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# Inflation Targeting: Could Bad Luck Explain Persistent One-Sided Misses?

*By Andreas Hornstein, Joe Johnson, and Karl Rhodes*

**In January 2012, the Federal Open Market Committee set an explicit inflation target of 2 percent, but the annual inflation rate has been 0.25 percentage points or more below that target for the past 10 quarters. Extended periods of one-sided misses are common among inflation-targeting countries, but it is not clear whether these persistent deviations are caused by structural changes, bad policy, or bad luck. Analysis of the statistical properties of the inflation process in the United States suggests that bad luck remains a plausible explanation for the FOMC's current string of one-sided misses.**

Explicit inflation targeting is a fairly new feature of U.S. monetary policy. The FOMC announced an explicit inflation target of 2 percent in its January 2012 statement of longer-run goals and policy strategy. The committee said "that inflation at the rate of 2 percent, as measured by the annual change in the price index for personal consumption expenditures (PCE), is most consistent over the longer run with the Federal Reserve's statutory mandate" of promoting price stability and maximum employment.[1]

Soon after the FOMC set that target, the annual inflation rate (headline PCE inflation in all references) fell below 2 percent and stayed there.[2] Inflation has remained below target for 13 straight quarters and at least 0.25 percentage points below target for 10 consecutive quarters. Since 2000, the United States has experienced one other such episode—a string of above-target misses from the second quarter of 2004 through the third quarter of 2006. (See Figure 1.) At that time, the FOMC did not have an explicit inflation target, but for comparative purposes, we are assuming that the committee had an implicit target of 2 percent from 2000 through 2011.[3]

As the current episode has persisted, policymakers and economists have begun to question whether extended periods of one-sided misses reflect bad luck, bad policy, or changes in other structural features of the economy that may affect inflation dynamics. In another portion of the statement quoted above, the FOMC noted that "the inflation rate over the longer run is primarily determined by monetary policy." Based on that assertion alone, it is tempting to conclude that long stretches of below-target inflation primarily reflect policy failure. But since over the short run there are factors besides monetary policy that affect inflation—such as large movements of oil prices—it would seem quite possible that the current string of one-sided misses is the result of bad luck.[4]

This *Economic Brief* does not attempt to evaluate the effectiveness of the FOMC's inflation-targeting policy. Instead, it calculates how "unusual" extended periods of one-sided misses are given the "usual behavior of inflation"—that is, the behavior of inflation with unchanging economic structure and monetary policy. For example, based on an estimated model of U.S. inflation deviations from target since 2000, the probability that random events would cause 10 or more consecutive quarters of one-sided misses of 0.25 percentage points or more during a 16-year period is 46 percent. However, the current episode of such misses is unlikely to end soon. If it continues for one more year—as some forecasters predict—the probability of its random occurrence during an 18-year period drops to 12 percent. That would require some bad luck, but not exceptionally bad luck.

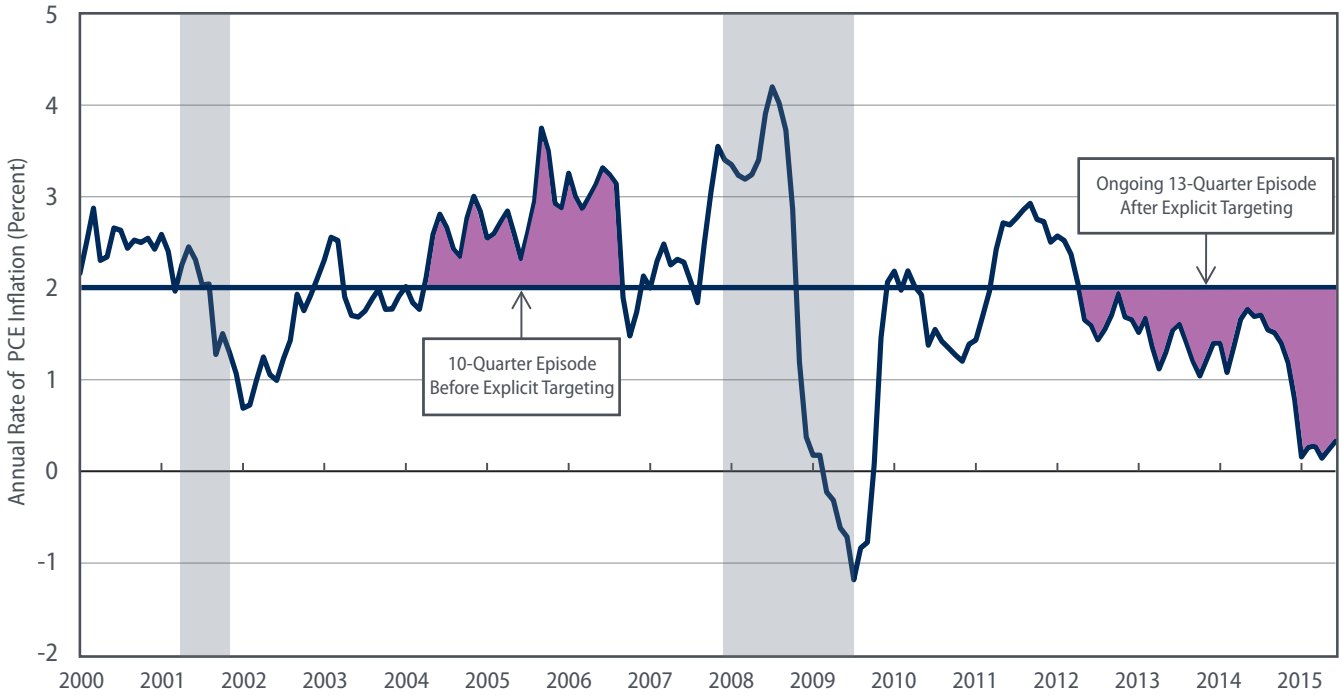
## How Have Other Countries Done?

Inflation targeting as a monetary policy strategy was introduced in the 1990s, mostly by countries that were trying to reduce inflation. These nations also sought to make inflation less volatile and more predictable. Early adopters included New Zealand (1990), the United Kingdom (1992), and Canada (1992).

Beginning in the late 1990s, economists have attempted to evaluate the effectiveness of inflation targeting. Most of this research has focused on the reduction of the level and volatility of inflation following a country's adoption of an inflation target. The results of this research have been ambiguous, judging inflation targeting as neither a complete failure nor an unqualified success.[5]

Table 1 shows the experience of several countries—including the United States—that have been targeting inflation since 2000.[6] As noted above, during this period, the United States has experienced two episodes of one-sided deviations from the current inflation target of 2 percent that lasted at least 10 quarters. In fact, all of the countries listed in Table 1 have experienced at least two episodes in which inflation was consistently above or below their

**Figure 1: Extended Episodes of Consecutive One-Sided Inflation-Target Misses in the United States**




**Sources:** U.S. Bureau of Economic Analysis, Haver Analytics

**Notes:** The inflation target is assumed to be 2 percent throughout the 16-year period. Areas shaded lavender indicate episodes of consecutive one-side misses lasting 10 quarters or more. Areas shaded gray indicate recessions.

targets for at least two years. Sweden and the United Kingdom have experienced completed spells of 18 quarters and 20 quarters, respectively. Currently, three other inflation targeters—New Zealand, Sweden, and the European Central Bank—are experiencing ongoing spells of inflation below target that have already lasted 10 or more quarters. And for Sweden and the European Central Bank, inflation has been 0.25 percentage points or more below target for at least nine quarters.

It appears that even central banks that have been targeting inflation for many years cannot prevent persistent deviations from target. Taken individually, any one of these episodes could have been the result of structural changes, policy failure, or bad luck. But taken together, it would seem possible that bad luck—defined as factors beyond structural changes and monetary policy—has played a significant role.

### What Are the Odds?

To further explore the likelihood that persistent one-sided misses of the Federal Reserve's inflation target could be caused by bad luck, we simulate a statistical model of the deviations from the FOMC's inflation target. For this purpose, we estimate a simple univariate time-series model of inflation deviations from target for quarterly data from 2000 through the second quarter of 2015. As stated above, we assume that even though the FOMC did not announce an explicit inflation target until January 2012, actual policy prior to this period evolved around an implicit 2 percent target.

We estimate the model by regressing the current target deviation on lagged values of target deviations, where the lag length is determined optimally. We then interpret the estimated coefficients on lagged deviations from target as a reduced form representation of the interplay of U.S. economic structure and monetary policy (the structure and policy portion of the equation). We interpret the residuals of the regression as representing exogenous shocks to inflation (the luck portion of the equation). We then generate 1,000 random samples—each 16 years long—using the fixed reduced form, but drawing random shocks for the residuals consistent with their estimated stochastic properties. In other words, we randomly vary the luck portion of the equation (which represents shocks to the economy) to simulate 1,000 periods (each lasting 16 years) in which deviations from the inflation target (misses) are driven solely by luck. For each sample, we find the episodes of one-sided deviations from target and calculate the percent of samples in which we find episodes of 10 quarters or more. These percentages represent the probabilities that extended periods of one-sided misses would occur as a result of factors beyond the

**Table 1: Episodes of Consecutive One-Sided Inflation-Target Misses Lasting at Least Eight Quarters**

| | One-Sided Misses of Any Size | | One-Sided Misses ≥ 0.25 PP | |
|---|---|---|---|---|
| Inflation Targeters | Episodes | No. of Quarters | Episodes | No. of Quarters |
| Australia (1995) | 2 | 8, 9 | 1 | 8 |
| Canada (1992) | 2 | 8, 8 | 1 | 8 |
| European Central Bank (1999) | 5 | 8, 8, 10, **10**, 11 | 2 | 8, **9** |
| New Zealand (1990) | 2 | 12, **15** | 2 | 12, 14 |
| Norway (2001) | 2 | 12, 14 | 2 | 10, 11 |
| Sweden (1995) | 3 | 8, **14**, 18 | 2 | 14, **14** |
| United Kingdom (1992) | 2 | 17, 20 | 2 | 15, 20 |
| United States (2012) | 2 | 10, **13** | 2 | 10, **10** |

**Sources:** Central banks of each nation and the European Central Bank (ECB)

**Notes:** Years in parentheses indicate when each country (and the ECB) officially adopted inflation targeting. The authors assume the United States had an implicit target of 2 percent from 2000 through 2011. Bold numbers denote episodes that are ongoing as of the second quarter of 2015. PP is an abbreviation for percentage points.

control of monetary policy—in other words, the simulations quantify the role of bad luck.

Table 2 displays the resulting probability distributions. Based on the estimated model for inflation deviations from target, this analysis shows a 36 percent probability of having two episodes with persistent deviations from target for at least 10 quarters, and an 11 percent probability of having two such periods with persistent deviations of at least 0.25 percentage points from target. This suggests that, in the context of the past 16 years, the current period does not represent an unlikely event so far, but the current episode is not complete. Some forecasts call for inflation to remain below 1.75 percent into the second quarter of 2016 and below 2 percent into the first quarter of 2017.[7] If those forecasts turn out to be true, then the inflation rate would stay at least 0.25 percentage points below target for another four quarters and below target by any amount for another seven quarters. According to the lower section of Table 2, the probability of having one completed spell of at least 14 quarters with one-sided misses that are 0.25 percentage points or more would be 12 percent. Likewise, the likelihood of having one completed spell of at least 20 quarters with one-sided misses of any size would be 5 percent, a probability that is low, but not extremely low.

### Are These Results Robust?

Perhaps a simple univariate time-series model is too simplistic to adequately capture U.S. inflation dynamics. Presumably this problem would show up in the residuals of the regression equation, but it would not be reflected in the simulations, which employ normal random shocks by design. It turns out that standard statistical tests do not reject the assumption of normal frequency distribution for the actual residuals of the regression equation. In other words, the real-world deviations from the equation do not cast doubt on the adequacy of the inflation model. Furthermore, constructing shocks as random draws from the regression residuals in the simulations of the inflation-deviation equation—that is, "bootstrapping" the residuals—does not affect the results.

**Table 2: Probabilities of Extended Episodes of One-Sided Misses in the United States**

| | IN A 16-YEAR SAMPLE (EQUAL TO THE CURRENT PERIOD) | | | |
|---|---|---|---|---|
| | One-Sided Misses of Any Size | | One-Sided Misses ≥ 0.25 PP | |
| No. of Quarters | 1 Episode | 2 Episodes | 1 Episode | 2 Episodes |
| Q ≥ **10** | 0.77 | **0.36** | **0.46** | **0.11** |
| Q ≥ **11** | 0.62 | 0.18 | 0.32 | 0.04 |
| Q ≥ **12** | 0.49 | 0.10 | 0.21 | 0.02 |
| Q ≥ **13** | **0.37** | 0.05 | 0.13 | 0.01 |
| | IN AN 18-YEAR SAMPLE (EQUAL TO THE CURRENT PERIOD PLUS TWO YEARS) | | | |
| Q ≥ **14** | 0.33 | 0.04 | **0.12** | 0.00 |
| Q ≥ **16** | 0.18 | 0.01 | 0.06 | 0.00 |
| Q ≥ **18** | 0.09 | 0.00 | 0.02 | 0.00 |
| Q ≥ **20** | **0.05** | 0.00 | 0.01 | 0.00 |
| Q ≥ **22** | 0.03 | 0.00 | 0.01 | 0.00 |

**Sources:** Authors' calculations based on a simple univariate time-series model of inflation in the United States with normal random shocks from 2000 through the second quarter of 2015.

**Notes:** Blue numbers highlight the probability of the random occurrence of events that have happened during the past 16 years. Red numbers highlight the probability of the random occurrence of events as they are projected to conclude during the next two years. PP is an abbreviation for percentage points.

Another issue with the simulations is basing them on an estimate of the inflation-deviation equation for the past 16 years. A substantial part of this sample period includes the ongoing episode of one-sided deviations from target that we are evaluating. To see how much this issue affects the results, we re-estimate the inflation-deviation equation for 2000 through 2011—leaving out the ongoing episode. Of course, this exercise reduces the sample size considerably and may therefore make the estimate of the inflation-deviation equation less reliable.[8] That being said, running the simulation using the estimated equation for the shorter period reduces the probabilities of extended periods of one-sided deviations by about one-half. This would put the probability of 20 or more consecutive one-sided misses at 2 percent, which would seem to require very bad luck indeed.

Alternatively, we could estimate our inflation-deviation equation for the period 1995–2007. This period excludes the Great Recession and its aftermath but includes the second half of the 1990s, a time when some FOMC members were proposing 2 percent as a numerical value for the term "price stability." Simulations based on this alternative model of inflation deviations generate a 30 percent probability for 20 or more consecutive one-sided misses. In this case, the bad luck required doesn't seem that great.

Considering the three sample periods for our statistical model of inflation-target deviations, we believe that our baseline period best balances the need for a sufficiently large sample size with an unchanging policy regime and economic structure. As mentioned above, using the inflation-deviation equation estimated from our baseline period puts the likelihood of 20 or more consecutive one-sided misses at 5 percent. That probability would not rule out bad luck as a possible explanation for the FOMC's current string of one-sided misses—even if the streak continues for seven more quarters. ■

Andreas Hornstein is a senior advisor, Joe Johnson is a research associate, and Karl Rhodes is a senior managing editor in the Research Department of the Federal Reserve Bank of Richmond.

## Endnotes

[1] This statement is part of the FOMC's minutes from January 24–25, 2012. The minutes are available online at www.federalreserve.gov/monetarypolicy/fomcminutes20120125.htm.

[2] Headline PCE inflation covers all types of personal consumption in the index, while core PCE excludes prices for food and energy, which tend to be highly volatile. Core PCE is of interest since it tends to be a good predictor of headline PCE inflation.

[3] The FOMC's goals and strategy statement intends to communicate to the public the committee's interpretation of its congressional mandate to promote maximum employment and price stability. Over the past quarter century, the committee has discussed several times how to interpret "price stability," and its understanding of price stability has changed over time. Initially, FOMC discussions revolved around price stability as price-level stability or zero inflation, but the minutes of the July 1996 meeting seem to reflect a shift toward a view of price stability as low positive inflation. At that time, most of the proposed numerical values for the inflation target involved 2 percent for the Consumer Price Index (CPI). Because there was some concern about an inflationary bias of up to 1 percent in the CPI, the FOMC eventually moved toward the PCE as a better measure of inflation in its discussions. Given the relative stability of PCE inflation around 2 percent since the late 1990s, the assumption of an implicit 2 percent inflation target seems reasonable.

[4] For the period 2004 to 2008, when headline PCE inflation exceeded 2 percent most of the time, oil prices (West Texas Intermediate) more than quadrupled from $30 a barrel to $130 a barrel. The sharp decline and recovery of headline PCE inflation from mid-2008 through 2009 was associated with movements in oil prices from $130 a barrel to $40 a barrel and back to $70 a barrel. Finally, headline PCE inflation appeared to be headed back to 2 percent in the middle of 2014, but then oil prices declined from $105 a barrel to $50 a barrel during the second half of the year.

[5] For examples of this research, see Andrew T. Levin, Fabio M. Natalucci, and Jeremy M. Piger, "The Macroeconomic Effects of Inflation Targeting," Federal Reserve Bank of St. Louis *Review*, July/August 2004, vol. 86, no. 4, pp. 51–80; Laurence M. Ball and Niamh Sheridan, "Does Inflation Targeting Matter?" in Ben S. Bernanke and Michael Woodford (eds.), *The Inflation-Targeting Debate*, pp. 249–282, Chicago: University of Chicago, 2004; Scott Roger, "Inflation Targeting at 20: Achievements and Challenges," International Monetary Fund Working Paper No. 09-236, October 2009; and Laurence M. Ball, "The Performance of Alternative Monetary Regimes," in Benjamin M. Friedman and Michael Woodford (eds.), *Handbook of Monetary Economics Vol. 3*, pp. 1303–1343, Amsterdam: North Holland Press, 2011.

[6] These countries are a subset of the 20 listed in Ball (2011). To create the subset, we chose countries with central banks whose stated policies can be loosely interpreted as involving a symmetric inflation target. We also included other central banks that have experienced substantial positive and negative deviations from target. Since monetary policy in the Eurozone is implemented by the European Central Bank, which targets a Euro-area-wide average inflation rate, we do

not separately list inflation target deviations for individual Eurozone countries.

[7] These forecasts are roughly consistent with annual forecasts summarized in Federal Reserve System Board of Governors, "Advance Release of Table 1 of the Summary of Economic Projections," at http://www.federalreserve.gov/monetarypolicy/fomcprojtabl20150617.htm.

[8] It also may be unnecessary to exclude the current episode since oil-price shocks have been an important driver of headline inflation during this episode, the same way they had been prior to 2011, as described in footnote 4.