

FRBSF ECONOMIC LETTER

Number 2006-27, October 13, 2006

Inflation Persistence in an Era of Well-Anchored Inflation Expectations

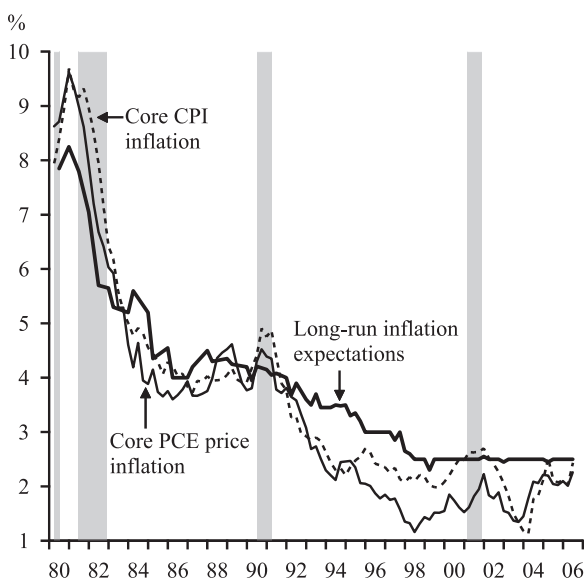
Inflation expectations and core inflation in the United States have been remarkably stable during the past 10 years, a dramatic break from the pattern seen in the prior two decades, as seen in Figure 1. Indeed, long-run inflation expectations, as measured by the median response of the Survey of Professional Forecasters have barely budged since 1998. Economic theory suggests that the observed behavior of inflation may be different in a regime of stable inflation and inflation expectations compared to regimes in which inflation is allowed to drift for a considerable period of time and expectations are poorly anchored. Such a change in the behavior of inflation, if it has occurred, potentially has important implications both for forecasting inflation and for the appropriate monetary policy response to a change in the inflation rate. This *Economic Letter* examines whether the recent stability of inflation and inflation expectations represents a fundamental shift in the observed behavior of inflation and explores some possible reasons why inflation dynamics may have changed.

Has the persistence of inflation changed?

A large research literature has examined the determination of inflation in the United States. Much of this research focuses on the issue of how persistent inflation is, that is, how slowly it returns to its average value following a disturbance of some kind. During much of the postwar period, inflation appears to have been extremely persistent. Indeed, Atkeson and Ohanian (2001) find that inflation behaves like the so-called random walk model, where the best forecast of inflation next year is simply the most recent observed inflation rate and the inflation rate does not predictably tend to an average value *ever*.

Recent research has found evidence that inflation persistence in the United States may have declined starting in the early 1980s or early 1990s, when inflation became relatively low and stable. Researchers use different methods to measure persistence and to gauge whether the persistence has changed. Cogley and Sargent (2005) study a model where the inflation process changes over time and find that inflation persistence declined in the 1980s and 1990s. Stock and Watson (2006) examine a model where inflation is affected by both transitory and permanent shocks. They find a large reduction in the magnitude of per-

Figure 1
Inflation



Note: Gray bars denote NBER recessions. Long-run inflation expectations is from the Survey of Professional Forecasters: median expected inflation over the next 10 years.

manent shocks to inflation during the 1980s and 1990s, implying that inflation has become much less persistent on average. And Levin and Piger (2002) find that after adjusting for a shift down in the average inflation rate that occurred in the early 1990s, inflation has tended to return to its average value reasonably quickly since the early 1980s.

The decline in inflation persistence can also be examined in the context of a Phillips curve model of inflation that has been popular for forecasting and policy analysis. In this model, the inflation rate in the current quarter depends on the inflation rates observed in the recent past, the unemployment rate in the previous quarter, and a constant. I adjust the unemployment rate for changes in the labor market using the Congressional Budget Office's estimates of the natural rate of unemployment. In implementing this model using quarterly data, I include four lags of inflation. The sum of the coefficients on the four inflation lags provides a rough measure of the degree of intrinsic inflation persistence, after controlling for the effects of labor market slack on inflation as measured by the unemployment rate. For

example, if the sum of the coefficients on past inflation is near one, then inflation over the past four quarters has an important influence on the inflation rate in the current quarter, while if the sum of the coefficients is small, the influence of past inflation is correspondingly smaller.

In order to see whether the intrinsic persistence in inflation has changed over the past few decades, I estimated this Phillips curve model over and over for different data samples. In each case, the sample ending point is held fixed at the most recent observation of the second quarter of 2006. The sample start date ranges from the first quarter of 1980 to the fourth quarter of 1999. Because many of these data samples are quite short, I estimate this model using Rudebusch's (1992) median-unbiased estimator that corrects for the bias in standard least squares estimation that can occur with small samples. I look at two popular measures of "core" inflation based on: (1) the price index of personal consumption expenditures (PCE), and (2) the Consumer Price Index (CPI). In both cases, the "core" price index excludes prices of food and energy components. For the CPI, I use the Bureau of Labor Statistics' methodologically consistent series that corrects for changes in methodology over the past few decades.

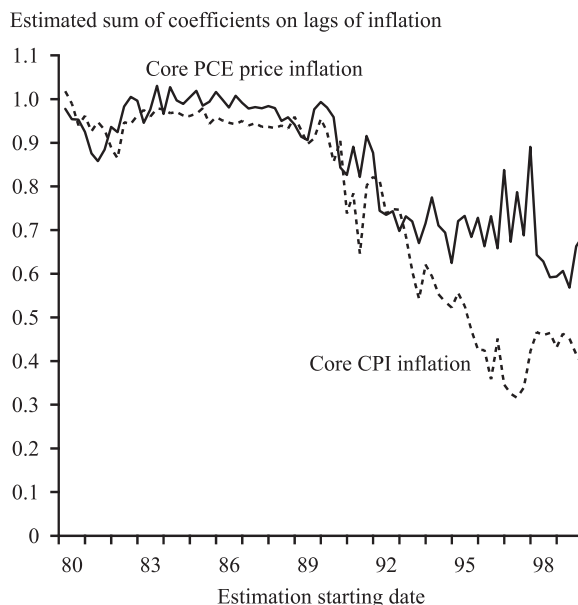
The estimated sum of coefficients on lagged inflation falls well below one for samples that begin in the early 1990s or later, indicating that inflation has become much less persistent in the past 15 years. Figure 2 shows the resulting estimated sum of the coefficients on lagged inflation, where the date on the horizontal axis indicates the starting date of the sample used for estimation. The decline in the estimated degree of inflation persistence is evident in both measures of core inflation.

Although the decline in the point estimates of the sum of the coefficients for more recent samples shown in the figure is clear to the eye, standard statistical tests do not confirm this. This inability to find clear evidence of a break reflects the imprecision of the coefficient estimates and is consistent with the findings of Pivetta and Reis (2006) and indicates that, from a purely statistical point of view, the low degree of inflation persistence observed in recent years may well be due to random variation in the data rather than a true shift in the observed behavior of inflation.

Interpreting the change in the observed behavior of inflation

One interpretation of the contemporaneous attainment of stable inflation and inflation expectations and low inflation persistence is that we have experienced a run of good luck. This is the view of those

Figure 2
Some evidence of less inflation persistence since the early 1990s



who think inflation persistence has always been high and the recent evidence is not compelling enough to convince them that anything has changed. Alternatively, we may have been "lucky" in that the magnitude of "permanent inflation shocks" has fallen, as in the analysis of Stock and Watson (2006).

A different interpretation is that the change in the observed behavior of inflation reflects the effects of a past fundamental shift in monetary policy whereby the Federal Reserve now systematically acts to stabilize core inflation around a constant long-run "target" and has gained credibility with the public that it will continue to do so in the future. The observed high degree of inflation persistence in the past puzzled many macroeconomists, as discussed in Fuhrer and Moore (1995). Textbook theories of price dynamics with forward-looking expectations typically predict that inflation will display relatively low persistence, meaning that the inflation rate will tend to move close to its average value within, say, a year or two. Thus, the recent behavior of inflation appears to be more consistent with standard theories than its past behavior was.

The change in the observed persistence of inflation may reflect the effects of a shift from poorly anchored inflation expectations in the past to well-anchored expectations today. Erceg and Levin (2003) show that inflation will appear to be highly persistent if the central bank changes its inflation objective but the public is uncertain of the change, even in a model where inflation displays very little persistence if the long-run inflation objective is constant. In this view,

the very high observed degree of inflation persistence seen in the past reflects the conduct of monetary policy during this period, which led to the sustained rise in inflation in the 1970s and the disinflations of the early 1980s and early 1990s. Similarly, in the model of Orphanides and Williams (2005), if long-run inflation expectations are well anchored, then inflation will be less persistent than if the public is uncertain about the long-run inflation objective.

An extreme but nonetheless illuminating example of how changes in monetary policy regimes affect the behavior of inflation is found by comparing inflation dynamics in two very different monetary policy regimes. Ball (2000) shows that variations of the random walk model describe inflation reasonably well over 1960–1999, but these models perform very poorly in the period of 1879–1914 when the monetary regime was very different and inflation displayed little persistence. In the pre-World War I period, a reasonable model is one where inflation returns to a sample mean with only a modest degree of persistence.

Conclusion

Recent research finds evidence suggesting that the observed degree of inflation persistence may have become far lower in the past decade than it was in the prior two decades. This finding is consistent with the prediction of theoretical models when monetary policy systematically acts to stabilize inflation around a constant long-run target and has credibility with the public. If true, then one should expect inflation to display low persistence in years to come as long as policy continues to act in the pattern of the past decade and inflation expectations remain well anchored. This conclusion is admittedly quite tentative. Because I am looking at a relatively short period of time, it is simply not possible to determine unequivocally whether the observed shift in the observed persistence in inflation represents a sustained change in the observed behavior of inflation or instead is due to random causes.

Importantly, even taken at face value, this evidence regarding possible shifts in the persistence of inflation may only reflect changes in the correlations in the data, possibly induced by changes in the behavior of monetary policy, and not correspond to any change in the true structure of the economy. Therefore, the recent low level of inflation persistence *cannot* be taken as a given in designing monetary policy: if policy acts in ways to create a high degree of in-

flation persistence, then the public's expectations would eventually shift to reflect that reality.

John C. Williams
Senior Vice President and Advisor

References

[URLs accessed October 2006.]

- Atkeson, Andrew, and Lee E. Ohanian. 2001. "Are Phillips Curves Useful for Forecasting Inflation?" *FRB Minneapolis Quarterly Review* 25(1), pp. 2–11. <http://www.minneapolisfed.org/research/QR/QR2511.pdf>
- Ball, Laurence. 2000. "Near-Rationality and Inflation in Two Monetary Regimes." NBER Working Paper 7988.
- Cogley, Timothy, and Thomas J. Sargent. 2005. "Drifts and Volatilities: Monetary Policies and Outcomes in the Post WWII U.S." *Review of Economic Dynamics* 8, pp. 262–302.
- Erceg, Christopher J., and Andrew T. Levin. 2003. "Imperfect Credibility and Inflation Persistence." *Journal of Monetary Economics* 15, pp. 915–944.
- Fuhrer, Jeff, and George Moore. 1995. "Inflation Persistence." *The Quarterly Journal of Economics*, pp. 127–159.
- Levin, Andrew T., and Jeremy M. Piger. 2002. "Is Inflation Persistence Intrinsic in Industrialized Economies?" FRB St. Louis Working Paper 2002-023E. <http://research.stlouisfed.org/wp/2002/2002-023.pdf>
- Orphanides, Athanasios, and John C. Williams. 2005. "Imperfect Knowledge, Inflation Expectations, and Monetary Policy." In *The Inflation-Targeting Debate*, eds. Ben S. Bernanke and Michael Woodford. Chicago: University of Chicago Press, pp. 201–234.
- Pivetta, Frederic, and Ricardo Reis. 2006. "The Persistence of Inflation in the United States." *Journal of Economic Dynamics & Control*, forthcoming.
- Rudebusch, Glenn D. 1992. "Trends and Random Walks in Macroeconomic Time Series: A Re-examination." *International Economic Review* 33 (August), pp. 661–680.
- Stock, James H., and Mark W. Watson. 2006. "Why Has Inflation Become Harder to Forecast?" NBER Working Paper 12324 (June).

ECONOMIC RESEARCH
FEDERAL RESERVE BANK
OF SAN FRANCISCO

PRESORTED
STANDARD MAIL
U.S. POSTAGE
PAID
PERMIT NO. 752
San Francisco, Calif.

P.O. Box 7702
San Francisco, CA 94120
Address Service Requested

Printed on recycled paper
with soybean inks



Index to Recent Issues of *FRBSF Economic Letter*

DATE	NUMBER	TITLE	AUTHOR
4/07	06-06	What Is the Federal Reserve Banks' Imputed Cost of Equity Capital?	Barnes/Lopez
4/14	06-07	Security Analysts and Regulatory Reform	Marquez
4/21	06-08	Job Matching: Evidence from the Beveridge Curve	Valletta/Hodges
4/28	06-09	Prospects for the Economy	Yellen
5/12	06-10	Bank Diversification, Economic Diversification?	Strahan
5/19	06-11	Central Bank Capital, Financial Strength, and the Bank of Japan	Cargill
6/2	06-12-13	Monetary Policy in a Global Environment	Yellen
6/23	06-14	International Financial Integration and the Current Account Balance	Cavallo
6/30	06-15	Residential Investment over the Real Estate Cycle	Krainer
7/7	06-16	A Monetary Policymaker's Passage to India	Yellen
7/21	06-17	Labor Markets and the Macroeconomy: Conference Summary	Dennis/Williams
7/28	06-18	Property Debt Burdens	Doms/Motika
8/4	06-19	Performance Divergence of Large and Small Credit Unions	Wilcox
8/11	06-20	Would an Inflation Target Help Anchor U.S. Inflation Expectations?	Swanson
8/25	06-21	New Uses for New Macro Derivatives	Wolfers
9/1	06-22	Inflation Targets and Inflation Expectations: Some Evidence...	Trehan/Tjosvold
9/15	06-23	The Exchange Rate–Consumer Price Puzzle	Valderrama
9/22	06-24	Oil Prices and the U.S. Trade Deficit	Cavallo
9/29	06-25	Health Insurance Costs and Declining Coverage	Buchmueller/Valletta
10/6	06-26	Safe and Sound Banking, 20 Years Later	Kwan

Opinions expressed in the *Economic Letter* do not necessarily reflect the views of the management of the Federal Reserve Bank of San Francisco or of the Board of Governors of the Federal Reserve System. This publication is edited by Judith Goff, with the assistance of Anita Todd. Permission to reprint portions of articles or whole articles must be obtained in writing. Permission to photocopy is unrestricted. Please send editorial comments and requests for subscriptions, back copies, address changes, and reprint permission to: Public Information Department, Federal Reserve Bank of San Francisco, P.O. Box 7702, San Francisco, CA 94120, phone (415) 974-2163, fax (415) 974-3341, e-mail sf.pubs@sf.frb.org. **The *Economic Letter* and other publications and information are available on our website, <http://www.frbsf.org>.**