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All in the Family: The Close Connection Between Nominal-GDP Targeting and the Taylor Rule

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Abstract

The classic Taylor rule for adjusting the stance of monetary policy is formally a special case of nominal-gross-domestic-product (GDP) targeting. Suitably implemented, moreover, nominal-GDP targeting satisfies the definition of a "flexible inflation targeting" policy rule. However, nominal-GDP targeting would require more discipline from policymakers than some analysts think is realistic.

JEL codes: E52, E58
Keywords: Flexible inflation targeting, Taylor rule, nominal-GDP targeting

In view of persistently high unemployment and a less-than-robust economic outlook, some prominent economists and commentators have recently advocated a change in how the Federal Reserve conducts monetary policy. Specifically, they have proposed that the Federal Reserve adopt a measure of nominal income or spending—typically nominal gross domestic product (nominal GDP)—as an intermediate target (Crook 2011; Hatzius and Stehn 2011; Krugman 2011; Romer 2011). While acknowledging that nominal-GDP targeting has been the subject of Federal Open Market Committee (FOMC) discussion, Federal Reserve Chairman Ben Bernanke has indicated that the committee has no plans to move away from its current policy framework, "flexible inflation targeting."[1] Leaving aside the question of whether a change in strategy is a good idea, this paper demonstrates that certain implementations of nominal-GDP targeting are fully consistent with flexible inflation targeting. Indeed, they are close cousins to Stanford economist John Taylor's classic formalization of flexible inflation targeting, the Taylor rule. Nominal-GDP targeting does imply tighter control of inflation expectations than does the Taylor rule, however, so a shift to nominal-GDP targeting would commit Fed officials to more-disciplined policymaking. Well-designed policy commitments can be useful tools—especially when short-term interest rates are constrained by the zero lower bound—but they are effective only insofar as they are credible.

1. WHAT IS FLEXIBLE INFLATION TARGETING?

"Flexible inflation targeting" describes an approach to conducting monetary policy that holds longer-term inflation expectations steady while giving policymakers leeway "to respond to economic shocks as needed to moderate deviations of output from potential" (Bernanke 2011). What does this mean, concretely? The classic formalization of flexible inflation targeting is due to John Taylor, who argued that monetary policy should be restrictive, or "tight," whenever the sum of the deviation of inflation from long-term target inflation and the deviation of output from trend or estimated "potential output" is positive and should be accommodative, or "easy," whenever the sum of these deviations is negative (Taylor 1993). Specifically, the Taylor rule prescribes a relatively high real (inflation adjusted) short-term interest rate if, and only if,

$$(\pi - \pi^*) + (y - \mathrm{E}_{-1} y^*) > 0, \tag{1}$$

where π is the current one-period (one-year) GDP inflation rate, π^* is the desired long-run inflation rate, y is (the logarithm of) real GDP; y^* is (the logarithm of) real potential GDP; and $\mathrm{E}_{-1} y^*$ is the central bank's estimate of potential GDP based on recent past information.[2] Equivalently, the Taylor rule prescribes tight policy if, and only if,

$$\pi > \pi^* - (y - \mathrm{E}_{-1} y^*). \tag{1'}$$

Note that realized inflation in excess of long-run target inflation doesn't trigger corrective policy action by the Fed to the extent that output is below estimated potential output: Output below estimated potential raises the Fed's inflation tolerance.

Because monetary policy affects output and inflation with long and variable lags, even in an economy in which the central bank follows the Taylor rule, the sum of the inflation and output gaps will rarely exactly equal zero. In the absence of new shocks, however, policy will force this sum to diminish in magnitude over time so that the expected sum will approximate zero at some point in the future. Formally, if $\mathrm{E}(\pi_T - \pi^*)$ and $\mathrm{E}(y_T - y_T^*)$ are today's expectation of the inflation and output gaps T years hence, under the Taylor rule

$$\mathrm{E}[(\pi_T - \pi^*) + (y_T - y_T^*)] = 0 \tag{2}$$

if the look-ahead horizon, T, is sufficiently large. In practice, a horizon of five years will usually be about right: It takes about five years for the sum of the inflation and output gaps to get back to zero once it has moved away. But five years is also the length of time it typically takes output to fully recover from recessions or, more generally, for output to return to potential.[3] So for $T \geq 5$, we have $\mathrm{E}(y_T - y_T^*) = 0$,

[1] See Bernanke (2011). For a formal statement of the FOMC's longer-run goals and policy strategy, see FOMC (2012).

[2] Taylor (1993), for example, estimates current potential output by fitting a line through log-levels of real GDP in prior years. The Congressional Budget Office, in contrast, fits trends to lagged factor-input and multifactor-productivity data and plugs these trends into an estimated production function. Much of the underlying data come from the Multifactor Productivity Report released by the Bureau of Labor Statistics each May.

[3] Regress the sum of the output and inflation gaps on its own four-quarter lagged value and you get a coefficient of 0.63 over the Great Moderation period, which implies that just over 90 percent of any initial deviation from zero can be expected to disappear after five years. A similar regression in the output gap alone also yields a 0.63 coefficient estimate. The sample periods that produce these estimates end in second quarter 2008, before the collapse of Lehman Brothers.

which means that equation 2 reduces to:

$$\mathrm{E}\pi_T = \pi^* \tag{2'}$$

for $T \geq 5$. Under the Taylor rule, we should expect inflation five or more years hence to equal long-run target inflation, π^*.

We've verified that the Taylor rule meets the key flexible-inflation-targeting criteria: The rule implies that inflation is expected to converge to target over the longer term (equation 2′), but it allows short-term inflation flexibility contingent on estimated slack in the economy (equation 1′). Does the Taylor rule provide a reasonable approximation of *actual* U.S. monetary policy? Using the slope of the real yield curve (the difference between long-forward and short-term real interest rates) to measure the Fed's policy stance, the answer is a qualified "yes."[4] From the late 1980s through 2004, the FOMC typically set real short-term interest rates at a high level relative to long-forward real rates when the sum of the inflation and output gaps was high, and it typically set real short-term interest rates at a low level relative to long-forward real rates when the sum of the inflation and output gaps was low (*Figure 1*).[5] Since second quarter 2009, the sum of the two gaps has started moving in the right direction (toward zero), despite the fact that it hasn't been possible to further reduce short-term nominal interest rates. However, it remains large in magnitude, and progress has been slow.

How about inflation expectations? Are expectations of inflation several years hence low and steady, as ought to be the case if the Taylor rule is a good policy approximation? Median Consumer Price Index (CPI) inflation expectations from the Survey of Professional Forecasters (SPF) indicate that the inflation rate expected over the nine years starting one year hence drifted downward in the mid-1990s before stabilizing at 2.5 percent beginning in 1998 (*Figure 2*). The series has stayed within a few tenths of a percentage point of that level ever since, suggesting that forward inflation expectations have been well anchored.[6] A better test of the Taylor rule is the behavior of the inflation rate expected over the five years starting five years from now—the five-year, five-year forward rate—which is only available beginning third quarter 2005. This inflation-expectations measure is somewhat less stable than the nine-year, one-year forward rate. It rises from an average of 2.4 percent over the years leading up to the recent recession to as high as 2.85 percent immediately after the recession's end. At 2.3 percent, the series is back in its prerecession range of 2.3 to 2.5 percent.

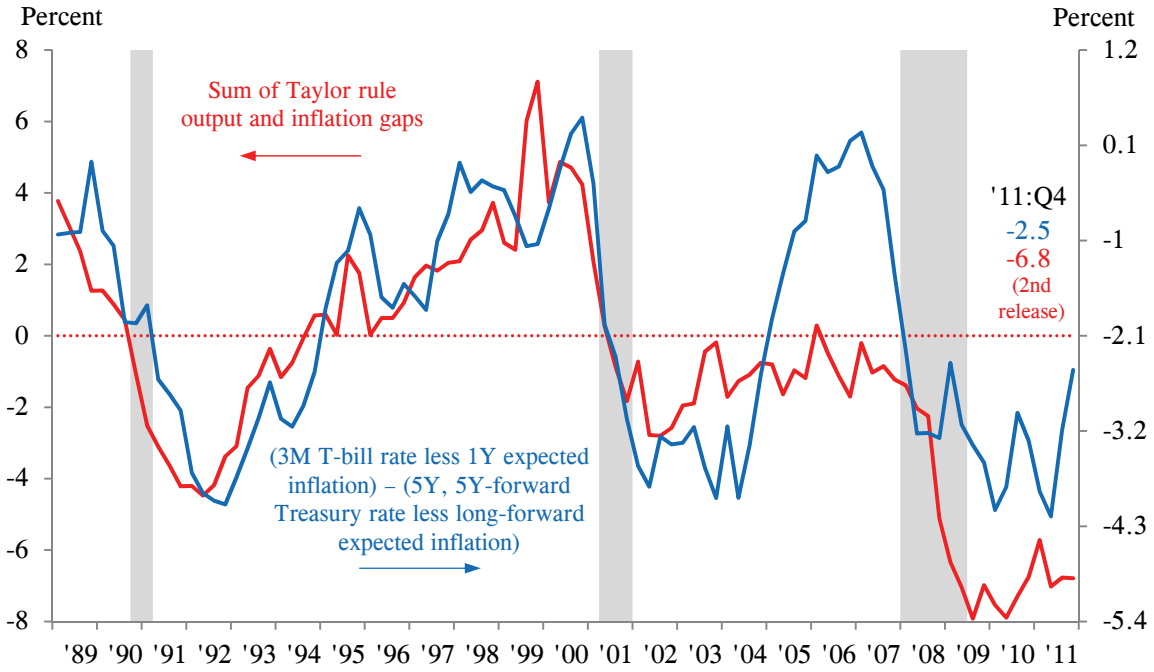
On the whole, given the shocks with which the economy has been buffeted, the Federal Reserve's use of relatively unfamiliar policy tools and the troubling fiscal outlook, forward inflation expectations have held remarkably steady.

[4] Taylor (1993) uses the difference between the real short-term interest rate and 2 as his measure of the stance of monetary policy. The advantage of using the real yield curve's slope instead is that it allows for changes over time in the neutral real rate. The hope is that these changes will be captured by movements in the long-forward real rate.

[5] The chart assumes a 2 percent long-run inflation target. Note that monetary policy is much tighter than predicted by this version of the Taylor rule over the period from 2005 to 2007. It may be that the equal weighting of output and inflation gaps assumed in the chart is incorrect after 2004. (Statistical tests reject the equal-weighting hypothesis in a sample that extends through 2007, but not over a sample that ends in 2004.) It may be that the FOMC deliberately lowered its inflation target beginning in 2005. It may be that considerations other than the output and inflation gaps played a significant role in policy deliberations after 2004. Finally, it may be that the FOMC's real-time estimates of the output gap were different from those of the Congressional Budget Office (CBO). (CBO estimates of the output gap from 2004 through 2007 were eventually revised sharply upward.) The available data do not allow any firm conclusions to be drawn.

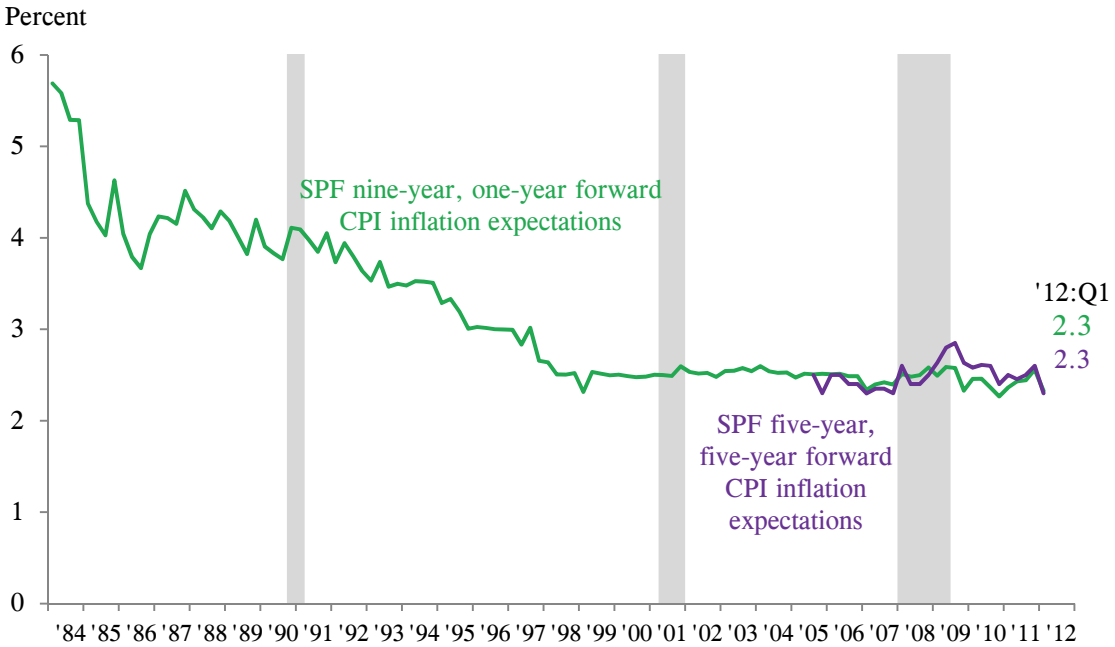
[6] CPI inflation runs 0.5 percentage points above personal consumption expenditure (PCE) inflation, on average. The FOMC recently announced a 2 percent long-term objective for PCE inflation (FOMC 2012).

Figure 1: Monetary Policy Typically Tight When the Sum of the Output and Inflation Gaps Is Positive and Easy When It Is Negative



NOTES: Before 2005:Q3, long-forward expected inflation is 9Y, 1Y-forward expected inflation. After 2005:Q2, it is 5Y, 5Y-forward expected inflation. Prior to 1991:Q4, actual GDP data are December 1991 vintage, and potential GDP data are January 1992 vintage. After 1991:Q3, actual GDP data are third-release estimates, and potential GDP estimates are from January of the same year. Gray bars represent recession.
SOURCES: Federal Reserve Bank of Philadelphia; Congressional Budget Office; Bureau of Economic Analysis; Federal Reserve Board; author's calculations.

Figure 2: Long-Forward Inflation Expectations Steady Since the Late 1990s



NOTES: Gray bars represent recession. SPF=Survey of Professional Forecasters. CPI=Consumer Price Index.
SOURCES: Federal Reserve Bank of Philadelphia; author's calculations.

2. WHAT ABOUT NOMINAL-INCOME TARGETING?

Under nominal-income targeting, the FOMC would try to keep nominal GDP close to a preannounced target.[7] Theory suggests that the specific target value chosen is of secondary importance. What's essential is that firms and households be told well in advance what the target is going to be—far enough in advance that a large fraction of existing labor and debt contracts will expire before the target takes effect. The advance notice allows people to factor the target into labor and debt agreements currently under negotiation. In practice, this requirement means committing today to a target for nominal GDP five or more years from now.[8] For example, the FOMC might announce a (log) target of

$$n_T^* = p_T^* + \mathrm{E}y_T^* \tag{3}$$

for T years from now, where $\mathrm{E}y_T^*$ is today's best estimate of future potential real GDP and where $p_T^* \equiv p + T \times \pi^*$ extrapolates the current price level forward at inflation rate π^*. Why this particular target? Because *if* policymakers succeed in hitting it (so that $p_T + y_T = n_T^*$), *if* potential output evolves as expected ($y_T^* = \mathrm{E}y_T^*$) and *if* output converges to potential ($y_T = y_T^*$), the price level must converge to p_T^* and, given the definition of p_T^*, average annual inflation over the next T years $[(p_T - p)/T]$ will equal π^*. None of these conditions is likely to be met. However, every one of them is likely to hold in *expectation*: Under nominal-income targeting, policy is systematically adjusted so that $\mathrm{E}(p_T + y_T) = n_T^*$; trivially, $\mathrm{E}y_T^* = \mathrm{E}y_T^*$; and with $T \geq 5$ years, output can usually be expected to converge to potential so that $\mathrm{E}y_T = \mathrm{E}y_T^*$. Therefore, while inflation won't typically average out to π^* over the next T years, this version of nominal-GDP targeting ensures that[9]

$$\frac{\mathrm{E}(p_T - p)}{T} = \pi^*. \tag{4}$$

Importantly, equation 4 implies tighter control of inflation expectations than is achieved using the Taylor rule. Under the Taylor rule, policy is expected to drive inflation *to* target over the next several years, whereas under nominal-GDP targeting, policy is expected to keep inflation *equal* to its target level, on average, over the next several years: Nominal-GDP targeting is less forgiving of expected near-term departures of inflation from target than is the Taylor rule. This stricter control of inflation expectations is of vital importance when short-term interest rates are constrained by the zero bound because any slippage in the inflation rate expected between now and when the zero-bound constraint is no longer binding amounts to an implicit policy tightening (Krugman 1998; Koenig 2011a).

To implement nominal-GDP targeting, the FOMC would presumably choose a restrictive setting for the short-term interest rate if, and only if, nominal GDP is above target—i.e., if and only if,

$$p + y > n^*. \tag{5}$$

Using the income target given in equation 3, policy will be tight if, and only if,

$$p + y > p^* + \mathrm{E}_{-T} y^* = p_{-T} + T \times \pi^* + \mathrm{E}_{-T} y^*, \tag{5'}$$

or, equivalently, if and only if

$$T \times (\bar{\pi} - \pi^*) + (y - \mathrm{E}_{-T} y^*) > 0, \tag{5''}$$

where $\bar{\pi} \equiv (p - p_{-T})/T$ is the average rate of inflation over the past T years. *Note that the Taylor rule is a special case of nominal-GDP targeting:* Set $T = 1$ in equation $5''$ and you get equation 1. The chief difference between the two policy approaches is that under nominal-GDP targeting, policymakers look at a longer history of price changes than they do under the Taylor rule when deciding on the appropriate policy setting. Secondarily, the estimate of potential output that enters the nominal-GDP-targeting rule is less sensitive to short-term supply shocks than is the estimate that enters the Taylor rule.[10]

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[7] Variants would target nominal gross domestic purchases or nominal personal consumption expenditures.

[8] For further explanation of the need for advance announcement of the nominal-income target, see Koenig (1996, 2004, 2011b). For evidence on the duration of nonfinancial, private-sector nominal liabilities, see Doepke and Schneider (2006).

[9] More generally, $\mathrm{E}p_T = p_T^*$: Nominal-GDP targeting pins down the expected future price level. This result holds for any p_T^* choice that depends only on currently available information. The specific implementation of nominal-GDP targeting analyzed in this paper is mathematically equivalent to setting $n_T^* = (p + \mathrm{E}y^*) + \nu \times T$, where $\nu \equiv \mathrm{E}(y_T^* - y^*)/T + \pi^*$. In words: To obtain future target nominal GDP, extrapolate current nominal potential GDP forward at a rate that equals the economy's estimated potential growth rate plus the long-run desired inflation rate.

[10] The intuition is that financial-market and labor-market participants need to know, well before the fact, what the price–output trade-off defined by monetary policy will be. They do not have the necessary advance knowledge if the price–output trade-off is made contingent on recent information. See the references in note 8.

Much like the Taylor rule, nominal-GDP targeting allows variation in *realized* inflation, conditional on the performance of the real economy. Thus, rearranging equation 5″, nominal-GDP targeting prescribes tight policy if, and only if,

$$\bar{\pi} > \pi^* - \frac{y - \mathrm{E}_{-T} y^*}{T}. \tag{6}$$

Equivalently (assuming that T is large enough that output can be expected to converge to potential), nominal-GDP targeting prescribes tight policy if, and only if,

$$\bar{\pi} > \pi^* - \frac{y - \mathrm{E}_{-T} y}{T}. \tag{6′}$$

According to equation 6, inflation in excess of long-run target inflation is acceptable to the extent that real output falls short of the estimate of potential output that was available when the nominal GDP target was announced. Equivalently, inflation in excess of long-run target inflation is acceptable to the extent that real output disappoints (equation 6′). Because it holds longer-term inflation expectations constant (equation 4) while allowing realized inflation to vary depending on performance of the real economy (equations 6 and 6′), the version of nominal-GDP targeting outlined above falls squarely within the flexible-inflation-targeting class of policy rules.[11]

What is nominal-GDP targeting's verdict on the recent conduct of monetary policy? Consider expectations of future inflation. In the lead-up to the 2008-09 Great Recession, expected average five-year CPI inflation was stable at 2.5 percent, judging by the median SPF forecast (*Figure 3*). Postrecession, five-year inflation expectations have generally run a bit lower than before. Under a credible nominal-GDP targeting regime, the prospect of future accommodation would presumably have held five-year inflation expectations steady. And what of the sum of the inflation and output gaps that appears on the left-hand side of equation 5″? This sum would move systematically toward zero under nominal-GDP targeting, in the absence of new shocks. In fact, it shows no obvious signs of recovery and, indeed, has continued to fall (*Figure 4*).[12] By this measure, efforts to provide monetary stimulus have so far failed to gain traction.

3. FURTHER GENERALIZATION

The Taylor rule prescribes tight monetary policy if, and only if,

$$(p - p_{-1} - \pi^*) + (y - \mathrm{E}_{-1} y^*) > 0 \tag{7}$$

(*c.f.* equation 1). Nominal-GDP targeting generalizes the Taylor rule's tight-policy criterion to

$$(p - p_{-T} - T \times \pi^*) + (y - \mathrm{E}_{-T} y^*) > 0, \tag{8}$$

where T is determined by the speed with which the economy is able to overcome nominal frictions (*c.f.* equation 5′). A further generalization would prescribe tight monetary policy if, and only if,

$$(p - p_{-T} - T \times \pi^*) + \alpha(y - \mathrm{E}_{-T} y^*) > 0, \tag{9}$$

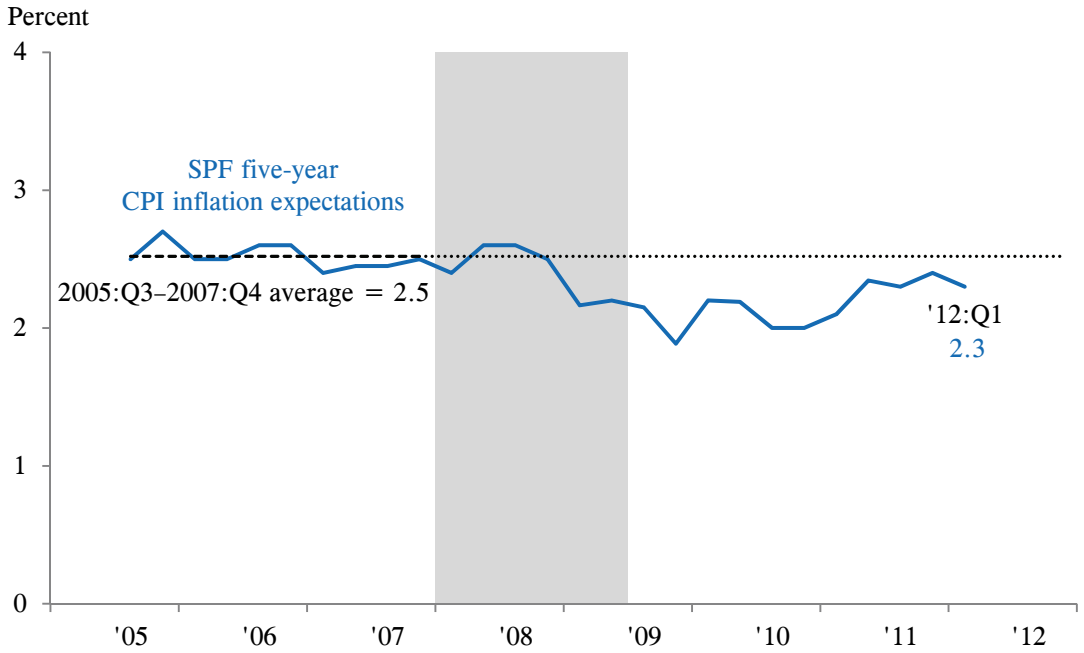
where $\alpha > 0$ determines the relative weight given to real activity in policy deliberations. Only in the special case where output and price surprises are equally weighted ($\alpha = 1$) does this policy qualify as "nominal-GDP targeting." Like nominal-GDP targeting, however, the policy pins down expected average inflation over the next T years.[13] So, like nominal-GDP targeting, it satisfies the definition of flexible inflation targeting.

[11] In general, nominal-GDP targeting pins down the expected future price level (*c.f.*, note 9) but allows the realized price level to surprise on the upside if output surprises on the downside. In the terminology of Stanford's Robert Hall, nominal-GDP targeting sets an "elastic price standard" (Hall 1984). By making the target future price level contingent on the realized current price level, however, we effectively convert an expected price-level target into an expected inflation target.

[12] Figure 4, like Figure 1, is constructed assuming a 2 percent long-run inflation target.

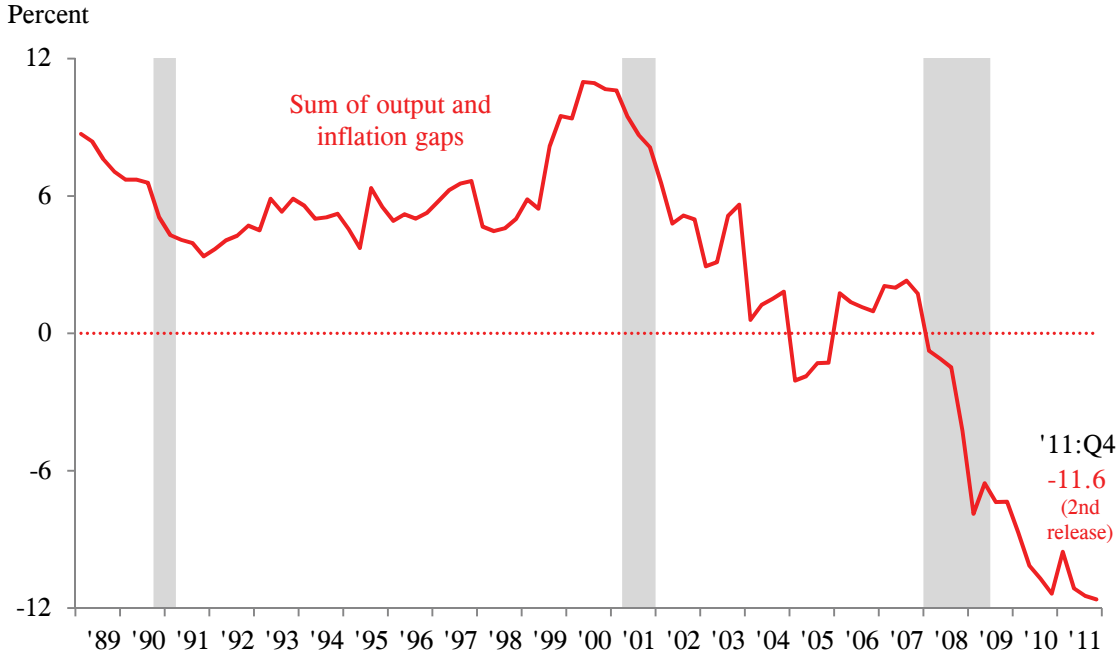
[13] This result assumes that T is large enough so that $\mathrm{E}(y_T - y_T^*) = 0$.

Figure 3: Expectations of Inflation Over the Next Five Years Somewhat Lower Than Before the Recession



NOTES: Gray bar represents recession. SPF=Survey of Professional Forecasters.
SOURCES: Federal Reserve Bank of Philadelphia; author's calculations.

Figure 4: Monetary Policy Has Failed to Stabilize the Sum of Output and Inflation Gaps That Is Relevant to Nominal-GDP Targeting



NOTES: Prior to 1991:Q4, actual GDP data are December 1991 vintage, and after 1991:Q3, are third-release estimate. Before 1997:Q1, potential GDP is January 1992 vintage, and after 1996:Q4, is from the January five years previous. Gray bars represent recession.
SOURCES: Federal Reserve Bank of Philadelphia; Congressional Budget Office; Bureau of Economic Analysis; Federal Reserve Board; author's calculations.

4. SUMMARY AND CONCLUSION

Suitably implemented, nominal-GDP targeting is the more-familiar Taylor rule's close cousin. The main difference between the two policy approaches is that nominal-GDP targeting takes a longer-term view of inflation than does the Taylor rule when pointing to a loose or tight policy setting. Consequently, nominal-GDP targeting is less forgiving of near-term expected deviations of inflation from long-run target inflation than is the Taylor rule: It requires that any near-term expected inflation shortfall be offset by expected forward inflation overages so that expected *average* inflation over the medium term holds steady. This unwillingness to "let bygones be bygones" can be an advantage if the zero bound limits current policy stimulus. Under nominal-GDP targeting, the monetary authority promises future accommodation to offset the current tighter-than-desired policy stance.

One might think that nominal-GDP targeting's ability to work around the zero-bound constraint would appeal to monetary policy doves and that its tighter control of inflation expectations would appeal to monetary policy hawks. Why hasn't nominal-GDP targeting received more widespread support? The main issue is credibility.[14] Some analysts are concerned that future FOMCs may fail to follow through on promises of accommodation, while others fear that future FOMCs may back away from nominal-GDP targeting should it call for tighter policy than the current approach. To the extent that the public shares the former concern, an announced shift to nominal-GDP targeting would do little to accelerate the economy's recovery. To the extent that the public shares the latter concern, an announced shift to nominal-GDP targeting might be seen as a relaxation of the Federal Reserve's commitment to price stability rather than an enhancement to that commitment.

[14] Another key issue, of course, is which strategy does a better job of helping the Federal Reserve maintain full employment and price and financial stability. A complete analysis of this question would involve stochastic simulations of a variety of general-equilibrium models of the U.S. economy and is well beyond the scope of this paper. The existing literature hints at several broad conclusions. First, nominal-GDP targeting tends to perform poorly to the extent that price setting is predominantly backward—rather than forward—looking (Ball 1999; McCallum 1997; Dennis 2001). Second, nominal-GDP targeting tends to perform relatively better in economies where the main nominal friction is in wage setting rather than price setting (Bean 1983; Koenig 1996, 2004). Finally, nominal-income targeting has desirable risk-sharing properties in economies in which debt obligations are fixed in nominal terms (Koenig 2011b; Eagle and Domian 2005). All of the cited studies ignore the zero-bound interest rate constraint.

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