Policy Rule Legislation in Practice[*]

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Abstract

The Federal Reserve Accountability and Transparency Act of 2014 would, if it became law, require the Fed to choose a "Directive Policy Rule" which describes how the federal funds rate would respond to a change in inflation and one or more measures of real economic activity. If the Fed deviated from its rule, the Chair of the Fed would be required to testify before the appropriate congressional committees as to why it is not in compliance. Using real-time data for the past 60 years, we consider whether Fed policy would have triggered congressional testimony under different variants of Taylor rules. The results cause us to be pessimistic that the Fed could comply with the proposed legislation and avoid triggering congressional testimony over extended periods of time without periodically changing the Directive Policy Rule. Historically, specifications that produce low deviations during most of the 1950s and early 1960s produce high deviations during the late 1960s and between 1975 and 1985. More recently, specifications that produce low deviations during the first half of the 2000s produce high deviations during the first half of the 2010s, and vice versa, causing doubt that a Directive Policy Rule which does not currently trigger congressional testimony will continue to do so in the future.

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1. Introduction

The Federal Reserve Accountability and Transparency Act of 2014, introduced into Congress on July 7, engendered both positive and negative reactions. On the positive side, Allan Meltzer testified before the Senate Banking Committee that "So you need a rule which says, look, you said you were going to do this, and you have not done it. That requires an answer, and that I think is one of the most important reasons why we need some kind of a rule." On the negative side, in a hearing before the House Financial Services Committee, Federal Reserve Chair Janet Yellen called the proposal a "grave mistake" which would "essentially undermine central bank independence." Alan Blinder wrote "In a town like Washington, the message to the Fed would be clear: Depart from the original Taylor rule at your peril." In later testimony before the Senate Banking Committee, Yellen said "I'm not a proponent of chaining the Federal Open Market Committee in its decision making to any rule whatsoever." [1]

The proposed legislation specifies two rules. The "Directive Policy Rule" would be chosen by the Fed, and describes how the Fed's policy instrument, such as the federal funds rate, would respond to a change in the intermediate policy inputs, presumably inflation and one or more measures of real economic activity such as the output gap, the unemployment rate, and real GDP growth. If the Fed deviated from its rule, the Chair of the Fed would be required to testify before the appropriate congressional committees as to why it is not in compliance. In addition, the report must include a statement as to whether the Directive Policy Rule substantially conforms to the "Reference Policy Rule," with an explanation or justification if it does not. The Reference Policy Rule is specified as the sum of (a) the rate of inflation over the previous four quarters, (b) one-half of the percentage deviation of real GDP from an estimate of potential GDP, (c) one-half of the difference between the rate of inflation over the previous four quarters and two, and (d) two. The Reference Policy Rule is the original Taylor rule.[2]

Nikolsko-Rzhevskyy, Papell, and Prodan (2014) provides evidence that supports using the original Taylor rule as the Reference Policy Rule. Using real-time data on inflation and the output gap from 1965 to 2013, we calculate policy rule deviations, the absolute value of the difference between the actual federal funds rate and the rate prescribed by (1) the "original" Taylor rule described above, (2) a "modified" Taylor rule with a coefficient of one, instead of

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[1] See Appelbaum (2014), Blinder (2014), and Taylor (2015a,c)
[2] Taylor (2015b) provides more detail and summarizes arguments in favor of the legislation.

one-half, on the output gap, and (3) an "estimated" Taylor rule from a regression of the federal funds rate on a constant, the inflation rate, and the output gap. We identify monetary policy eras by allowing for changes in the mean of the policy rule deviations with tests for multiple structural breaks, with discretionary eras defined by large deviations and rules-based eras defined by small deviations. Using six loss functions involving inflation and unemployment, we show that economic performance is uniformly better in rules-based than in discretionary eras, with the ratio of the loss during discretionary eras to the loss during rules-based eras largest for the original Taylor rule, next largest for the modified Taylor rule, and smallest for the estimated Taylor rule.

In this paper, we analyze the implications of the Directive Policy Rule. Consider the following thought experiment. Suppose that the policy rule legislation had been in effect from 1954, when federal funds rate data are first available, through 2015. When would deviations from the rule have triggered congressional testimony? Since this is a counterfactual, not a simulation, we assume that the existence of the legislation would not have altered the Fed's policy rate. We consider how, given its desired policy rate, whether or not the Fed would have complied with the legislation, not how the legislation might have changed Fed behavior. Since the Directive Policy Rule is chosen by the Fed, this naturally leads us to consider which version of the rule would have minimized deviations during various periods.

We need to make several choices in order to define the scope of our inquiry. First, we use only real-time data which was publicly available. In particular, we do not use Greenbook output gap and inflation forecast data because (1) is was not publicly available except after a long lag, currently seven years, and (2) even if it were to be publicly available, using Fed generated output gaps and inflation forecasts would create a (perceived or actual) moral hazard problem that seems undesirable. Second, the legislation does not define what constitutes a deviation. Based on the results in Nikolsko-Rzhevskyy, Papell, and Prodan (2014), where rules-based (discretionary) eras closely correspond to departures of the federal funds rate of less than (greater than) two percent from the rate implied by the original Taylor (1993) rule, we define a deviation as a greater than two percent departure of the federal funds rate from the rate implied by whatever rule is being used. Third, the legislation does not specify exactly how a deviation would trigger congressional testimony. Since the Fed Chair currently testifies semi-annually to both House and

Senate committees, we define a deviation of greater than two percent at the time of the testimony as the criteria for not being in compliance.[3]

We consider two candidates for the Directive Policy Rule. The first is the original Taylor (1993) rule. The second is the modified Taylor rule with a coefficient of one, instead of one-half, on the output gap. In the first case, the Directive Policy Rule would conform exactly to the Reference Policy Rule. In the second case, the arguments advanced by Yellen (2012, 2015) provide examples for how to justify why the two rules were different.

We divide the period from 1954 to 2015 based on data availability. Between 1954 and 1990, there are no official real-time measures of the output gap, so we use real-time data on the GDP deflator and real GDP from the Philadelphia Fed to construct measures of inflation and the output gap. Because no single method of detrending produces output gaps for the full 60 year period that are consistent with real-time approximations using Okun's Law during recessions, we use linear detrending until 1973 and quadratic detrending thereafter. Starting in 1991, real-time output gaps can be calculated from the Philadelphia Fed real-time GDP data and Congressional Budget Office (CBO) estimates of potential GDP and a wider range of real-time inflation rates are available.

We first consider the period from 1954 through 1990. Suppose that the original Taylor rule was the Directive Policy Rule. Fed policy adhered to the rule in the sense that the deviations would not have triggered congressional testimony during the Eisenhower, Kennedy, and the early part of the Johnson administration, with short deviations just prior to the recessions of 1957-1958 and 1960-1961. The first extended deviation occurred in 1967 and 1968, with the federal funds rate below the prescribed rate. Policy was back on track during the Nixon administration, with only short deviation during the early 1970s. Starting in1975, however, there was an extended period of negative deviations during the Great Inflation followed by an extended period of positive deviations during the Volcker disinflation. Fed policy consistently adhered to the rule during the Great Moderation, with no deviations from late 1985 through 1990.

Now suppose that the modified Taylor rule was the Directive Policy Rule. There are many more deviations during the Eisenhower, Kennedy, and Johnson administrations, with the

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[3] On May 12, 2015, Richard Shelby released a draft bill to the Senate Banking Committee with many similarities to the House Bill. It would require the Fed to submit quarterly reports to Congress and does not include a Reference Policy Rule. Taylor (2015d) discusses the draft bill.

federal funds rate consistently more than two percent above the prescribed rate from 1958 to 1961 and consistently more than two percent below the prescribed rate from 1965 to 1969. The subsequent low deviations period lasts from 1969 to 1977, with the period of negative deviations large enough to trigger congressional testimony during the Great Inflation from 1977 to 1979. The results for the Volcker Disinflation and Great Moderation periods are similar to those with the original Taylor rule.

While considering the implications of policy rule legislation over a long historical period provides a broad overview, it is not clear how relevant the events of the 1950s through the 1980s are to policymaking in the 2010s. In addition, calculating real-time output gaps over this period involves making arguable choices about the appropriate method of detrending. We repeat the same thought experiment starting in 1991, when real-time output gaps calculated using CBO potential GDP estimates are first available, through 2015. Since the Fed paid more attention to the Consumer Price Index (CPI) in the 1990s and the Personal Consumption Expenditure index (PCE) in the 2000s, we consider headline and core versions of the CPI and PCE which are available for all or most of the period. The policy rate is the federal funds rate through 2008 and the shadow federal funds rate in Wu and Xia (2014) during the zero lower bound period from 2009 to 2015.

We organize our analysis around several well-known examples of monetary policy evaluation using Taylor rules. Poole (2007) and Taylor (2007) report large deviations from the original Taylor rule for 2003 – 2005 with CBO output gaps and CPI inflation. We follow Poole by using real-time data, and find that the deviations were greater than two percent in 2001, 2003 – 2004, 2008 – 2009, and 2011 – 2015. If the original Taylor rule was the Directive Policy Rule, most of the 2000s would have triggered congressional testimony. The general pattern of deviations is not affected if the CPI is replaced by the PCE. Kohn (2007) argued that the large deviations reported by Taylor became much smaller if core, rather than headline, CPI was used to calculate inflation. If the Directive Policy Rule was the original Taylor rule with core CPI inflation, there would not have been deviations greater than two percent during 2003 – 2005. There would, however, have been greater than two percent deviations during 2001 – 2002 and 2011 – 2015.

Bernanke (2010) criticized Taylor's analysis on the grounds that inflation forecasts, rather than inflation rates, should be the basis for prescribed Taylor rule policy rates and

discusses how core PCE inflation was used by the FOMC as an indicator of the underlying trend of inflation. We compute deviations if the original Taylor rule with CBO output gaps and core PCE inflation was used for the Directive Policy Rule. While there were no deviations larger than two percent before 2012, including the 2003 – 2005 period highlighted by Taylor (2007), the deviations were large enough to trigger congressional testimony for most quarters between 2012 and 2015.

Yellen (2012) argued that the modified Taylor rule with a higher output gap coefficient was both a better description of Fed policy and closer to optimal policy than the original Taylor rule. In order to analyze the impact of the legislation under this rule, we compute deviations if the modified Taylor rule with CBO output gaps and PCE inflation was used for the Directive Policy Rule. Recent Fed policy under this rule is generally in accord with the legislation, as there were no deviations that would have triggered congressional testimony from 2011 through early 2014. There were, however, deviations greater than two percent in 1992, 2000 – 2004, 2008 – 2010, late 2014 and early 2015.

Most recently, Yellen (2015) argued that the fixed equilibrium real interest rate of two in the original Taylor rule should be replaced by a time-varying rate. We compute deviations using the original Taylor rule with the Laubach and Williams (2003) time-varying equilibrium real interest rate, CBO output gaps, and PCE inflation as the Directive Policy Rule. Under this specification, Fed policy since the end of the Great Recession is even more in accord with the proposed legislation than the Yellen (2012) specification, with no deviations that would have triggered congressional testimony from 2010 through early 2014. There were, however, deviations greater than two percent in 2003 - 2005, 2008 - 2009, and late 2014.

The division of the sample after 1990 obscures one important commonality. During the Great Moderation, from 1985 to 2000, there are very few periods for which the deviations are greater than two percent, and they are mostly associated with the 1990 – 1991 recession. This result holds whether the Directive Policy Rule is the original or the modified Taylor rule, whether detrended or CBO output gaps are used, and whether inflation is measured by the GDP Deflator, the CPI, or the PCE. During the Great Moderation, there would have been very few times when deviations triggered congressional testimony under all variants of the Directive Policy Rule.

2. Policy Rule Deviations

The centerpiece of the proposed policy rule legislation is the Directive Policy Rule. This rule is chosen by the Fed, and describes how the federal funds rate would respond to a change in inflation and one or more measures of real economic activity. There are two important aspects of the legislation that are designed to ensure transparency. If the Fed deviated from its rule, the Chair of the Fed would be required to testify before the appropriate congressional committees as to why it is not in compliance. In addition, the report must include a statement as to whether the Directive Policy Rule substantially conforms to the "Reference Policy Rule," which is the Taylor (1993) rule. Since the original Taylor rule uses the output gap, we restrict our attention to rules where the output gap is the only measure of real economic activity. This would facilitate the statement comparing the directive and reference policy rules.[4]

Taylor (1993) proposed the following monetary policy rule:

$$i_t = \pi_t + \phi(\pi_t - \pi^*) + \gamma y_t + R^* \tag{1}$$

where i_t is the target level of the short-term nominal interest rate, π_t is the inflation rate, π^* is the target level of inflation, y_t is the output gap, the percent deviation of actual real GDP from an estimate of its potential level, $\pi_t - \pi^*$ is the inflation gap, the percentage deviation of inflation from the target level of inflation, and R^* is the equilibrium level of the real interest rate. Combining terms,

$$i_t = \mu + \alpha \pi_t + \gamma y_t, \tag{2}$$

where $\alpha = 1 + \phi$ and $\mu = R^* - \phi \pi^*$.

Taylor postulated that the output and inflation gaps enter the central bank's reaction function with equal weights of 0.5 and that the equilibrium level of the real interest rate and the inflation target were both equal to 2 percent, producing the following equation,

$$i_t = 1.0 + 1.5\pi_t + 0.5 y_t \tag{3}$$

The most widely used alternative to the original Taylor rule increases the size of the coefficient on the output gap from 0.5 to 1.0, producing the following specification.

$$i_t = 1.0 + 1.5\pi_t + 1.0 y_t \tag{4}$$

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[4] This should not be interpreted as saying that a Directive Policy Rule cannot be constructed which incorporates measures of real economic activity such as the unemployment gap, output growth, and/or output gap growth, only that we don't consider such specifications in the paper.

We call this rule the modified Taylor rule. Rudebusch (2010) and Yellen (2012) use variants of this rule to justify unconventional policies after the federal funds rate hit the zero lower bound.[5] Policy rule deviations are defined as the difference between the actual federal funds rate and the interest rate target implied by either the original or the modified Taylor rule with the above coefficients.

In order for our analysis to be operational, we need to make several assumptions. The proposed legislation does not specify how large a deviation would need to be in order to trigger congressional testimony. In Nikolsko-Rzhevskyy, Papell, and Prodan (2014), we use Bai and Perron (1998) and Perron and Qu (2006) tests for multiple structural changes to define rules-based (low) and discretionary (high) deviations eras for various policy rules. For the original Taylor (1993) rule, which is the Reference Policy Rule in the proposed legislation, the rules-based (discretionary) eras closely correspond to departures of the federal funds rate of less than (greater then) two percent from the rate implied by the rule, with a correlation of 0.80 between the metrics. We therefore define a deviation as a greater than two percent departure of the federal funds rate from the rate implied by whatever Directive Policy Rule is being used.

While the legislation states that, if the Fed deviated from its rule, the Chair of the Fed would be required to testify before the appropriate congressional committees as to why it is not in compliance, it does not specify exactly how this would occur. The Fed currently submits the Monetary Policy Report semi-annually to the Senate Committee on Banking, Housing, and Urban Affairs and to the House Committee on Financial Services, along with testimony from the Fed Chair. One possibility for implementing the policy rule legislation would be for a statement stating whether or not the Fed is in compliance with the Directive Policy Rule to be included in the Monetary Policy Report and, if not, for the Fed Chair to testify as to why it is not in compliance. If implemented in this manner, the Fed would certify each February and July whether it is in compliance based on currently available data.[6]

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[5] Yellen (2012) called this rule the "balanced-approach" rule. We use the term "modified" in order to utilize more neutral language.

[6] The draft Senate bill would replace the current semi-annual monetary policy reports to Congress by the Fed with a quarterly report published by the FOMC, while still requiring the Fed Chair to testify semi-annually. This would increase the number of reported short-run deviations, but would not change the results for extended periods.

3. Real-Time Data

The prescribed Taylor rule interest rate is calculated from data on inflation and the output gap. Following Orphanides (2001), the vast majority of research on the Taylor rule uses real-time data that was available to policymakers at the time that interest rate setting decisions were made. In order to implement the policy rule legislation, the data also needs to be publicly available. This rules out Greenbook data unless the Fed changes its release policy, as it is currently only available with about a seven year lag.

3.1 Real-Time Data from 1954 to 1990

The Real-Time Data Set for Macroeconomists (RTDSM), originated by Croushore and Stark (2001) and maintained by the Philadelphia Fed, contains vintages of nominal GDP, real GDP, and the GDP deflator (GNP before December 1991) data starting in 1965:Q4, with the data in each vintage extending back to 1947:Q1. Data for the federal funds rate is available starting in 1954:Q3. Since we want to use the longest available span of data, we construct semi real-time vintages between 1954:Q3 and 1965:Q4 using the earliest available 1965:Q4 vintage.

We construct inflation rates as the year-over-year change in the GDP Deflator, the ratio of nominal to real GDP. While the Fed has emphasized different inflation rates at different points in time, real-time GDP inflation is by far the longest available real-time inflation series. This is the inflation rate that Taylor (1993) calculated with revised data.

In order to construct the output gap, the percentage deviation of real GDP around potential GDP, the real GDP data needs to be detrended. We use real-time detrending, where the trend is calculated from 1947:1 through the vintage date. For example, the output gap for 1965:4 is the most recent deviation from the trend calculated from 1947:Q1 to 1965:Q3, the output gap for 1966:Q1 is the most recent deviation from the trend calculated from 1947:Q1 to 1965:Q4, and so on, replicating the information available to policymakers. The lag reflects the fact that GDP data for a given quarter is not known until after the end of the quarter. In the context of the proposed legislation, because the congressional testimony would be in February and July, the relevant deviations with real-time data are for the first and third quarters, reflecting calculations based on fourth and second quarter data.[7]

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[7] While good estimates of fourth quarter inflation and real GDP are available by mid-February, only preliminary second quarter estimates are available by mid-July. This would require the Fed to either use preliminary estimates or earlier data.

The three leading methods of detrending are linear, quadratic, and Hodrick-Prescott (HP). Real-time output gaps using these methods are depicted in Figure 1. In contrast with output gaps constructed using revised data, where the trends are estimated for the entire sample, there is no necessity for the positive output gaps to equal the negative output gaps. While there are considerable differences among the gaps, the negative output gaps correspond closely with NBER recession dates for all three methods.

None of the three real-time output gaps provide a good approximation of the perceptions of policymakers over this period. Nikolsko-Rzhevskyy and Papell (2012) and Nikolsko-Rzhevskyy, Papell, and Prodan (2014) use Okun's Law, which states that the output gap equals a (negative) coefficient times the difference between current unemployment and the natural rate of unemployment, to construct "rule-of-thumb" output gaps based on real-time unemployment rates, perceptions of the natural rate of unemployment, and perceptions of the Okun's Law coefficient. Focusing on the quarters of peak unemployment associated with the recessions in the 1970s and 1980s, the congruence between real-time Okun's Law output gaps and real-time linear and quadratic detrended output gaps is fairly close while the real-time HP detrended output gaps are always too small. We performed similar calculations for the recessions of the late 1950s and early 1960s. During that period, the congruence between real-time Okun's Law output gaps and real-time linear detrended output gaps is fairly close while the real-time quadratic and HP detrended output gaps are always too small. Real-time linear detrending, however, is not the solution, as the output gap becomes negative in 1974 and stays consistently negative, reflecting the long-term flattening of growth rates following the productivity growth slowdown starting in 1973. For these reasons, we use real-time linear detrending until 1973 and real-time quadratic detrending thereafter to construct output gaps for the policy rule calculations.[8]

3.2 Real-Time Data from 1991 to 2015

The time span for our more recent analysis is determined by Congressional Budget Office (CBO) data availability. To calculate real-time CBO output gaps, we use quarterly estimates of potential GDP from "The Budget and Economic Outlook" published in January/February of every year since 1991. Starting in 2007, due to CBO's frequent and substantial potential GDP revisions, we also use data from the August updates. This data is combined with real-time actual GDP from the Philadelphia Fed RTDSM to obtain the output gap as the log-difference between

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[8] The results are robust to switching from linear to quadratic detrending anytime between 1971:Q2 and 1976:Q1.

the two values. Because GDP is updated quarterly and potential GDP is updated annually or semi-annually, we use forecasts of potential GDP between the CBO updates.[9]

The data for all of the inflation measures is from the Philadelphia Fed RTDSM, which contains quarterly vintages of the Consumer Price Index starting in 1994:Q3, monthly vintages of the core Consumer Price Index starting in 1999:M1, quarterly vintages of the Price Index for Personal Consumption Expenditures starting in 1965:Q4 and quarterly vintages of the core Price Index for Personal Consumption Expenditures starting in 1996:Q1.[10] Real-time inflation is calculated as the year-over-year log-change in the index. Following Koenig (2004), who argues that the Fed paid more attention to CPI inflation in the 1990s and PCE inflation in the 2000s, we use both measures.

The policy rate is the effective (average of daily) federal funds rate for the quarter. The federal funds rate is constrained by the zero lower bound starting in 2009:Q1 and is therefore not a good measure of Fed policy. Between 2009:Q1 and 2015:Q1 we use the shadow federal funds rate of Wu and Xia (2014). The shadow rate is calculated using a nonlinear term structure model that incorporates the effect of quantitative easing and forward guidance. The actual and shadow rates are depicted in Figure 2. The shadow rate is consistently negative between 2009:Q3 and 2015:Q1, with the most negative value in 2014:Q2. It stayed negative through 2015:Q1 even though the FMOC suspended its asset purchase program in October because, as discussed by Yellen (2015), the stimulus provided by unconventional monetary policy depends on the stock, not the flow, of longer-term assets held by the Fed.

4. Policy Rule Legislation from 1954 to 1990

We construct the following counterfactual. Suppose the policy rule legislation had been in place from 1954, when federal funds rate data is first available, through 1990. When would the deviations from the Directive Policy Rule have been large enough for the Fed to not be in compliance and trigger congressional testimony? As discussed above, we use the federal funds rate as the policy rate, the GDP deflator to calculate real-time inflation, and linear and quadratic

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[9] The CBO did not issue an update for August 2013. This creates a problem because, in July 2013, the Bureau of Economic Analysis substantially changed how GDP was calculated. Since we do not have an August 2013 update, output gaps for 2013:Q3 and 2013:Q4 based on potential GDP forecasts from the February 2013 update reflect changes in actual, but not potential, GDP. We therefore use potential GDP from the February 2014 update to construct output gaps for 2013:Q3 and 2013:Q4.

[10] For the core Consumer Price Index, we treat mid-quarter (second month) releases as quarterly releases.

detrended real GDP to calculate real-time output gaps. The criteria for a deviation is if the policy rate is greater than two percent above or below the rate prescribed by the rule, and congressional testimony is triggered if the Fed is not in compliance based on data available at the time of the semi-annual Monetary Policy Report to Congress in February and July.

The results if the Directive Policy Rule was the original Taylor rule are illustrated in Figure 3. Fed policy was in compliance with the legislation during the Eisenhower, Kennedy, and the early part of the Johnson administration. There were deviations in 1957:Q1 and 1960:Q1 just prior to the recessions starting in 1957:Q3 and 1960:Q2. The policy rate was below the prescribed rate in 1957:Q2 and above the prescribed rate in 1960:Q1. The first sustained deviations occurred during the latter part of the Johnson administration from 1967:Q1 to 1969:Q1, with the policy rate consistently below the prescribed rate. There were also two deviations during the Nixon administration, in 1971:Q1 following the recession of 1969 to 1970 and 1973:Q3 during the recession from 1973 to 1975.[11]

Large deviations became the norm starting in 1975. The federal funds rate was consistently more than two percent below the rate prescribed by the original Taylor rule during the Great Inflation from 1975:Q1 to 1979:Q3 and consistently more than two percent above the rate prescribed by the original Taylor rule during the Volcker disinflation from 1981:Q1 to 1985:Q1.[12] Fed policy was again in compliance with the legislation during the Great Moderation, as there were no deviations that would have triggered congressional testimony from 1985:Q3 to 1990:Q4.[13] The periods where the Fed would not have been in compliance with the legislation if the Directive Policy Rule was the original Taylor rule are in accord with the results in Taylor (1999), who describes the federal funds rate as "too high in the early 1960s, too low in the late 1960s, too low in the 1970s, on track in 1979-1981, too high in 1982-1984, and on track in the late 1980s and 1990s."

We now consider how the results would change if the Directive Policy Rule was the modified Taylor rule. As illustrated in Figure 4, there were many more occasions where policy would not have been in compliance with the legislation in the 1950s and early 1960s, with deviations large enough to trigger congressional testimony in 1954:Q3, almost consistently

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[11] Because we report deviations (and no deviations) for only the first and third quarters, the figures depict first quarter results for the first and second quarters and third quarter results for the third and fourth quarters.
[12] There is also a negative deviation in 1980:Q3 associated with the imposition of credit controls.
[13] While we do not report results with detrended output gaps after CBO real-time output gap data becomes available, there are no large deviations with quadratic detrended data until 2001.

between 1958:Q3 and 1961:Q3, and consistently from 1965:Q3 to 1969:Q1. Aside from 1974:Q1 and 1975:Q1, Fed policy was in compliance until 1977 when, starting in 1977:Q3, there was an extended period of consistently negative deviations at the peak of the Great Inflation until 1979:Q3 and an extended period of consistently positive deviations during the Volcker disinflation from 1981:Q1 to 1985:Q1. Fed policy was again in compliance with the legislation during the Great Moderation, as there were no deviations that would have triggered congressional testimony from 1985:Q3 to 1990:Q4.[14]

There are strong elements of commonality whether the original or the modified Taylor rule is used as the Directive Policy Rule. The latter part of the Johnson Administration, the Great Inflation and the Volcker Disinflation all contain extended periods where the federal funds rate was more than two percent above or below the prescribed rate under both rules. Neither version of the rule produces a consistent pattern of adherence. While the original Taylor rule produced low deviations during most of the 1950s and the early 1960s, it produced high deviations during the late 1960s and between 1975 and 1985. With the modified Taylor rule, the high deviations during the Great Inflation did not start until late 1977, but there were many more periods in the 1950s and 1960s where the deviations were greater than two percent and would have triggered congressional testimony.[15]

5. Policy Rule Legislation from 1991 to 2015

We proceed to construct the same counterfactual as above using data from 1991:Q1, when real-time CBO output gaps are available, through 2015:Q1. The question that we pose is again when would the deviations from the Directive Policy Rule have been large enough for the Fed to not be in compliance and trigger congressional testimony? For the more recent period, the Directive Policy Rule will also depend on how inflation is measured because we are able to use headline and core real-time CPI and PCE inflation in order to correspond more closely with the measures that were followed by the Fed. Starting in 2009, the combination of quantitative easing and forward guidance made the federal funds rate, set at between 0 and 0.25 percent, an incomplete measure of Fed policy, and we therefore use the shadow federal funds rate calculated

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[14] If the Directive Policy rule was the modified Taylor rule, there are no large deviations with quadratic detrended data until 2000.

[15] We find more differences between the original and modified Taylor rules than Taylor (1999) because we use real-time data with linear and quadratic detrending and he uses revised data with HP detrending. The differences are described in Nikolsko-Rzhevskyy and Papell (2014).

by Wu and Xia (2014) between 2009 and 2015. All of the subsequent analysis uses real-time CBO output gaps.

We first consider deviations if the Directive Policy rule was the original Taylor rule with inflation measured by the CPI. This analysis is in the spirit of Poole (2007) and Taylor (2007), and the results are depicted in Figure 5.[16] The first deviation greater than two percent is in 2001:Q3, followed by extended periods of deviations from 2003:Q1 to 2005:Q1, 2008:Q1 to 2009:Q3, and 2011:Q3 to 2015:Q1. The results are very similar if inflation is measured by the PCE. As shown in Figure 6, there are extended deviations from 2003:Q1 to 2004:Q3, 2008:Q1 to 2009:Q3, 2011:Q3 to 2012:Q1, and 2014:Q1 to 2015:Q1. Whether inflation is measured by the CPI or the PCE, the Fed would not have been in compliance with the Directive Policy Rule for most of the period since 2003.

If the Policy Rule Legislation had been enacted by 1990, it is quite possible that the Fed would have adopted the original Taylor rule with headline inflation as the Directive Policy Rule. It is inconceivable, however, that this choice would have been continued through the 2000s and 2010s. We proceed to consider alternatives that have been proposed by prominent Fed officials. Kohn (2007) argued that Fed policy between 2003 and 2005 was much closer to the prescriptions of the original Taylor rule with core instead of headline CPI inflation. The implications of making this specification the Directive Policy Rule are illustrated in Figure 7. This change eliminates the sustained deviations from 2003 to 2005 and 2008 to 2009 but doesn't eliminate the deviations from 2012 to 2015. It also adds an additional period, 2001:Q3 to 2003:Q1, where the Fed would not have been in compliance with the Directive Policy Rule.

Another argument was made by Bernanke (2010), who criticized Taylor's analysis on the grounds that inflation forecasts, rather than inflation rates, should be the basis for prescribed Taylor rule policy rates. In the context of policy rule legislation, we have argued that Greenbook or other Fed forecasts create a moral hazard problem which makes them inappropriate for the Directive Policy Rule. Bernanke, however, discusses how core inflation was used by the FOMC as an indicator of the underlying trend of inflation.[17] In the spirit of Bernanke's analysis, the deviations if the original Taylor rule with CBO output gaps and core PCE inflation was used for the Directive Policy Rule are depicted in Figure 8. While there were no deviations larger than

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[16] The real-time CPI data starts in 1994.
[17] Dokko et al. (2009), the Fed staff paper released as background to Bernanke's speech, contrasts the Taylor rule prescriptions with headline CPI and core PCE inflation.

two percent before 2012, including the 2003 – 2005 period highlighted by Taylor (2007), there was a deviation in 2012:Q1 and consistent deviations between 2013:Q3 and 2015:Q1.

Yellen (2012) argued that the modified Taylor rule with a higher output gap coefficient was both a better description of Fed policy and closer to optimal policy than the original Taylor rule. The deviations if the modified Taylor rule with CBO output gaps and PCE inflation was used for the Directive Policy Rule are shown in Figure 9. While there were no deviations that would have triggered congressional testimony from 2011:Q1 through 2014:Q1, there were deviations greater than two percent in 1992, the early 2000s, 2007:Q3 to 2010:Q1, and 2014:Q3 to 2015:Q1.

A different argument was recently made by Yellen (2015), who argued that, because the equilibrium real interest rate is low by historical standards, the fixed rate of two in the original Taylor rule should be replaced by a time-varying equilibrium real interest rate. Since she did not advocate that the original Taylor rule be replaced by the modified Taylor rule, we compute deviations using the original Taylor rule with the Laubach and Williams (2003) time-varying equilibrium real interest rate, CBO output gaps, and PCE inflation as the Directive Policy Rule. The results are depicted in Figure 10. While there were deviations that would have triggered congressional testimony from 2010:Q1 through 2014:Q1, there were deviations greater than two percent in 2001:Q3, 2003:Q1 to 2005:Q1, 2008:Q1 to 2009:Q3, and 2014:Q3.[18]

Laubach and Williams have recently posted real-time estimates of the equilibrium real interest rate from 2005:Q1 to 2014:Q4, which are discussed in Williams (2015). The results for the real-time equilibrium real interest rate are exactly the same as for the revised equilibrium real interest rate. There are no deviations greater than two percent from 2005 to 2007, consistent deviations in 2008 and 2009, and only one deviation (2014:Q3) between 2010 and 2014.[19]

There is less commonality among potential Directive Policy Rules between 2001 and 2015 than between 1954 and 1985. The original Taylor rule with CPI inflation produces large deviations in the early-to-mid 2000s and 2010s. Replacing headline CPI inflation with core CPI inflation decreases the large deviations in the mid-2000s but increases the large deviations in the early 2000s, while incorporating core PCE inflation only produces deviations in the 2010s. The

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[18] The most recent estimate is for 2014:Q4, so we cannot investigate whether there was a deviation in 2015:Q1. The updated estimates can be found at http://www.frbsf.org/economic-research/economists/john-williams/Laubach_Williams_updated_estimates.xlsx

[19] The real-time model estimates can be found at http://www.frbsf.org/economic-research/economists/john-williams/Laubach_Williams_real_time_estimates_2005_2014.xlsx

modified Taylor rule with PCE inflation and the original Taylor rule with PCE inflation and a time-varying equilibrium real interest rate produce the fewest large deviations in the 2010s but add more large deviations in the 2000s.

The Great Moderation from 1985 to 2000 overlaps both of our periods. In order to emphasize the differences between the Great Moderation and both the earlier and later periods, Figure 11 depicts the union of all deviations greater than two percent from 1985:Q1 to 1999:Q4 with the eight Directive Policy Rules in Figures 3 – 10, including extending the rules in Figures 3 and 4 through 1999:Q4. The only deviations that would have triggered congressional testimony for any rule were in 1985:Q1, 1991:Q1, and 1992. This is far fewer deviations than would have been produced by a similar exercise for either the 1954 – 1984 or the 2000 – 2015 periods.

6. Conclusions

The legislated policy rule proposed by the Federal Reserve Accountability and Transparency Act of 2014 has the potential to transform the conduct of monetary policy. For the first time, the Fed Chair would have the obligation to explicitly state a benchmark for how the federal funds rate would respond to variables such as inflation and the output gap. While the Fed would choose its own Directive Policy Rule, if it deviated from the rule the Chair would be required to testify before appropriate congressional committees and explain why it is not in compliance.

This paper poses a counterfactual. Suppose that the policy rule legislation had been in place for the past 60 years. When would the Fed have been in compliance, and when would deviations from the rule have triggered congressional testimony? We consider two candidates for the Directive Policy Rule, the original Taylor rule and a modified Taylor rule with a larger output gap coefficient. Based on data availability, we use linear/quadratic and CBO real-time output gaps and several measures of headline and core inflation.

Our results cause us to be pessimistic that the Fed could comply with the proposed legislation and avoid triggering congressional testimony over extended periods of time without periodically changing the Directive Policy Rule. While the deviations with the original Taylor rule were less than two percent during most of the 1950s and early 1960s, they were typically greater than two percent during the late 1960s and between 1975 and 1985. While the modified Taylor rule mitigated some of the deviations in the 1970s, it increased the number of deviations

in the 1950s. Either version of the rule would have produced extended periods in which the Fed would not have been in compliance with the legislation.

The more recent debate started with Poole (2007) and Taylor (2007), who documented large deviations from the original Taylor rule between 2003 and 2005. In response to these results, Kohn (2007) and Bernanke (2010) proposed different specifications which, if used as the Directive Policy Rule, would not have produced deviations greater than two percent between 2003 and 2005 but would have produced deviations greater than two percent between 2012 and 2014. In contrast, Yellen (2012, 2015) proposed specifications which, if used as the Directive Policy Rule, would not have produced deviations greater than two percent between 2011 and 2014 but would have produced deviations greater than two percent in the early-to-mid 2000s and between 2008 and 2010. The overall result is that rules which produce deviations less than two percent in the first half of the 2000s produce deviations greater than two percent in the first half of the 2010s, and vice versa. This leads us to believe that a Directive Policy Rule which does not currently trigger congressional testimony may very well do so in the future.

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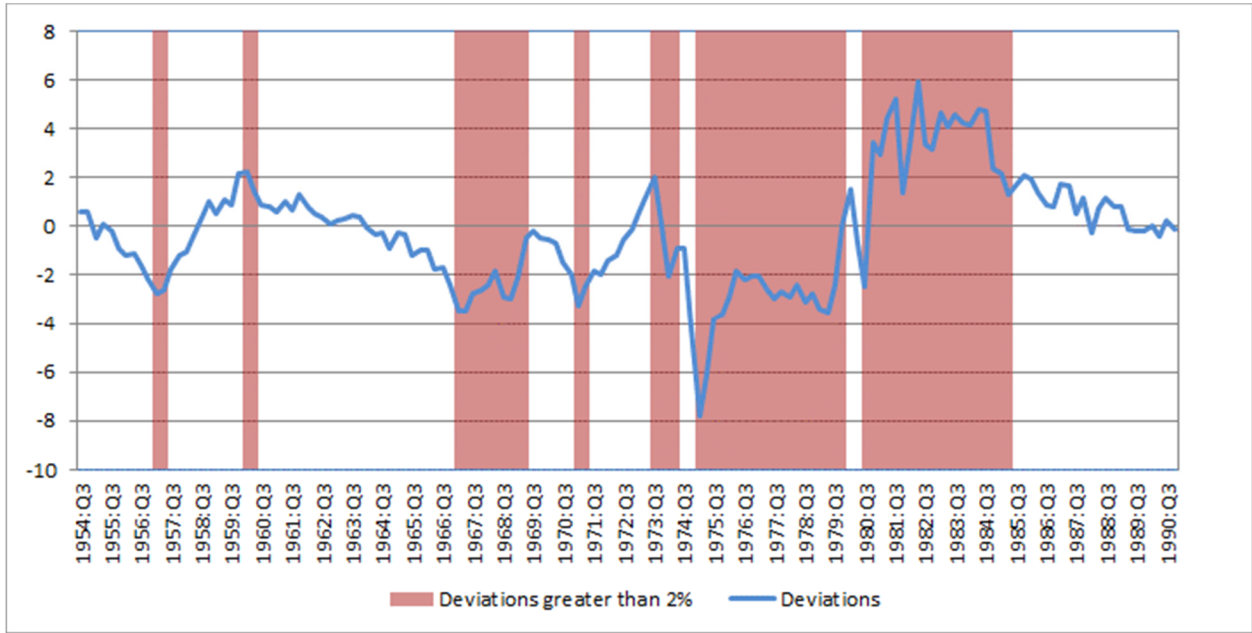
Figure 1. Real-Time Output Gaps using Linear, Quadratic, and Hodrick-Prescott Detrending
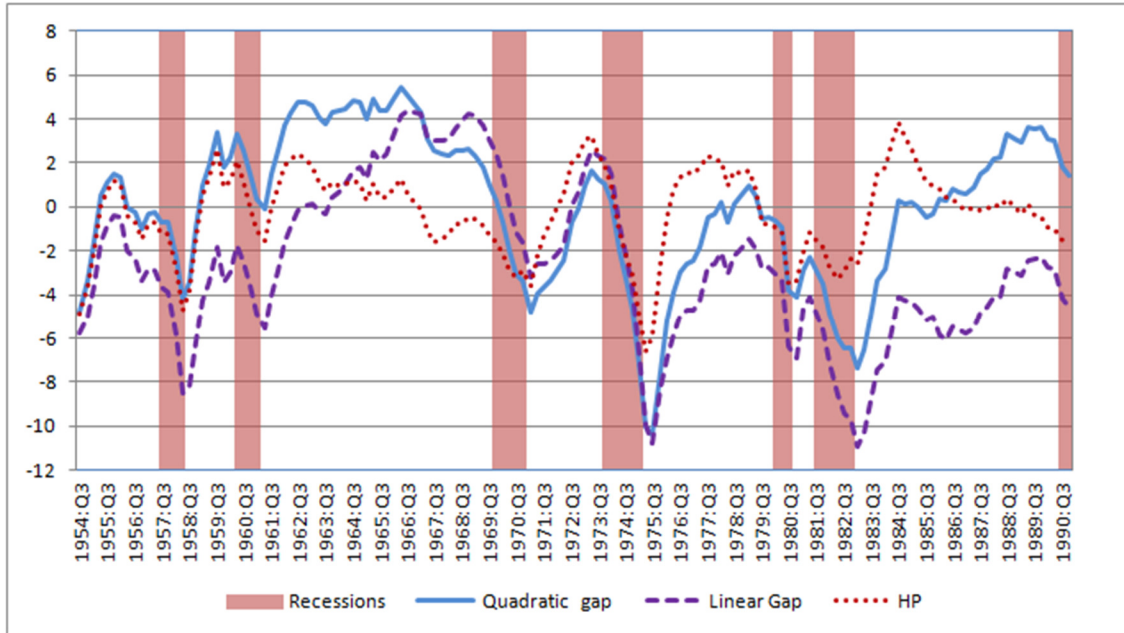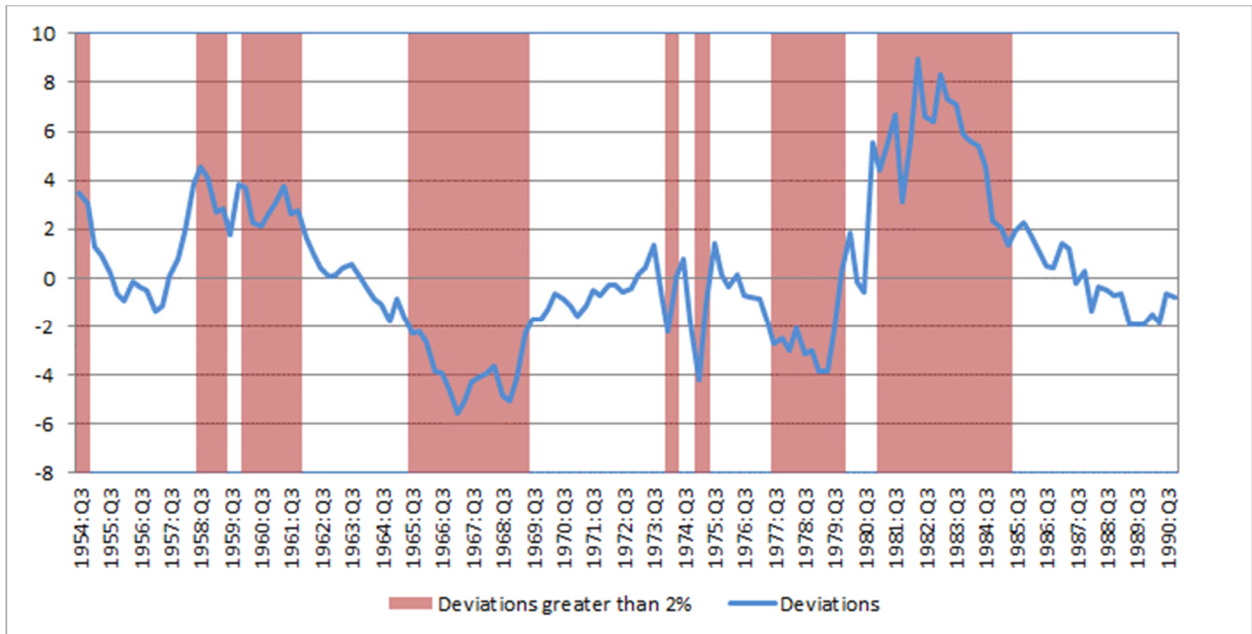

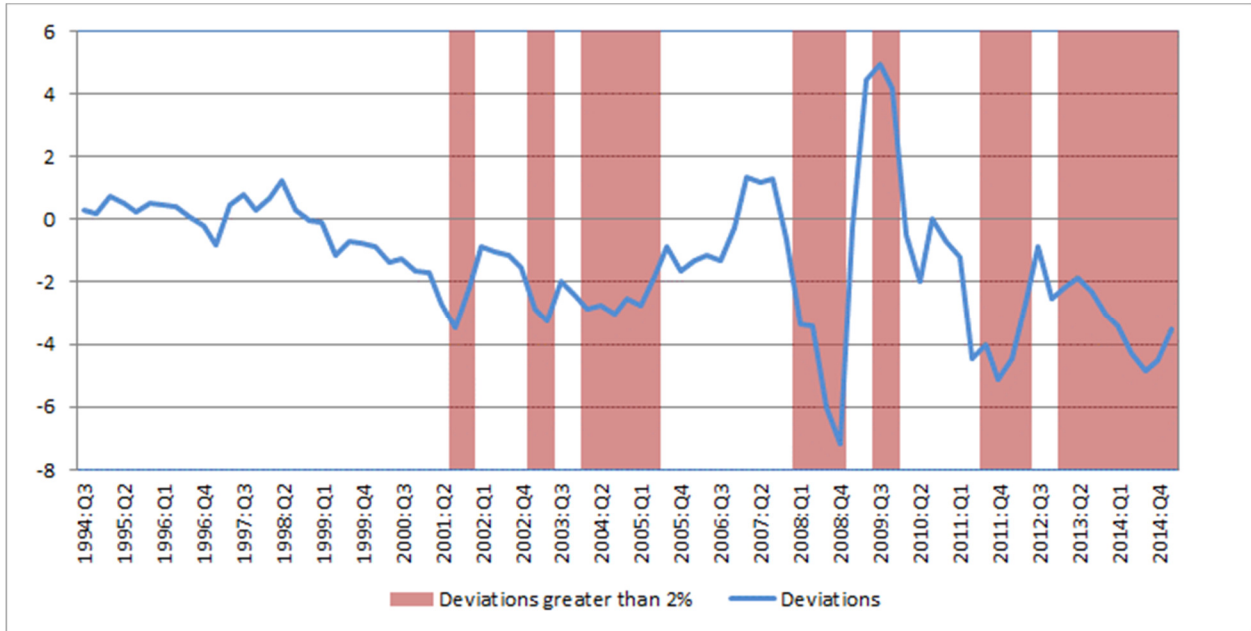**Figure 2. The Federal Funds Rate and the Shadow Rate**
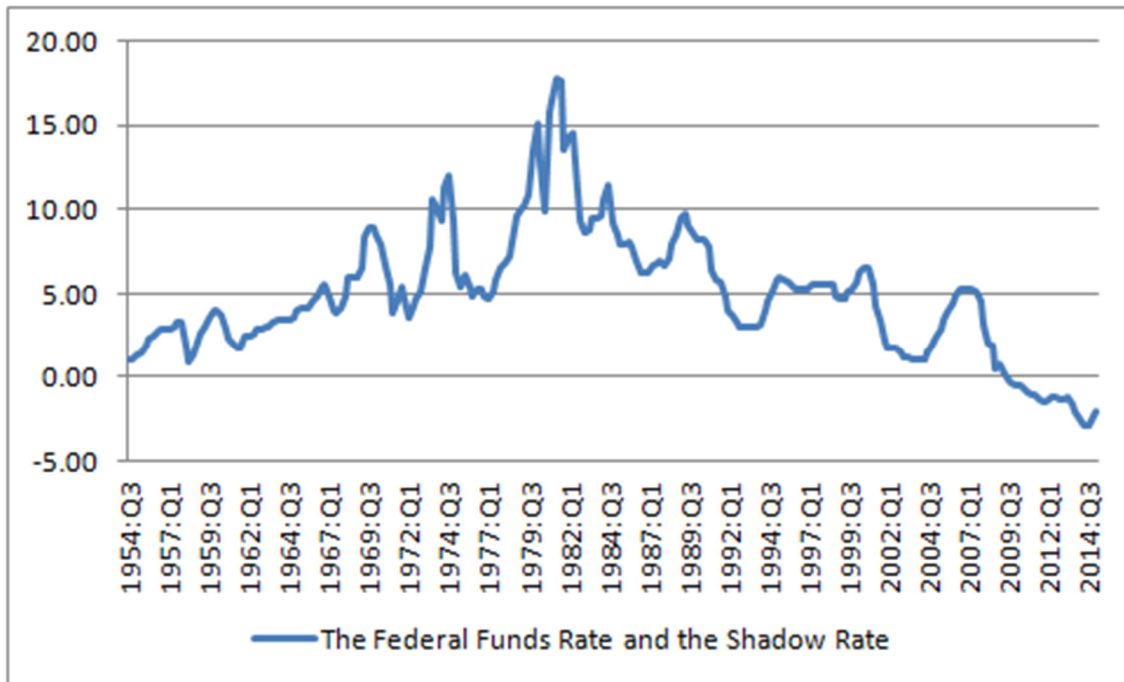
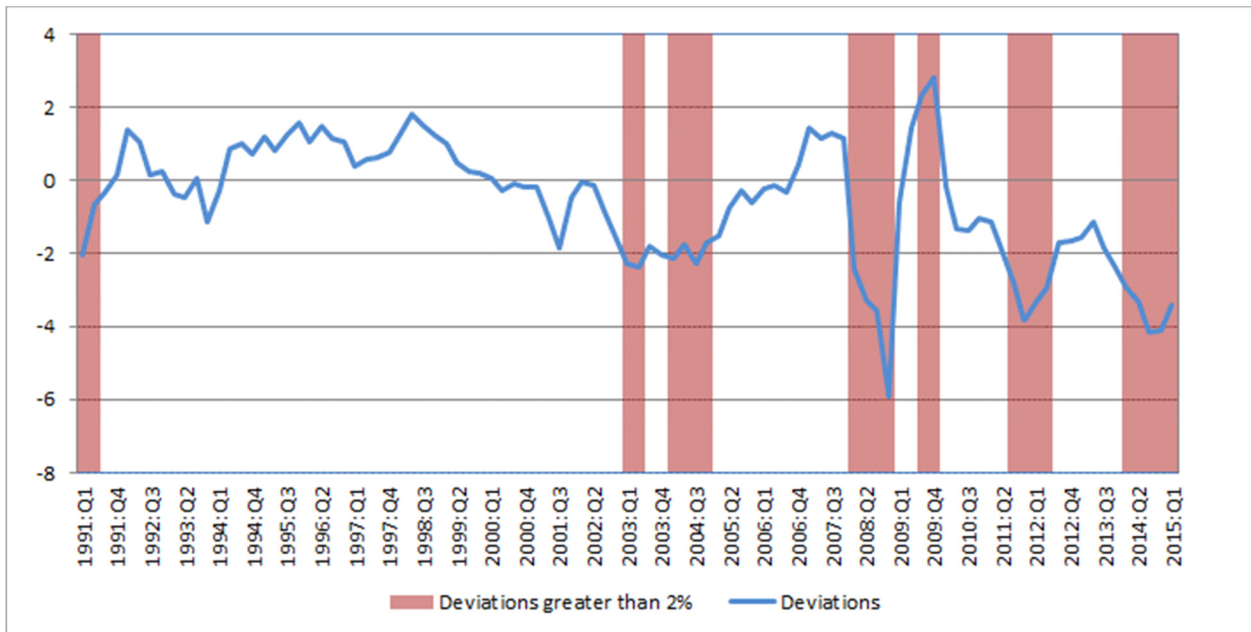**Figure 3. Original Taylor Rule: 1954-1990**

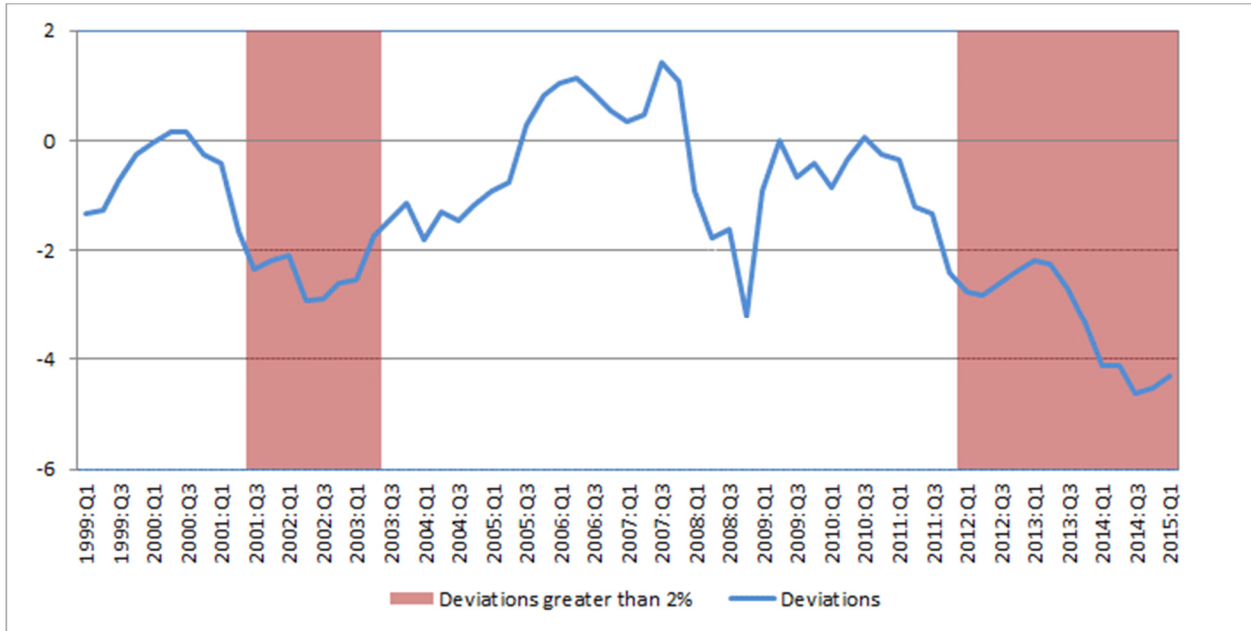**Figure 4. Modified Taylor Rule: 1954-1990**

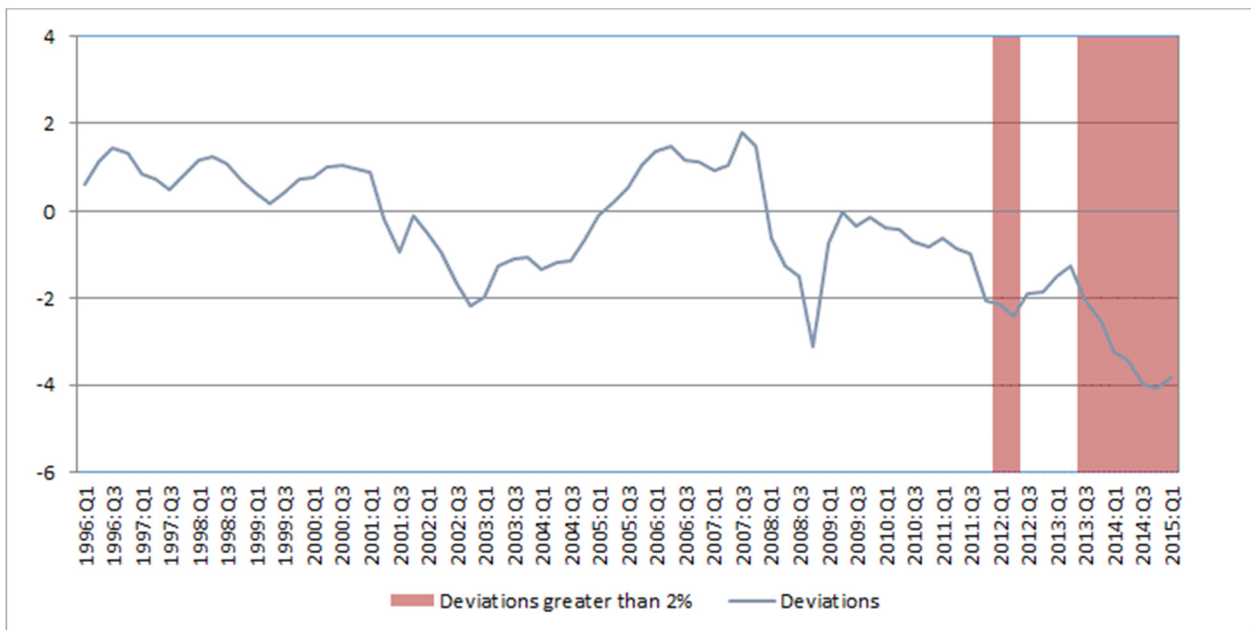**Figure 5. Original Taylor Rule with Real-Time CBO Output Gaps and CPI Inflation: 1994-2015**

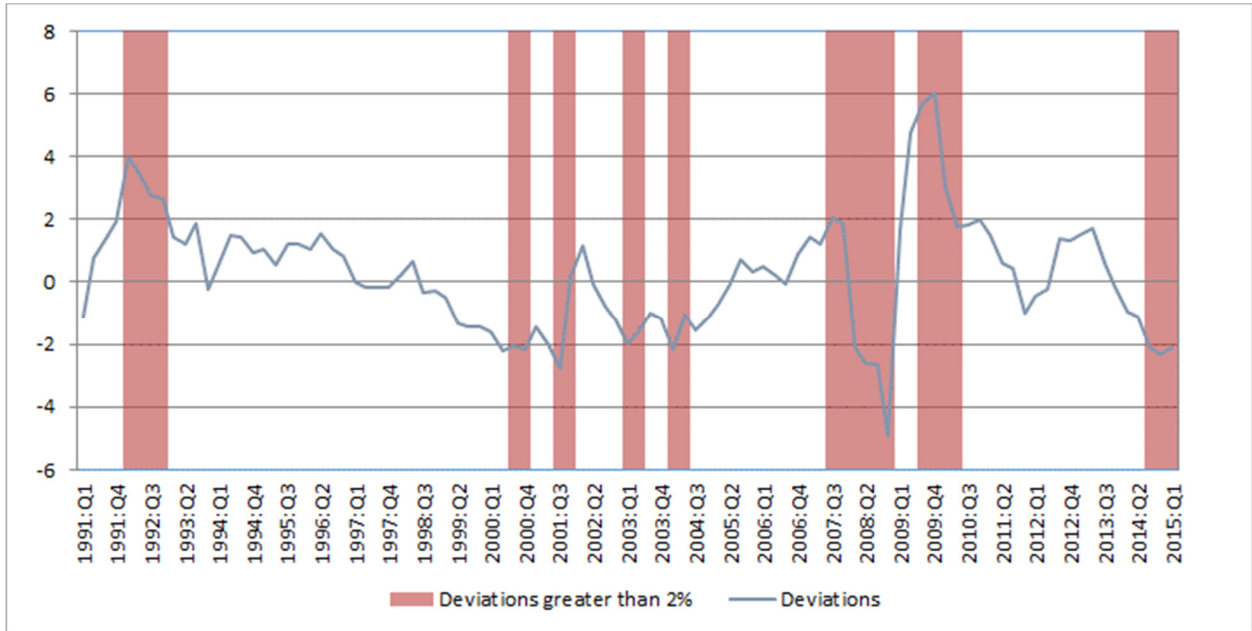**Figure 6. Original Taylor Rule with Real-Time CBO Output Gaps and PCE Inflation: 1991-2015**

Figure 7. Original Taylor Rule with Real-Time CBO Output Gaps and Core CPI Inflation: 1999-2015
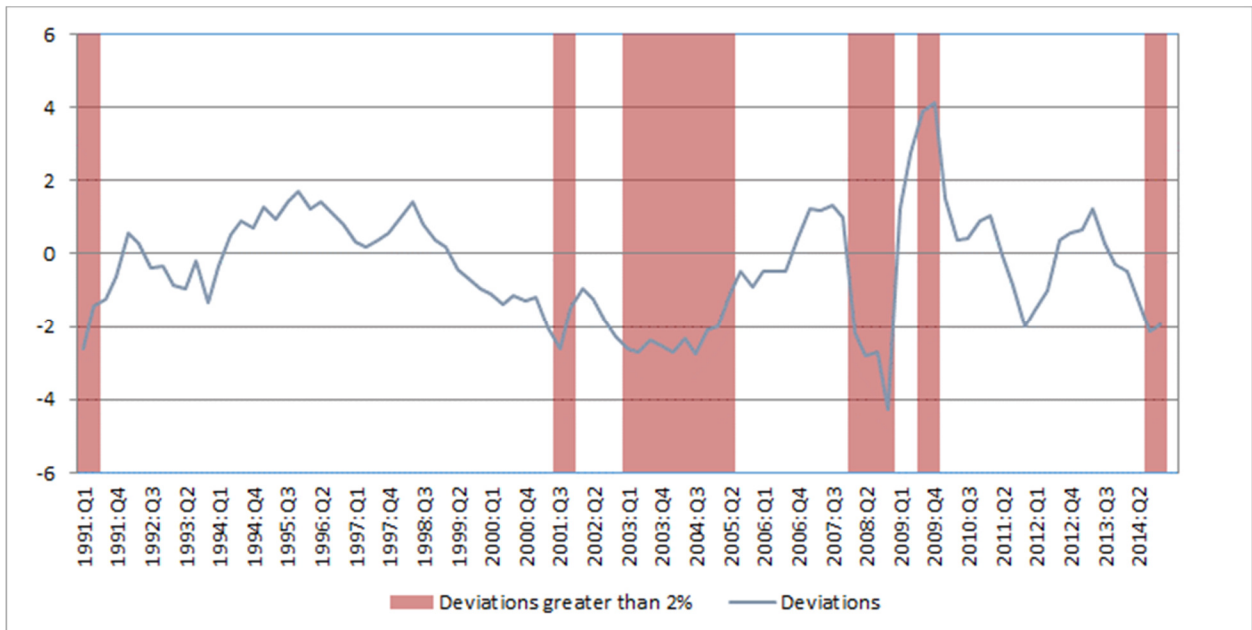

Figure 8. Original Taylor Rule with Real-Time CBO Output Gaps and Core PCE Inflation: 1996-2015

Figure 9. Modified Taylor Rule with Real-Time CBO Output Gaps and PCE Inflation: 1991-2015

Figure 10. Original Taylor Rule with Real-Time CBO Output Gaps, PCE Inflation and Time-Varying Equilibrium Real Interest Rates: 1991-2015

Figure 11. The Great Moderation: Union of All Deviations Greater than Two Percent: 1985-1999