economy and policy perform during deflation, in part so that we can see if or how strenuously it should be avoided.

Part of the argument that a positive inflation rate helps protect against the zero bound rests on the belief that a negative real rate is sometimes needed to spur spending. To assess that possibility, I embarked on a two-step process of ascertaining the relationship between the output gap and the real short-term interest rate in Japan and the United States. First, we must recognize that it is the expected, or *ex ante*, real short-term interest rate that matters for spending decisions. In that regard, Mishkin (1984) provides a means of estimating the *ex ante* real interest rate under the null hypothesis of the rationality of expectations. In particular, the *ex post* real rate, $r^{ex\ post}$, will differ from the *ex ante* real rate, $r^{ex\ ante}$, only because of forecast errors, which under rational expectations should be uncorrelated with anything observed concurrently or previously. Thus, the predictions of the regression of the *ex post* real rate at time t on macroeconomic variables observed at or before time t should provide an inefficient but unbiased estimate of the *ex ante* real rate.

Tables 2 and 3 report those first-stage regressions for Japan and the United States, respectively. In both cases, the *ex post* real rate is defined as the nominal policy rate

Table 2 Japan: Estimation of the *Ex Ante* Real Policy Interest Rate (1977/IV to 2002/IV)

	Estimate	Standard error	*t*-statistic
Constant	1.21	0.29	4.21
Discount rate	–0.57	0.25	–2.27
Lagged discount rate	1.40	0.25	5.62
U.S. short rate	–0.10	0.05	–2.08
Equity returns	–0.57	1.46	–0.39
Lagged inflation (once)	–23.63	18.06	–1.31
Lagged inflation (twice)	–27.04	17.64	–1.53
Variance of residuals			1.25
Standard error of regression			1.12
R-squared			0.67
Adjusted R-squared			0.64
Durbin-Watson			0.89

Note: Estimated using OLS.

Table 3 United States: Estimation of the *Ex Ante* Real Policy Interest Rate (1971/I to 2002/IV)

	Estimate	Standard error	*t*-statistic
Constant	–2.70	0.47	–5.74
Nominal short rate	0.66	0.08	8.69
Lagged short rate	0.07	0.08	0.91
Long rate	0.45	0.09	4.86
Equity returns	3.17	1.78	1.78
Lagged inflation (once)	–194.44	35.89	–5.42
Lagged inflation (twice)	–99.45	35.23	–2.82
Variance of residuals			1.44
Standard error of regression			1.20
R-squared			0.83
Adjusted R-squared			0.83
Durbin-Watson			0.54

Note: Estimated using OLS.

less the realized four-quarter-ahead inflation rate as measured by the GDP deflator. In the Japanese case, the availability of policy rate data limits the time span of the regression to 1977–2002 (with the sample ending in 2002 because of the forward-looking nature of the inflation-compensation term). However, because I include only those explanatory variables that are available for a longer period—the discount rate, lagged inflation rates, and equity returns in Japan and the nominal short rate in the United States—this relationship can be extrapolated outside the period of availability of the nominal policy rate.

The regressions explain a significant share of the variability of the *ex post* real rate in both Japan and the United States, and I use their predictions as an explanatory variable for the output gaps in the two countries.

Specifically, using the same HP-filtered output gaps presented earlier in this section, I estimated the following relationship for the two countries, which includes the error term u:

$$gap_t = \alpha + (\beta/5)\sum_{k=0}^{4} r_{t-k}^{ex\ ante} + \gamma gap_{t-1} + u_t. \qquad (1)$$

The five-quarter average of the *ex ante* real rate is included to capture the lags in monetary policy, while the lagged output gap helps control for the inertia in that time series. This expression has two-sided dynamics introduced by the forward-looking nature of the *ex ante* real rate and the backward-looking lagged gap. Both regressions were estimated over the quarterly data available from 1976 to 2000 using two-stage least squares (2SLS), where the instruments were the same as in the Mishkin regressions plus lagged observations of the output gap.

A feature of this regression is that, when output is at its potential in the long run, the real short rate must equal

$$r^{equilibrium} = -\alpha/\beta, \qquad (2)$$

which we can take as a measure of the equilibrium real interest rate that prevailed over the entire sample. The results of these regressions are reported in Table 4 for Japan and Table 5 for the United States, with the implied estimates of the long-run real equilibrium short rate given in the fourth row of both tables. Those estimates, at 3.30 percent for Japan and 4.34 percent for the United States, are higher than conventional estimates in part because they rely on GDP deflators rather than consumer price indexes. Inflation as measured by GDP deflators has tended to run about 1 percentage lower than as measured by consumer price indexes.

These estimates differ statistically from zero, implying that the real equilibrium short-term interest rate is unlikely to have been negative, on average, over the entire period. But the whole-period result does not imply that such a possibility was unlikely for sub-periods of the data. In both cases, the coefficient on the lagged gap

Table 4 Japan: Estimated Relationship between the Output Gap and the *Ex Ante* Real Policy Interest Rate (1976/I to 2000/IV)

	Estimate	Standard error	*t*-statistic
Constant	0.35	0.19	1.81
Real rate	–0.11	0.05	–2.02
Lagged gap	0.83	0.06	14.49
Implied equilibrium real interest rate	3.30	0.69	4.76
Variance of residuals			0.49
Standard error of regression			0.70
R-squared			0.69
Adjusted R-squared			0.68
Durbin-Watson			2.15

Note: Estimated using 2SLS with lags of financial quotes, the output gap, and inflation.

Table 5 United States: Estimated Relationship between the Output Gap and the *Ex Ante* Real Policy Interest Rate (1976/I to 2000/IV)

	Estimate	Standard error	*t*-statistic
Constant	0.33	0.16	2.10
Real rate	–0.08	0.04	–2.11
Lagged gap	0.86	0.05	17.72
Implied equilibrium real interest rate	4.34	0.99	4.38
Variance of residuals			0.53
Standard error of regression			0.73
R-squared			0.77
Adjusted R-squared			0.77
Durbin-Watson			1.61

Note: Estimated using 2SLS with lags of financial quotes, the output gap, and inflation.

term is important (both numerically and statistically) in explaining the dynamics of the gap, which as a consequence suggests that the effects of monetary policy are distributed over time with a considerable lag.

In both cases, the *ex ante* real rate is negatively related to the output gap, and statistically significantly so related. These estimates are crude in that they exclude critical factors shaping aggregate demand, such as a measure of fiscal policy, the terms of trade, activity in important trading partners, and household real net worth. Moreover, the estimation does not explicitly take account of the degrees of freedom used up in the first-stage calculation of Mishkin-style real interest rates, implying that there is a generated-regressor problem. That said, these simple equations afford a role for monetary policy in influencing activity and are not notably more limited than the estimated relationship of Rudebusch and Svensson (1999), for instance.

The long-run estimate of the equilibrium real short-term rate seems to suggest the zero bound to the nominal interest rate would pose no particular concern, but persistent forces that would move the equilibrium rate away from its long-run level may be at work in the short run. One way of capturing that possibility is to incorporate a run of systematic error terms (the u's) in calculating intermediate-term measures of the equilibrium real rate. To be specific, I calculated a backward-looking two-year moving average of the errors from the estimated output-gap relationship, attributed those errors to changes in the constant term, and then asked what real short-term interest rate, if sustained, would have held the output gap at zero.[18] That is, the equation

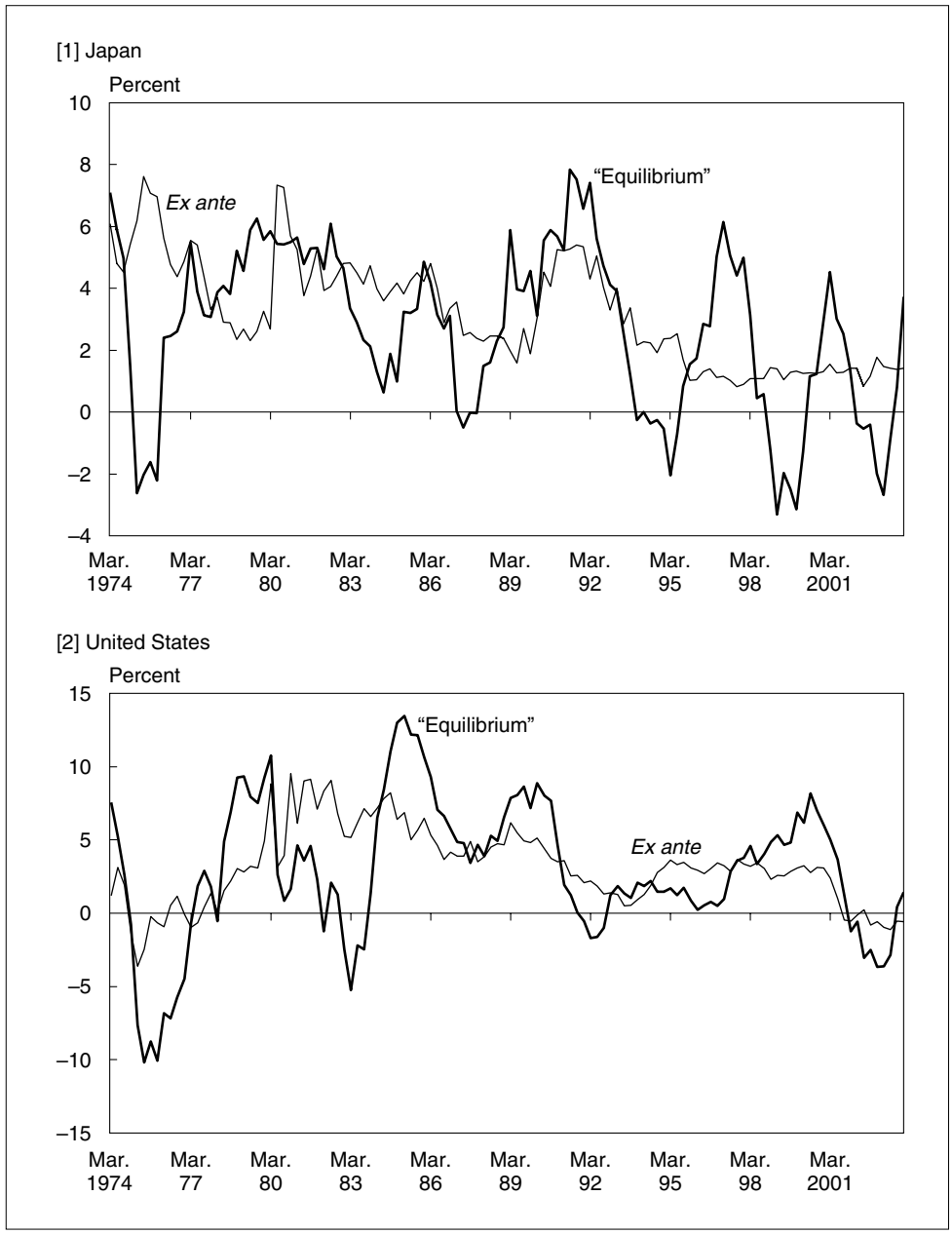
$$r_t^{\textit{temporary equilibrium}} = -(\alpha + \sum_{k=0}^{8} u_{t-k})/\beta, \qquad (3)$$

allows scope for time variation in the equilibrium real interest rate. Of course, this may allow too much time variation, in that changes in the forces of productivity and thrift, and their reflection in the equilibrium real rate, are likely to evolve more slowly than captured in this two-year moving average.

The estimates of the equilibrium real policy rate, along with the Mishkin-style *ex ante* rate, are presented in Figure 7, with those for Japan plotted in panel [1] and those for the United States plotted in panel [2]. As is evident, the real short rate consistent with the full employment of resources moves through a wide range—perhaps an unbelievably wide range—and is not infrequently below zero. Moreover, policymakers seem often to chase after a moving target, in that the equilibrium rate moves up before changes in policy. For both Japan and the United States, the source of the pickup in inflation in the 1970s seems to have been an actual real rate that was originally allowed to drift below its equilibrium and was subsequently raised insufficiently to catch up to a rising equilibrium. Similarly, the disinflation of the 1980s was associated with a significant stretch of policy stringency, at least as measured by the excess of the *ex ante* real rate over its estimated equilibrium.

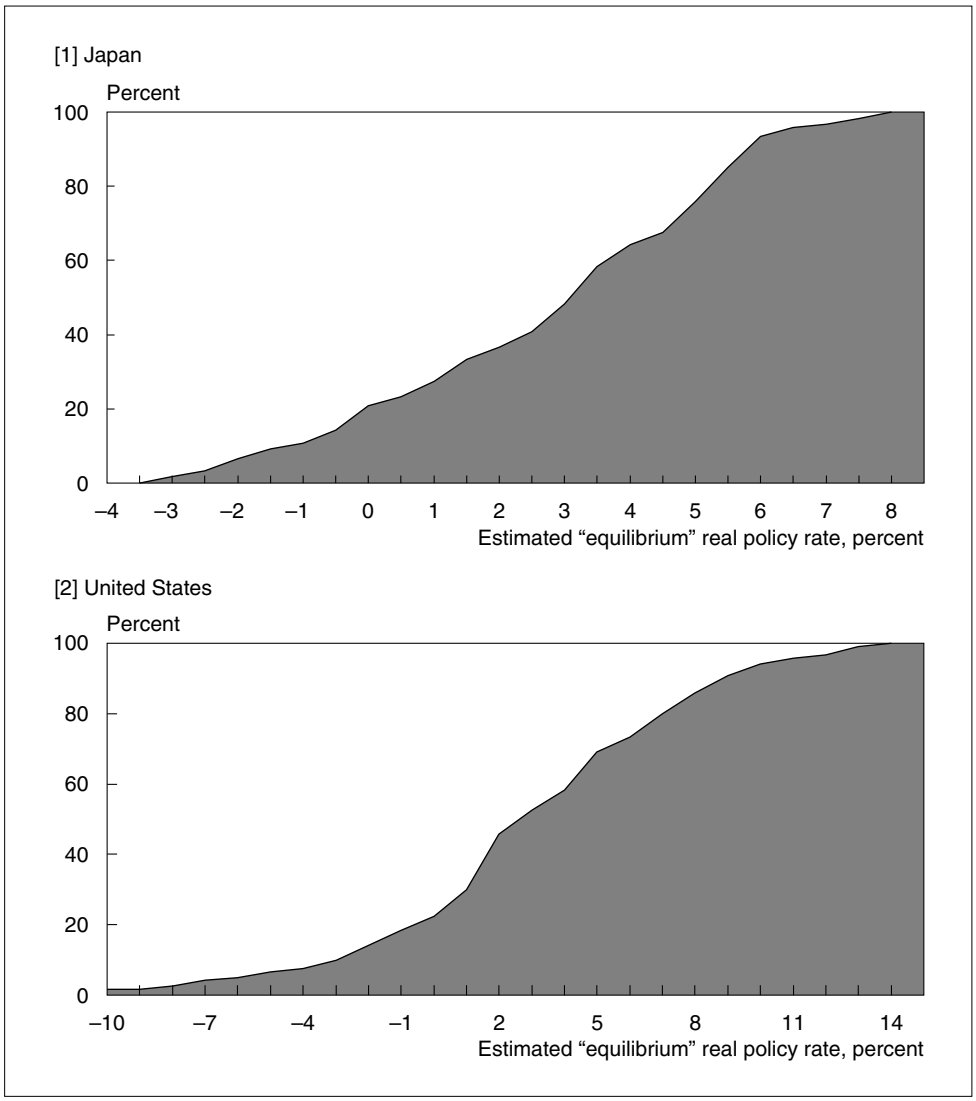
18. See Laubach and Williams (2001) for a discussion of a more satisfactory method of estimating the equilibrium real federal funds rate.

Figure 7 Estimated *Ex Ante* and "Equilibrium" Real Policy Interest Rates



With regard to the insurance value of some inflation, the more evocative representation of the data is to sort the observations for both countries by the level of the estimated equilibrium real interest rate, as in the cumulative distributions plotted in Figure 8. In particular, in about one in five of the quarters since 1976 the estimated equilibrium real rate was in negative territory. Thus, strict price stability—a measured inflation rate of zero—would have bound the central bank from providing interest rate stimulus sufficient to eliminate the output gap on many occasions.

Figure 8 Cumulative Distribution of Estimates of the "Equilibrium" Real Policy Interest Rate



From a risk management perspective, the region to the left of zero can be reduced by allowing some positive inflation, acknowledging that some efficiency losses may occur as households economize on money balances, resources are used up changing price tags, and tax distortions loom larger. However, the need to avoid that region depends critically on policymakers' assessment of their ability to prevent such outcomes and the efficacy of their tools should the nominal short rate become pinned to zero.

V. What Are the Tools of Policy in a Period of Low Inflation?

Japan's experience at and the United States' close brush with the zero lower bound to nominal interest rates have elicited considerable attention from the economics profession. Some contributions have rigorously framed the problem in a general equilibrium setting, for example, Woodford's description of the rate of time preference dipping for a time into negative territory (Woodford [2003]). Some models have emphasized the importance of shaping expectations about the future path of the policy rate, either by committing to a permanent expansion in the monetary base (as in Auerbach and Obstfeld [2004]) or by being explicit about future interest rate action (as in Eggertsson and Woodford [2003]). And in some examples, other policy levers provide the needed impetus, whether fiscal policy (Eggertsson [2003]) or the external sector (Svensson [2001]). Less work has been done thus far on empirical aspects of the zero bound, with the exception of Nagayasu's explication of the behavior of the term structure of interest rates during the zero interest rate period (Nagayasu [2004]) and Shirakawa's examination of balance-sheet adjustment during that episode (Shirakawa [2001]). The purpose of this section is not to review the options of policymaking *in extremis* (as is done in Bernanke [2002] or Bernanke and Reinhart [2004]), but rather to point out two lessons of more general practicality to a central bank that is operating in a low-inflation environment.

The first lesson is that policymakers operating at a nominal interest rate above the zero bound should appreciate that their actions can make becoming pinned at the zero bound less likely. In particular, two strategies for action exist if there is significant potential for an adverse shock. Policymakers can "save their ammunition" by waiting until the shock materializes before acting, or they can move preemptively before the expected shock. Simulation work in a large-scale econometric model (such as Reifschneider and Williams [2000]) indicates that it is better to have the economy on the strongest possible footing when the shock hits by easing before, even accepting the fact that policy would be mispositioned should the shock not materialize. Unless the act of easing has an independent effect from the level of the rate (which might occur, say, if policy action timed with the release of adverse news bolstered confidence), moving preemptively works better.

There are trade-offs, of course, in that erring toward the side of ease when rates are low would create an inflation bias, but the earlier discussion suggests that an inflation goal of zero may be too low. And a systematic tendency to err toward an easier policy when adverse shocks bulk large and nominal interest rates are low can be offset by a willingness to unwind that accommodation quickly once the situation clears.

The second general lesson to take away from the work on the zero bound is that the short-term nominal interest rate under the direct control of policymakers has little direct effect on behavior. Rather, it is the current value of the short-term rate and its expected future course that gets embedded into capital values and that thereby affects spending decisions. Even if the nominal short-term rate is low, a central bank can provide impetus to the economy if it can convince investors that the rate may hold at that level for longer than previously expected or that it may go even lower. For such assurance to be credible, a policymaker's description of its outlook and

public understanding of the policymaker's objectives must combine to indicate a subdued path of short-term rates for, to coin a phrase, a considerable period.

That this lesson is nothing new is an understatement. In 1936, John Maynard Keynes explained in *The General Theory of Employment, Interest, and Money:*

> [T]he rate of interest is a highly conventional, rather than a highly psychological, phenomenon. For its actual value is largely governed by the prevailing view as to what its value is expected to be.[19]

Lord Keynes went on to draw out the policy implication:

> Such comfort as we can fairly take from more encouraging reflections must be drawn from the hope that, precisely because the convention is not rooted in secure knowledge, it will not be always unduly resistant to a modest measure of persistence and consistency of purpose by the monetary authority.[20]

Work in the field since then has increasingly viewed expectations about the future course of interest rates as centrally connected to investors' outlook for the economy, rather than as a *deus ex machina* convention. But these insights offer the possibility that, by conveying its view of the economic outlook to the public, perhaps with a modest measure of "persistence and consistency of purpose," a monetary authority can induce helpful adjustments in capital values (in a manner described rigorously by Woodford [2003]).

An interesting observation in that regard can be gotten by examining the volatility of private-sector interest rates along the term structure in Japan and the United States. Table 6 records the absolute weekly change in one-month deposit rates and swap yields at the two-, three-, five-, and 10-year maturity from 1990 to mid-year 2004. As is evident, yields at the front end of the term structure—at the one-month maturity—have been equally variable in both countries, at about a mean absolute change of 5 basis points per month. But volatilities have stepped up markedly moving out the yield curve in the United States in a manner not observed in Japan. At the 10-year horizon, swap yields in the United States have been almost twice as volatile as those in Japan. In the sense of Keynes and Woodford, U.S. markets

Table 6 Changes in Selected Nominal Interest Rates

Mean absolute weekly change, basis points, January 1, 1990 to May 21, 2004

	Japan	United States
One-month deposits	5.2	5.7
Two-year swaps	6.0	11.4
Three-year swaps	6.8	11.6
Five-year swaps	6.8	11.6
10-year swaps	6.7	10.9

Source: Bloomberg.

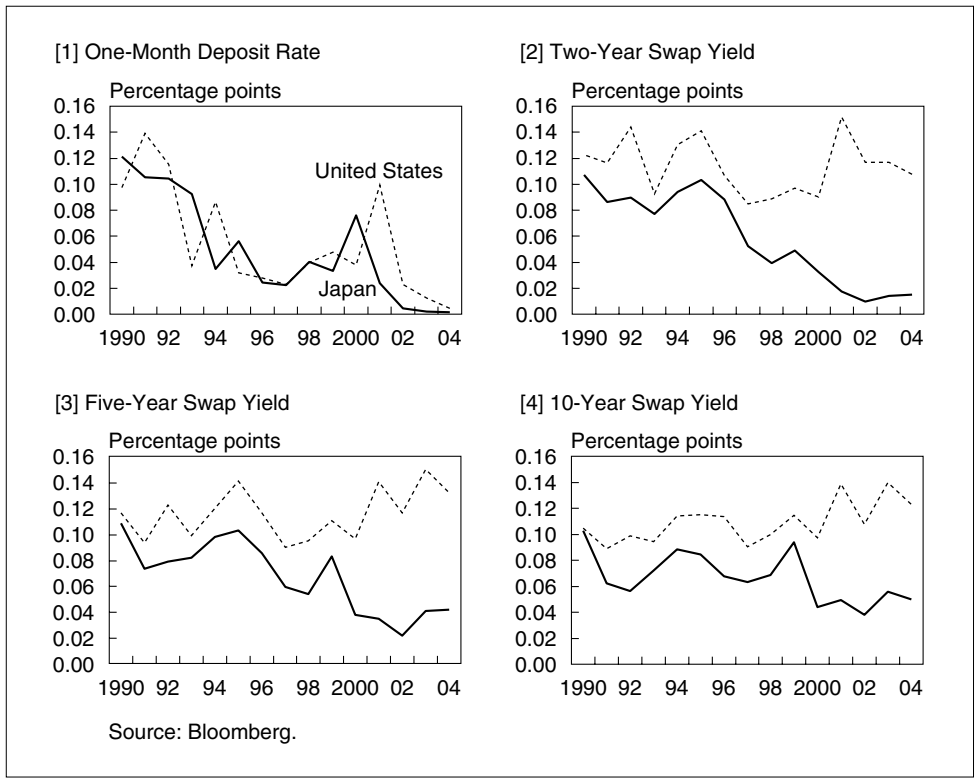
19. Keynes (1936, p. 203).
20. Keynes (1936, p. 204).

appear to have been getting signals that vary more significantly as to the appropriate allocation of capital than do those in Japanese markets.

These longer-period averages are representative of finer slices of the data, as is clear in Figure 9, which plots measures of the volatility of rates each year since 1990. Short rates, year by year, have been equally variable in the United States and in Japan. But this has decidedly not been the case further out on the yield curve. One wonders if a policy tool—encouraging changes in the longer-run outlook—has either been left unexploited or for institutional reasons has been less available for use in Japan than in the United States.

Acting preemptively and shaping expectations about the economy are tools that are available to central banks at all times, and they may be particularly important when nonlinearities are feared to be adverse. But policy need not be constrained when events turn adverse and these two tools prove inadequate to the task. In particular, when the funds rate is zero, a central bank can oversupply reserves at that interest rate floor, a tactic that is described by Auerbach and Obstfeld (2004). In effect, a zero nominal funds rate is a classic example of the Brunner and Meltzer (1973) problem, in that the nominal rate is not informative about the stance of policy when it is attained at a depressed demand for reserves. Increasing the quantity of reserves at that point—that is, oversupplying reserves—may have an effect. In point of fact, our understanding of the monetary transmission mechanism is sufficiently imprecise not

Figure 9 Average Absolute Weekly Change in Selected Private Rates



to rule out a quantity channel that might work through the size of banks' balance sheets or through banks' willingness to lend.

If oversupplying reserves has no obviously discernible effect, the central bank can attack the term structure of interest rates more directly. In particular, if asset prices adjust insufficiently to stimulate spending, then open market purchases of longer-term Treasuries, in sizable quantities if necessary, can move term premiums lower. Of course, such a promise to put a ceiling on parts of the yield curve would be reinforced if it were associated with a credible promise to keep the short rate along a path consistent with those long-term rates.

No doubt, all of these policy mechanisms are uncertain. Such uncertainty about containing deflation implies that the best policy is to deal with deflation by strenuously avoiding it through preemptive action. Perhaps the most important message from Lord Keynes, filtered through what has been learned in the 70 years since he wrote, is:

> [A] monetary policy which strikes public opinion as being experimental in character or easily liable to change may fail in its objective of greatly reducing the long-term rate of interest . . .[21]

Improvisation indicates a commendable flexibility of action, but is an unfortunate trait in an entity relied upon to provide a predictable backdrop against which investors price long-lived assets. Before a central bank puts even slim odds on policy alternatives at the zero bound to nominal interest rates, it should use its conventional interest rate stimulus as aggressively as possible and should explain the alternative—and ultimately effective—sources of stimulus once the zero bound takes hold.

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21. Keynes (1936, p. 203).

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Comment

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I. Introduction

I am very grateful to the organizers for inviting me to act as a discussant on this paper, which brings a nice mix of theoretical analysis and empirical evidence to the important question of macroeconomic policy in a low-inflation world.

As central bankers, our collective aim is "price stability," which means low and steady inflation. Mervyn King, then deputy governor and now governor of the Bank of England, discussed this topic in King (2002). In the United Kingdom, as in many other parts of the world, price stability has arrived. It appears to have been associated, certainly in the United Kingdom at least, with a more stable macroeconomic environment, with fewer surprises to inflation, less inflation uncertainty, lower real interest rates, and lower output volatility. This does demonstrate that it is rather hard to disentangle low levels of and low volatility in inflation, as they tend to go together.

Vincent R. Reinhart's paper considers some of the benefits of this outcome, then focuses on a potential constraint on policy, the zero bound, before considering what the policy response should be.

II. Low Inflation and Growth

In the first half of the paper, it is argued that low inflation brings higher growth. This means there are profound benefits from a low-inflation policy, as the present value of even small increases in growth is large.

But on the evidence, I think we need to be somewhat cautious. This is partly because there is an important reservation about the direction of causality, which is practically hard to resolve. Does the causality run from low inflation to stability, or from a more stable economic environment to lower inflation? There have been many shocks over the past low-inflation decade and a half, of course. But perhaps good monetary policy delivers both low and steady inflation and steady growth. And there are further grounds for skepticism about how strong the evidence is for a link between low inflation and high growth.

A. Theory

Reinhart rehearses the major arguments, which are also discussed in King (2002). I shall not try to cover all the ground in the short time available to me, but I have a few observations.

Our standard model is a dynamic stochastic general equilibrium (DSGE) model with some real and nominal rigidities. As Bennett T. McCallum suggested in his

22. These comments represent the views and analysis of the author, and should not be thought to represent those of the Bank of England or Monetary Policy Committee members.

opening address is broadly true about modern macroeconomics, these models do not have anything to say about the effect of steady-state inflation (because they are not monetary models). In fact they are detrended—linearized around a steady state and constant inflation rate, usually assumed to be zero for simplicity,[23] so it is simply impossible to begin exploring the implications of differing steady-state inflation rates. Perhaps that is because there is not an issue? One has to look elsewhere for an explanation.

One might broadly characterize theories as those where inflation affects the rate of return on investment (in physical or human capital) and those where there is an impact on efficiency, or total factor productivity. I think we have also to distinguish between effects on the growth and the level of output. Many (in fact, arguably, most) of the theories and stories suggest level effects, not rates of growth.

Temple (2000) suggested in his survey of this topic that the arguments about inflation and growth are often "stories" rather than theories—some may be "taller" than others. Be that as it may, I want to make some remarks regarding three broad stories.

1. Relative price variability

This has to do with efficiency.

The level of inflation is positively associated with volatility. There is some evidence that relative price variations are larger too. This follows more or less immediately from models of price setting with heterogeneity—higher inflation will lead to larger revisions in nominal prices. There must be a welfare loss from this (prices are wrong) although, plausibly, consumers may gain from more price variability if they are aware of the degree of price dispersion (as indirect utility is convex in prices). And with arguably small costs of price adjustment and small losses in the profit-maximizing region, it is rather hard to see that welfare losses are large. Indeed, as relative prices continually change, it is not at all clear that menu costs are lower at zero percent than 2 percent—or even 5 percent. Currently in the United Kingdom, while total inflation hovers around 2 percent, the price of services increases at 5 percent or so per annum, while for many goods prices are falling.

2. Uncertainty

If this volatility leads to uncertainty, there will be a further welfare loss: nevertheless, growth need not necessarily suffer. The usual link argued to exist between uncertainty and output works through the capital stock. But the effects of uncertainty on the capital stock are themselves uncertain. We have known for a long time (since Hartman [1972]) that there is quite likely to be a positive effect of uncertainty on the capital stock. The real options approach to investment under uncertainty that has become popular recently (see Dixit and Pindyck [1994]) does not reverse this—it mainly has implications for the timing and chunkiness of investment at the firm level. However, increased uncertainty must have an effect on the required rate of return. Uncertainty also reduces the effectiveness of monetary policy in most of the models I am aware of—although we need to beware of why inflation is uncertain; it could be policy shocks.

23. It should be said that this may not be an innocuous assumption. Bakhshi *et al.* (2003) explore the consequences of linearizations around different steady states for the New Keynesian Phillips curve.

Other mechanisms that might reduce welfare by more include those put forward by Ball and Romer (1993). Customers might enter inefficient long-run relationships as the current price is a poor signal of the long run; and if demand becomes more inelastic, markups rise.

3. Inflation and rates of return

The Tobin effect (lower returns on money encouraging excess physical investment) leads to more investment as inflation rises, which anti-inflationers find awkward, although it is hard to see that this amounts to much when holdings of money are so small relative to the capital stock.

A more popular macro approach is to follow Stockman (1981), in which the inflation rate acts as a tax on investment, through a cash-in-advance constraint on the purchase of capital goods. I have always thought of cash-in-advance as mainly an analytically convenient fiction, perhaps more plausible for households. Do firms really need cash before they invest? But in this context, periods of high inflation will lead to lower investment and, hence, a lower capital stock. This reduces the demand for labor and leads to lower employment, output, and real wages.

An effect on long-run *growth* requires more. A recent paper by Gillman, Harris, and Mátyás (2002) combines cash-in-advance with endogenous growth. Both parts are important: if one wants to explain long-run growth, a negative correlation between inflation, on the one hand, and output (and investment and consumption) on the other is insufficient.

Finally, I would add seigniorage to Reinhart's list of arguments supporting a little inflation (not in the paper, although mentioned in the presentation). All taxes distort: the inflation tax is at least cheap to collect and hard to evade.

B. Evidence

I was not that convinced by the unconditional evidence presented in the paper. It is surely untrue that the monetary authorities can control inflation completely at all times. In the short run at least, the inflation outcome must depend on the shocks hitting the economy.

My view of the voluminous literature is that it is clear that very high inflation is bad, and inflation and output growth are negatively correlated in high-inflation countries: e.g., Fischer, Sahay, and Vegh (2002). But for inflation rates in single digits, the impact of inflation on growth is less clear.

There is, however, controversy over the nature of the relationship at low inflation rates. There is some debate about the cutoff. Many people would put it at 40+ percent, but Sarel (1996) searches for a breakpoint in the relationship between inflation and growth, and locates it at an annual rate of 8 percent, while Khan and Senhadji (2000) analyze this relationship separately for industrial countries and developing countries and find that "the threshold level of inflation above which inflation significantly slows growth is estimated at 1–3 percent for industrial countries and 7–11 percent for developing countries." (Below the threshold, however, inflation benefits growth.[24])

24. But the estimated impact in Khan and Senhadji (2000) seems large. Moreover, if inflation works *via* the reduction of investment, why condition on investment, as they do? No account is taken of simultaneity.

We need to be very clear about frequencies. It is hardly odd that there is a short-run correlation between changes in GDP and inflation. Temple (2000) observes that there is a contrast between the cross-section (very long averages) and panel results (typically annual and five-year averages): no effect and a negative effect, respectively. Perhaps this means there is no long-run effect. This is something that emerges from several of the papers in Feldstein (1999), supported by evidence from the Organisation for Economic Co-operation and Development (Andrés and Hernando [1999]), and my take on Reinhart's stories is that they largely relate to the level.

In all these studies, the causality problem is profound. Low growth reduces tax revenues, increasing the demand for seigniorage. Supply shocks lead inflation and growth to move together. Low-growth episodes lead to expansionary policy that raises inflation before growth responds. Granger causality tests do not necessarily resolve these questions.

Good instruments may be hard to find. Barro (1995) uses bank independence, lagged inflation, and colonial status. Institutional "natural experiments" are attractive instruments, but may not be exogenous. And the first of these may not be so good for developing countries; the last may be independently correlated with other relevant factors. Ghosh and Phillips (1998) use similar institutional variables and a similar exchange rate regime. Gillman, Harris, and Mátyás (2002) use lagged money growth on the grounds that in the model it is exogenous: perhaps not in the world, however.

C. Conclusion on the Evidence?

If I were forced to take a view, I would conclude that low inflation tends to be associated with steady growth, perhaps at a higher rate. But given the difficulties that arise in the interpretation of the many empirical studies, I would rather focus on the theoretical mechanisms. These strike me as suggesting a rather small levels effect. I suggest that good monetary policy can deliver price stability and reduced output volatility and increase welfare. But it is the shocks and policy responses that deliver the observed correlations: it is the absence of monetary shocks and good policy that have delivered the benign outcome.

Having said this, it is pretty clear that if policy can deliver price stability with less real volatility, then even without a positive effect of low inflation on growth it is hard to see that anyone would want to pursue any other policy.

III. The Zero Bound

Let us now look at the consequences of low inflation. Some of these issues were rehearsed in Yates (2003).

First, what might the equilibrium rate be, given the current target? The Bank of England does not take a view on what the natural rate of interest is, as although the notion is theoretically coherent and arguably has some advantages over alternative summaries of the balance of demand and supply like the output gap, there is no definitive way of calculating it. But the number for the natural real rate from

calibrated models (e.g., Neiss and Nelson [2003]) implicitly based on the historical average, is often set at about three, and an empirically based estimate by Larsen and McKeown (2004) suggests the figure might be around 3.5 percent, averaging over the recent past. So the nominal rate might perhaps be around 5 percent, a good way away from zero, and similar to Reinhart's estimate for the United States, although this ballpark number is uncertain and will vary over time, so it is really just a possible point in a wide and fluctuating band.

Accepting that the true number is unknown, given this kind of equilibrium rate, is there a practical risk of hitting the zero bound? (And speaking as I do at this conference in Japan, it is clear given the recent history of interest rates here that one does not want to be too sanguine.) Judging from Reinhart's estimates, the answer is yes. Those results are based on a neat and simple method. (I would guess the confidence interval is understated, however: I do not believe the simple dynamics are right, and there is a generated regressor problem.) But are the estimates of the amount of time negative real rates are required plausible? Yates (2003) put together five estimates of the probability of hitting the zero bound at different steady-state inflation rates for Japan, the United States, and Canada. The probability at a zero target varies from about 1 percent to about 17 percent. But of the estimates, Reifschneider and Williams (2000), who use the Federal Reserve Board model of the U.S. economy, put it at about 14 percent, in the same region as Reinhart. I do wonder, though, if the numbers from the 1970s should be included. We were hit by an exceptional supply shock then, but it was followed up with a series of policy mistakes. So I would argue that those large negative numbers were partly driven by monetary shocks unlikely to reoccur. I also note that the 1990s *ex ante* rate was far above the long run—reflecting the mistaken over-tightening of policy at that time.

Nevertheless, the possibility of hitting a zero bound clearly exists and it appears that there is a real issue. What then to do about the bound once we hit it (although hitting it is not usually going to be a disaster—more, that policy cannot respond as quickly as we would like)?

Before considering this, however, perhaps I should mention a proposal put forward by Buiter and Panigirtzoglou (2000) to pay negative interest on notes and coins, and therefore to lower the bound. For some reason, this has not been adopted. I suspect this would be ruled out on grounds of administrative complexity—and perhaps because of the likely substitution of foreign for domestic currencies by the public.

I found little to disagree with in the paper's analysis, but would make a couple of comments. It was Goodfriend (1991) who first introduced the idea of gradualism in this context, which Woodford later formalized. Gradualism—persistence—in short-rate setting influences long rates in a helpful way, which has a payoff when we approach the zero bound. There is a cost: you relinquish optimal short-rate policy to reap an occasional, unlikely benefit. Short rates move by less than we would like when we are away from the bound.

An attractive solution avoiding this cost would be for behavior to change appropriately only when we approach the bound; but the public may not believe that the authorities have adopted a new policy. So this leads to a discussion of credibility. If we could make credible announcements that policy is now more

persistent when we are near the bound, that would help (Reifschneider and Williams [2000]). Reinhart places a strong premium on making a clear explanation of why policy is different (at the zero bound). I think this is somewhat hopeful. Banks regularly try to explain and educate, but it often seems as if lessons take a long time to be absorbed.

In the U.K. context, it seems clear that inflation expectations are now firmly anchored on the target. As it is expectations that matter for real rates, it follows that a good defense against the bound is a credible nonzero target. If inflation expectations do not move with actual inflation, in principle real rates can survive protracted low-inflation episodes. Naturally, it does help to have an explicit target in this context.

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Comment

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The paper by Vincent R. Reinhart raises a number of interesting issues. My purpose here is to comment on his paper from the viewpoint of a central bank staff member who has been involved in implementing various unconventional measures under deflation. Although such measures have never been undertaken by other central banks, they fully follow the spirit of John Maynard Keynes cited by Reinhart. By unconventional measures, I mean the zero interest rate policy, a massive increase in bank reserves, a commitment to continue with the zero interest rate policy or quantitative easing, and the purchase of equities held by banks as well as of asset-backed securities.

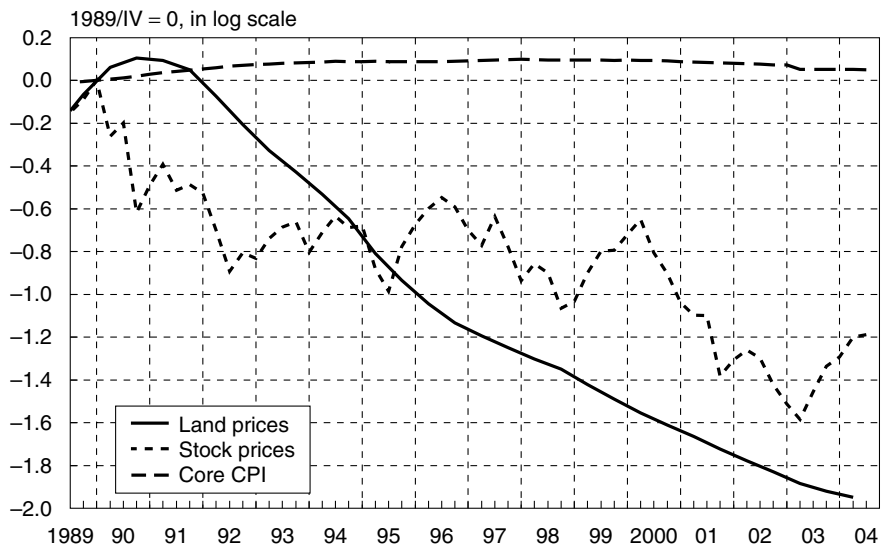
Reinhart's paper can be summarized by the following two propositions. First, very low inflation, or deflation, may pose unacceptable macroeconomic risks given the zero bound of nominal interest rates. Second, the peril of the zero bound of nominal interest rates may appear less threatening if a central bank is willing to be aggressive in conducting accommodative policy when the economy is nearing the zero bound and to be flexible in using available policy tools. In light of the Japanese experience, my initial, summary comment on these propositions is that it all depends. Specifically, it depends on what type of "war" we have in mind.

Let me elaborate on my summary comment on the two propositions, starting with the first. As economic history tells us, deflation was not an unusual phenomenon until the 20th century. In fact, there were not a few periods of sustainable growth under deflation.

The major reason why we are concerned about deflation is, obviously, that it may cause economic activity to stagnate. Viewed from this perspective, the main cause of Japan's economic stagnation since the 1990s has not been a decline in the general price level. During this period, both the general price level and nominal interest rates have been declining, and the rate of decline in the consumer price index (CPI) has been moderate, as is shown in Figure 1. The situation in the 1990s is quite a contrast to that in the 1930s in the United States and the 1920s in Japan when real interest rates increased.

The main cause of Japan's economic stagnation since the 1990s has been the asset price deflation and its impact on the economy rather than the decline in the general

Figure 1 Asset Prices and General Prices



Note: CPI excluding fresh food is seasonally adjusted by X-12-ARIMA with options of (0 1 2)(0 1 1) ARIMA model and level shifts in April 1989 and April 1997, when the consumption tax was respectively introduced and subsequently hiked.

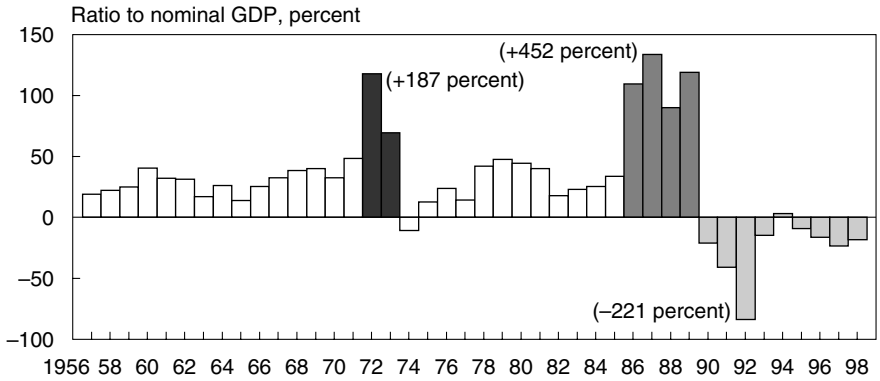
Sources: Bank of Japan, "Financial and Economic Statistics Monthly"; Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Consumer Price Index"; Japan Real Estate Institute, "Urban Land Price Index."

price level. The substantial rise and fall in asset prices have been unprecedented. Cumulative capital loss of land and equity holdings as a percentage of nominal GDP amounts to about 220 percent, as is shown in Figure 2. Asset price deflation has affected not only the demand side but also the supply side as was discussed by Okina and Shiratsuka (2004) at the previous session. Thus, the trend growth rate has declined.

One reason why I feel some uneasiness about Reinhart's first proposition is that he seems to analyze the economic stagnation solely in terms of the general price level rather than asset prices. It seems to me that such an approach is not a suitable analytical framework, at least for an economy in which the decline in asset prices plays an overwhelmingly dominant role.

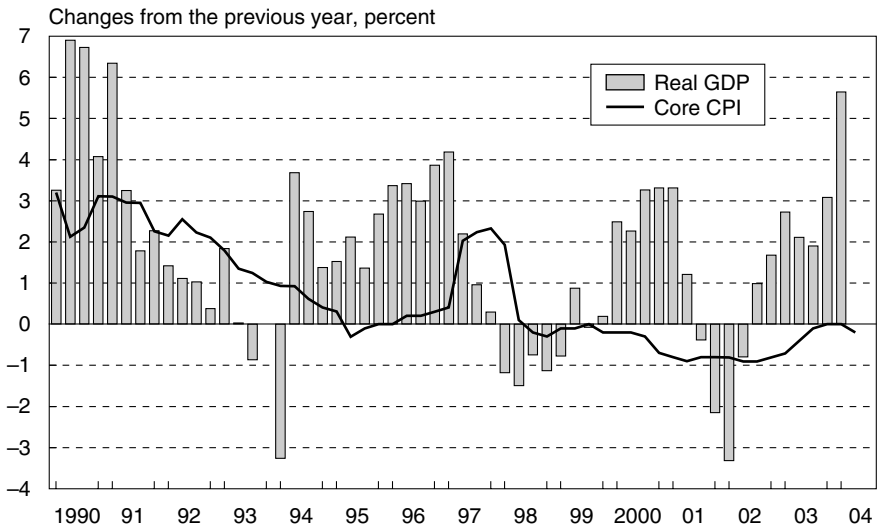
Another reason for my uneasiness about the first proposition in his paper is that Japan's economy is actually expanding, while prices are still falling in recent years, as is shown in Figure 3. If we pursue the logic behind the peril of deflation, deflation leads to a contraction of economic activity, which in turn leads to further deflation. Thus, the economy is bound to fall into a vicious cycle of deflation, or a deflationary spiral. However, we have not observed a deflationary spiral in Japan, as is shown in Figure 3. Among several hypotheses, one possible explanation for this is that nominal wages are being determined flexibly without any downward rigidity. In Japan, nominal wages have been falling faster than consumer prices. Kuroda and Yamamoto

Figure 2 Asset Price Deflation



Source: Cabinet Office, "National Accounts."

Figure 3 CPI and Real GDP Growth

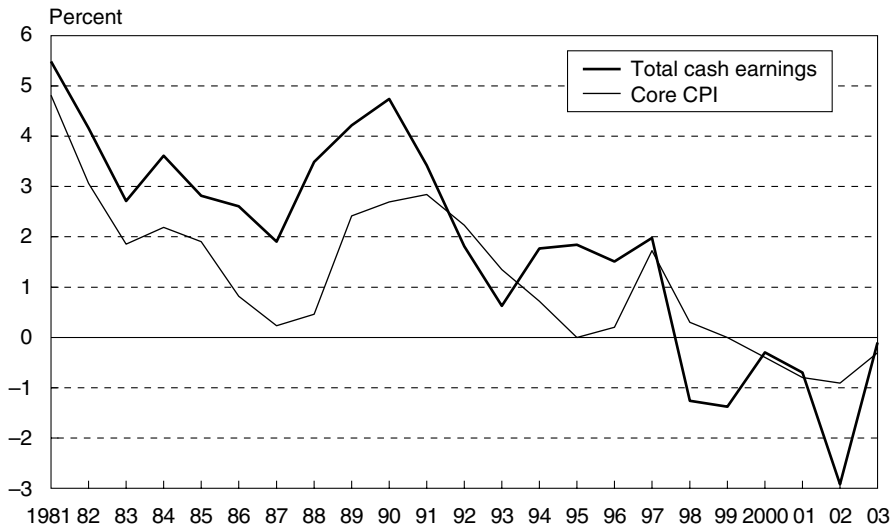


Sources: Cabinet Office, "National Accounts"; Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Consumer Price Index."

(2003), who have applied the analysis of Akerlof, Dickens, and Perry (1996) to the Japanese economy, suggest that wage determination is more flexible in Japan than in the United States. It may be the case that the degree of downward rigidity of nominal wages is a function of the rate of change in prices (Figure 4).

Let me now turn to Reinhart's second proposition, on which I will comment in more detail. Reinhart emphasizes the importance of managing expectations, particularly the commitment effect on long-term interest rates under the zero interest rate

Figure 4 Nominal Wages and CPI Inflation



Notes: 1. The total cash earnings and scheduled cash earnings are the percentage changes from the previous year. The inflation rate is the percentage change from the previous year in the overall CPI (adjusted for the April 1997 consumption tax increase).
2. The total cash earnings and scheduled cash earnings are per capita for workplaces with at least 30 employees.

Sources: Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Consumer Price Index"; Ministry of Health, Labour and Welfare, "Monthly Labour Survey."

environment, and I definitely agree with him. As you all know, the Bank of Japan (BOJ) has made a commitment to continue with the quantitative easing policy until the year-on-year change in the CPI registers zero percent or higher on a sustainable basis. This is virtually the same as the commitment to continue with the zero interest rate policy, and it is playing a very important role in the current phase of economic recovery.

Having said this, we should also be aware of the limits of the commitment effect as students of the "dismal science."

First, the commitment effect depends very much on the economic conditions at the time when the commitment is being made. In Japan, the risk-taking capability of both banks and firms has been declining as their capital position has been greatly impaired since the bursting of the asset bubbles. In such circumstances, their sensitivity to long-term interest rates has been weak, and the commitment effect tends to become weaker than it would be otherwise. The room for long-term interest rates to come down will be limited if the rates are already low at the time when the commitment is made. Long-term interest rates in Japan have been at extremely low levels even compared with those in the 1930s in the United States.

Second, some exogenous factors are necessary for the commitment to have an impact on the economy. The economy will not be able to escape from deflation

solely through lower long-term interest rates engineered by expectations management if the interest rate elasticity of expenditure is low. This is particularly true in Japan in the 1990s due to capital constraints, as shown in Table 1. When deflation is severe and short-term interest rates are zero, market participants naturally anticipate the continuation of zero interest rates, and under such circumstances the commitment to continue with the zero interest rate policy may not have an intrinsic effect. The commitment will have an effect on the economy if the natural rate of interest begins to rise due to some exogenous factors. In Japan, high growth in China and the economic recovery in the United States have contributed to the rise in the natural rate of interest.

Table 1 Interest Rate Channel (+) versus Balance-Sheet Channel (–)

Sample period	Firms	Contribution to $I/K(-1)$ ratio		
		Interest rate	Firm's balance sheet	Bank's balance sheet
Fiscal 1993–2000	With bond issues	0.56	–1.18	–0.26
	Without bond issues	0.54	–2.27	–2.09

Source: Nagahata and Sekine (2002).

As for the increase in bank reserves or the monetary base, its effect on the economy seems to be rather limited. The BOJ has been substantially increasing liquidity in terms of bank reserves and the monetary base since the start of quantitative easing. However, as is shown in Figure 5, we have so far not observed the increase in the money stock and the rise in prices.

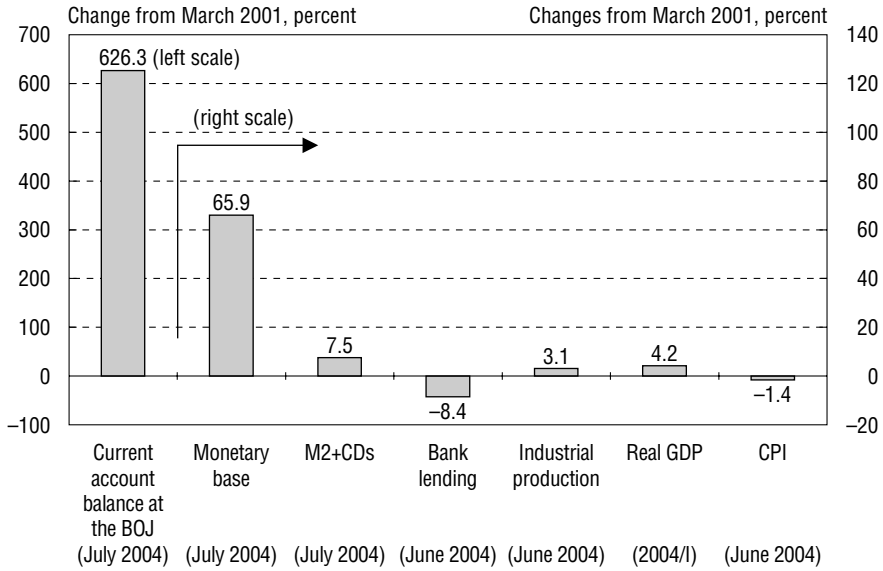
The increase in reserves has produced various unintended and unfamiliar phenomena. For example, since transaction costs have not been covered by short-term interest rates, commercial banks have a greatly reduced incentive to make transactions in the call market, and demand is raised for current account deposits at the BOJ. As is shown in Figure 6, the outward shift of the supply of reserves has been at least partially negated by the outward shift of demand. The outright purchase of long-term government bonds has contributed to the increase in reserves. However, I am more skeptical than Reinhart about its impact on long-term interest rates given our strong commitment. The BOJ has already made a credible commitment regarding the future trajectory of short-term interest rates by announcing that it will continue with quantitative easing until the year-on-year change in the CPI registers zero percent or higher on a sustainable basis. Given this credible commitment by the central bank, we do not expect the outright purchase of long-term government bonds to have an additional impact on long-term interest rates (see Baba *et al.* [2004] for the details).

It is only recently that progress has been made in the academic research on deflation, and much more research is certainly necessary to draw any decisive conclusions.

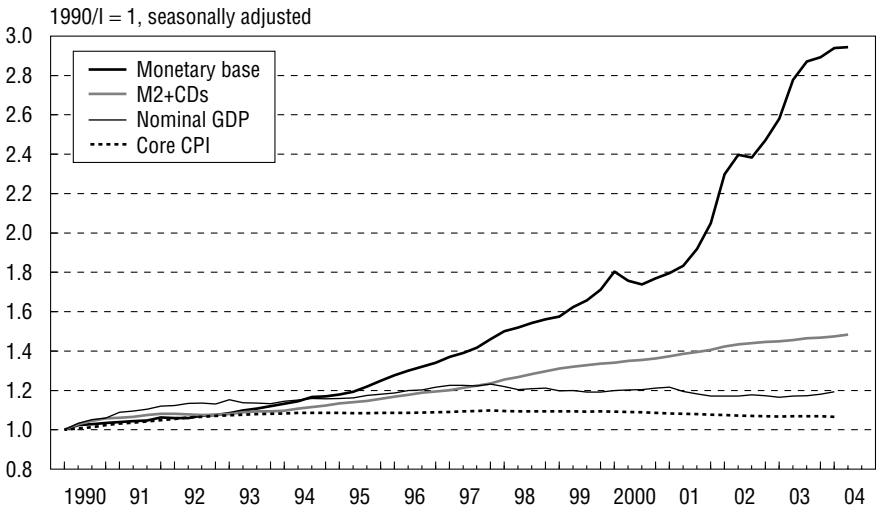
In closing, I will make two comments that I think are important in terms of future research on deflation. First, we must look into the cause of the problem more deeply. When economists discuss the peril of deflation or how to combat deflation, they naturally tend to form their views based on their own experience. However, the nature of deflation varies. To lump together the economies experiencing a negative

Figure 5 Monetary Aggregates, Economic Activity, and Price Development

[1] Changes from March 2001

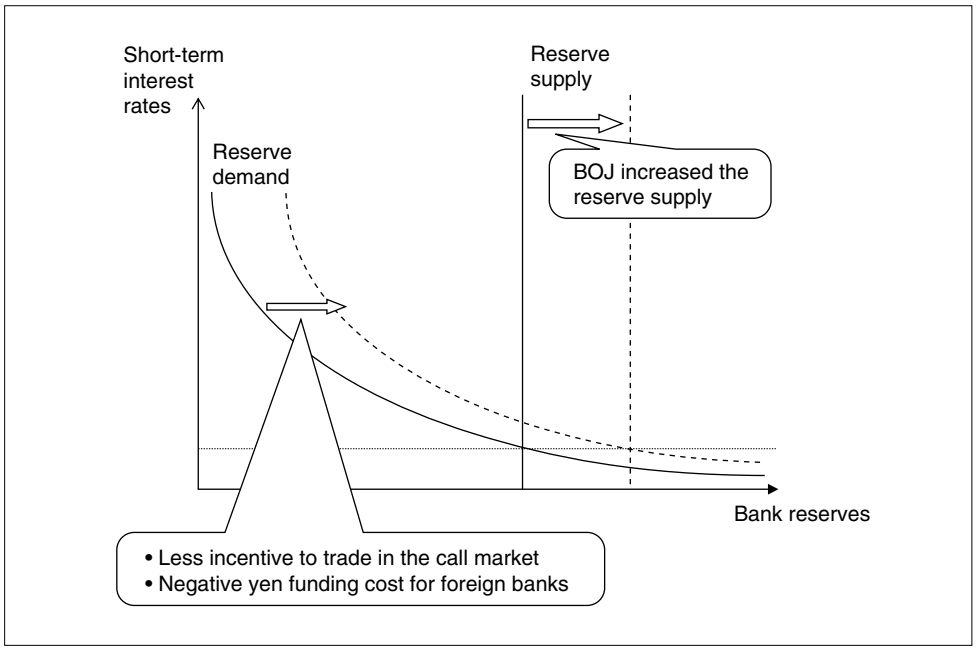


[2] Development since 1990



Sources: Cabinet Office, "National Accounts"; Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Consumer Price Index"; Ministry of Economy, Trade and Industry, "Indices of Industrial Production"; Bank of Japan, "Financial and Economic Statistics Monthly."

Figure 6 Illustration of Reserve Market



CPI inflation rate under the heading of deflation misses an important point. For example, Japan's stagnant economy is more the result of an asset price decline, rather than a decline in the general price level.

Second, we must look into the incentive structure of private economic agents. For example, a massive increase in liquidity together with capital constraints has created a somewhat unique situation that in turn affects the effectiveness of monetary policy (see Baba *et al.* [2004] for the details).

Although time does not permit me to say more along these lines, the Japanese experience seems to tell us that the current tools of economics are insufficient and must be supplemented.

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General Discussion

Responding to comments made by the discussants, Vincent R. Reinhart agreed with Simon Price that high inflation could indicate government failure. He added that this might be a reason behind the negative correlation between inflation and low economic growth. Reinhart's view on asset price deflation, an issue raised by Masaaki Shirakawa, was that, in the presence of a zero bound constraint on nominal interest rates, the phenomena of asset price deflation and real interest rate increases should not be viewed separately. Reinhart agreed with Shirakawa's view on the effectiveness of quantitative easing, and admitted that it could have a limited impact in stimulating real economic activity. Rather than relying on uncertain mechanisms, Reinhart's preference was to rely on a familiar instrument, i.e., a commitment to short-term nominal interest rates. Reinhart also agreed with Shirakawa that structural impediments in the Japanese economy magnified and prolonged the recession. Reinhart noted there were limits to what a central bank can do to offset an aggregate demand shock, especially if the shock is sudden and large.

Following this discussion, other participants raised a wide spectrum of issues. Assaf Razin (Tel Aviv University and Cornell University) addressed the topic of monetary policy stances in a low-inflation environment. He agreed that low inflation in the 1990s was partly due to globalization, which likely reduced the monopolistic power of firms via increased competition. Price objected that the level of inflation in the long run was solely determined by a central bank's monetary policy. Charles L. Evans (Federal Reserve Bank of Chicago) pointed out that strong productivity growth, to the extent of creating deflationary pressure, might also induce the nominal interest rate to hit the zero bound. Stefan Gerlach (Hong Kong Monetary Authority) noted that historical episodes of deflation were often associated with positive economic growth. Etsuro Shioji (Yokohama National University) questioned whether monetary policy responses to supply shocks in a low-inflation environment would be similar to those in a mild-inflation one.

Reinhart responded that deflation would be a risk when it turned out to be pernicious, raising the real interest rate, and further weakening aggregate demand. He further noted that if deflation were truly caused by a rapid increase in aggregate supply, then the resultant high real interest rates would have far less impact than in the case of a tremendous decline in aggregate demand. Finally, he stated that it is a central bank's responsibility to keep the price level stable, even in the face of rapid productivity growth.

George A. Kahn (Federal Reserve Bank of Kansas City) noted that a commitment to the future path of the monetary policy instrument was hard to achieve merely through central bank communication. He also noted that such a commitment could

tie the hands of a central bank in an undesirable manner in an uncertain economic environment. Bennett T. McCallum (Carnegie Mellon University) commented that, when considering the future path of interest rates, the level of the steady-state inflation rate would be crucial since it also governed the steady state of nominal interest rates. Shigenori Shiratsuka (Bank of Japan) expressed the importance of a commitment effect, especially when the short-term nominal interest rate is close to zero. He noted, however, that the theoretical basis underlying the commitment effect was still in a developmental phase and voiced the need for more research in pursuit of an empirically reliable mechanism.

Regarding the issue of inflation targeting, Gregory D. Hess (Claremont McKenna College) questioned whether adoption of an inflation target alone would reduce the likelihood of hitting the zero bound. Kahn commented that a credible commitment to an inflation target could anchor expectations at a low positive level, which he suggested was a better way to deal with zero bound problems. William R. Easterly (New York University) asked whether inaccurate inflation measures, mainly stemming from quality improvements, might affect the conduct of monetary policy. Reinhart cautioned that an inflation target alone could not be a sufficient solution, since the inflation target itself was silent about intermediate-term dynamics on how to reach the target.

Regarding the quantitative easing policy adopted by the Bank of Japan (BOJ), Jean-Philippe Cotis (Organisation for Economic Co-operation and Development) pointed out that a massive liquidity provision might have prevented the cumulative deflation scenario from occurring, and contributed to maintaining a mild-deflation regime in Japan. Shirakawa mentioned that it was argued whether increases in the current account balance at the BOJ had produced stimulative effects on output and prices through various channels, such as achievement of zero interest rates, stabilization of the financial system, and signals for the commitment duration of zero interest rates. He then pointed out that the BOJ's aggressive liquidity provision played an important role in stabilizing financial markets. Philip W. Lowe (Reserve Bank of Australia) asked whether a central bank's direct financing of a government budget deficit could be an effective channel as a more direct method for money creation. Kazuo Ueda (Bank of Japan) replied that the BOJ was forbidden by law to underwrite government budget deficits and further questioned the effectiveness of such underwriting on theoretical grounds.

Hess commented on structural problems in the Japanese economy, noting that deflation is often a structural issue for the real, banking, and financial sectors rather than a monetary policy issue alone. Lowe added that a central bank should be careful in monitoring a structural change that may occur even when inflation is low and stable.