Real time data, regime shifts, and a simple but effective estimated Fed policy rule, 1969-2009

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Abstract
This paper re-examines the use of estimated Taylor rule equations as a standard long run description of Federal Reserve policy. The empirical results suggest that until 1979 Fed policy changed the real funds rate in response to the output gap, with no response to an inflation target. During the Volcker period the policy rule kept the real funds rate at a high but constant level, with no response to the output gap. These regime shifts affect the descriptive performance of the basic Taylor rule equation and any further analysis that is based on it. Taking into account the regime shifts and real time data, a simple but effective federal funds rate equation can be estimated using only inflation and the output gap.

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1. INTRODUCTION

There is and has been a long-time interest in central bank's reaction functions, or, in modern parlance, estimated policy rules. Modelling monetary policy reaction functions is important for a variety of reasons. For example, financial market practitioners need to understand policymaking in order to make sound forecasts of future monetary policy and to evaluate the likely direction of future financial market prices. Macroeconomists require a reaction function to endogenize policy in macroeconomic models. Many empirical analyses of economic theories depend on expected values of future variables that are linked to monetary policy, for example, the expectations theory of the term structure of interest rates.

Unfortunately, estimating central bank reaction functions has turned out to be complicated. The literature provides many studies, for many countries, containing mixed or contradictory results with respect to the significance of variables and the sign and size of coefficients.[1] There are several reasons for the empirical difficulties with estimated policy rules. First, in practice, policy decision makers tend to look at 'everything' and the range of possible explanatory variables is very large, both in scope and in their precise measurement. For a long time, economists were also strongly divided on how to actually measure the stance of monetary policy, arguing for or against alternative definitions of money and some specific policy interest rate.[2] Furthermore, policy decisions are probably asymmetric and non-linear, giving different weights to variables under different economic circumstances.[3] Also, policy regimes are subject to more fundamental structural breaks, for example related to changes in policy targets, leading to multiple periods, each with consistent but different policy making.

Since the seminal work of Taylor (1993) monetary economists have converged on the so-called Taylor rule as a fundamental framework for most monetary policy descriptions. The Taylor rule simplifies the policy reaction function and focuses on two key economic variables that determine central bank policy interest rates: inflation relative to an inflation target (inflation gap) and the real economy relative to its long-run equilibrium (output gap or unemployment gap). These two variables are closely linked to the main goals of macroeconomic policy. Furthermore, focusing on these two indicator variables has been shown to provide a robust and reasonably efficient monetary policy in a wide variety of alternative economic models. More importantly from a practical viewpoint, the Taylor rule has shown to be a reasonably accurate description of monetary policy in several countries, at least for more recent time periods starting somewhere in the 1980s.[4] Today, the Taylor rule has become a standard component of macroeconomic analyses, exemplified by the frequently used 3-equation small macroeconomic model (for example, Rudebusch and Svensson, 1999)

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[1] For the U.S., Khoury (1990) found that there appeared to be little consistency in the results for the various explanatory variables. Smant (2002) provides a survey of studies of Deutsche Bundesbank reaction functions, with similar results.

[2] Although consensus has settled on the money market interest rate as the appropriate measure of monetary policy, technically this is an assumption that depends on the structure of the market of bank reserves and the operating procedures selected by the central bank. See Bernanke and Mihov (1998). Incorrect identification of policy actions can result in seriously misleading empirical results, although the problem is most severe for high frequency (daily, weekly) data.

[3] For example, Bernanke and Mishkin (1992) stress the time-changing behaviour of many central banks, switching between their inflation and real economy objectives.

[4] A cautionary note is that several monetary policy strategies can be shown to result in Taylor-type equations linking the interest rate with inflation and the output gap. Therefore, although the Taylor rule may work as a description of monetary policies, we cannot conclude that policy makers actually have implemented the Taylor rule as a specific strategy.

and the structural interpretation of the short-term interest rate in VAR models (for example, McCallum, 1983).

Despite its appeal of simplicity, however, using the Taylor rule as a unified description of monetary policy over long time periods without taking into account structural breaks can have serious consequences. One specific example is the use of VAR models in tests of the expectations theory of interest rates. The VAR models are frequently used to generate interest rate forecasts and to test theoretical restrictions on the model.[5] Problems arise when the policy rule embedded in the model is inaccurate and does not reflect actual policy behaviour and/or financial market expectations of it. For example, Fuhrer (1996) reports that the performance of this type of model and tests is seriously affected by the presence of structural breaks in the short-term interest rate equation. By taking into account monetary policy regime changes the relationship between the actually observed long-term interest rate and its theoretical value derived from forecasted monetary policy rates can be dramatically improved. Consequently, empirical failures of the expectations theory reported in many empirical studies may be related more to failing interest rate forecasting models than to a failure of the tested theory itself. Other examples of potential problems related to monetary policy regime shifts can be found in empirical tests based on long-run cointegration models that include the short-term interest rate. One such example relates to long-run tests of the Fisher hypothesis (for example, the approach suggested by Mehra, 1998).

The purpose of this paper is to re-evaluate the use of the estimated Taylor rule as a simple standard long-run monetary policy reaction function in macroeconomic analyses. I will largely follow Judd and Rudebusch (1998) and estimate Taylor rule functions for periods linked to various Chairmen of the Federal Reserve. The subperiod estimates do indeed exhibit important regime shifts. The various regimes have simple but economically plausible interpretations. Finally, the three different policy regimes are unified in a simple but effective Taylor-type reaction function that covers the full period under review and provides an accurate description of Federal Reserve policy over the period 1969-2009.

The remainder of this paper is structured as follows. Section 2 provides a brief discussion of important issues in the estimation of policy rules. Section 3 discusses the empirical estimates. Section 4 concludes.

2. ISSUES IN ESTIMATING TAYLOR RULES

The basic Taylor (1993) equation is

$$i_t = r^* + \pi_t + \beta_\pi \ (\pi_t - \pi^T) + \beta_y \ y_t$$

where i, r*, π, π^T, and y denote the federal funds rate (policy rate), the equilibrium real federal funds rate, inflation rate, target inflation rate and the output gap. Coefficients β_π and β_y are the policy response coefficients to the inflation gap and the output gap. Taylor (1993) assumed for β_π and β_y values of 0.5 and also assumed for r* and π^T values of 2 percent, which seemed appropriate for Federal Reserve policy during the period 1987-1992.

[5] These tests follow the methodology proposed by Campbell and Shiller (1987).

When estimating the Taylor rule coefficients as a description of actual monetary policy, the literature over time has identified several issues that need to be addressed.

Real time data
At least since the work of Orphanides (2001) the estimated policy rule literature has seen an increased emphasis on using real-time datasets.[6] Not only do we need to consider carefully the fact that official economic statistics become available after the reporting period, but, more importantly, some statistics are subject to major revisions, for example when at future moments in time additional source material becomes available and when definitions and statistical procedures are changed. An important part of this paper has been to collect a real time database to estimate the Fed's historical policy rule. Specifically, the real time data I use in this study are 'first release' data. By using the first released values for a given reporting period, I ignore publication lags, which have varied somewhat over time, and make the assumption that Federal Reserve staff is able to predict contemporaneous values of the variables using a variety of leading indicators available to them.

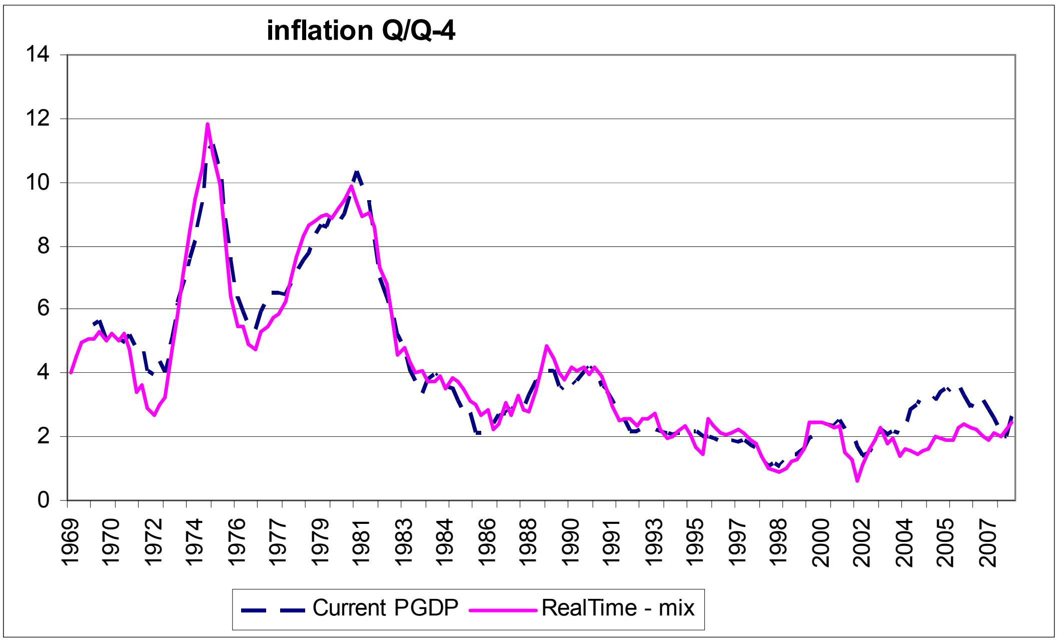
Inflation
Inflation in the Taylor rule is most commonly measured by the annual change in the aggregate price index, Q/Q-4 or M/M-12. Somewhat more contentious is the precise measure of the aggregate price level that should be used. Reviews of Fed policy suggest that the Fed's preferred inflation measure has changed over time. Historically the Fed used the GNP and later GDP deflator. In the February 2000 Monetary Policy Report to Congress the Fed's emphasis changed to the PCE chain-type index. And in July 2004 the emphasis changed to the core-PCE index (i.e, excl. food and energy). The headline CPI appears not to have been in favour with Fed policy makers although it featured in policy discussions with the U.S. Administration and Congress.

Following Taylor (1993), I use the current and thus revised data for the GDP deflator in one set of estimations that aims to represent usual practice. In the second part of the analysis, using real time data, the definition of inflation is period specific. Real time inflation data are for the GNP/GDP deflator until 1999Q4, PCE chain-type index from 2000Q1, and core-PCE from 2004Q2.

Figure 1 provides a graphical representation of the inflation data. Figure 1 shows that generally the difference between the current and real time inflation data is not very large. Larger differences between the two data series existed during the early 1970s and the mid 2000s, where in both cases the GDP deflator inflation was substantially lower.

[6] Other important contributions to the real-time data literature are Runkle (1998), Keane and Runkle (1990), Diebold and Rudebusch (1991) and Croushore and Stark (1999).

FIGURE 1 Comparison of current and real-time inflation



Note: Current PGDP Q/Q-4 inflation is based on the current GDP chain-type price index (vintage August 2010). Real-time inflation data are first release data and reflect changes in Fed emphasis on GNP/GDP, PCE and PCE-core.

Output gap

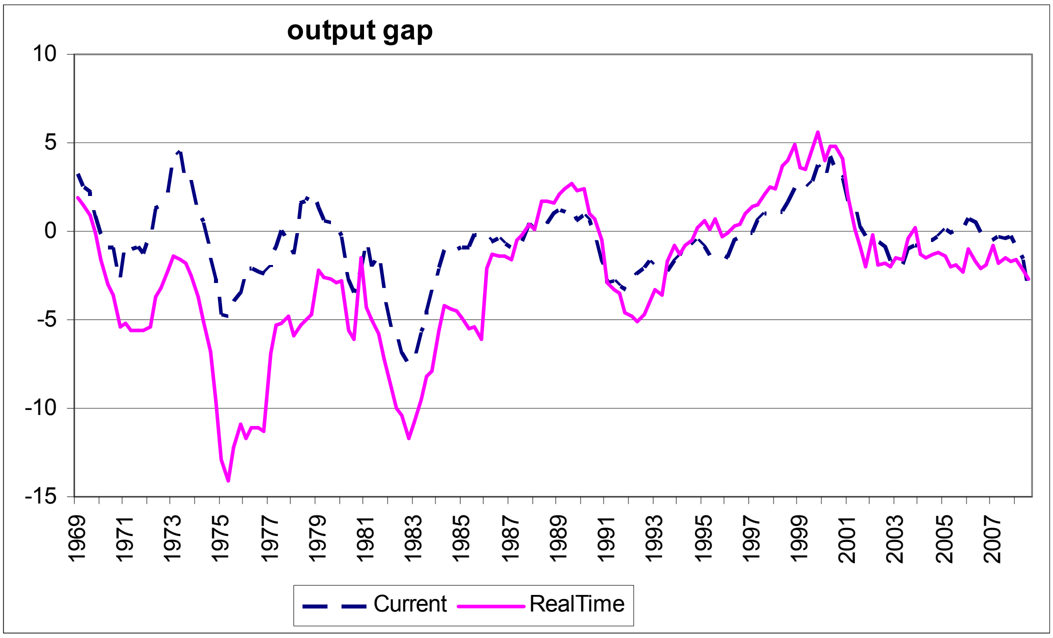
The output gap has a long history in U.S. economic policy and was first introduced in the early 1960s as part of policy analysis by the Council of Economic Advisors (CEA). Official estimates were subsequently published by the Bureau of Economic Analysis (BEA) and the Congressional Budget Office (CBO) as responsibility for producing the government estimates was rearranged over time. The Federal Reserve has also produced its own estimates in preparation for the regular FOMC policy discussions, but the data contained in the Greenbook start at a much later date and are only available with a substantial lag.[7] One important problem with the output gap variable is that potential or trend output is unobserved and must be estimated. Various methods of potential output estimation have been used in the literature, such as fitted linear trends, quadratic trends, segmented trends, moving average or filter methods and structural or production function methods. Gap estimates vary widely between the various methods. Most importantly, the available evidence shows that the (quasi-) official estimates of potential output have changed drastically over time, re-emphasizing the importance of using real time data in policy descriptions.

I use a reproduction of real-time potential output and output gap values based on the historical analyses made by the CEA, BEA and CBO. Information available at the start of every year is used to construct an expected quarterly time series for expected potential output during that year. These estimates of expected potential output are then matched with the first release data on actual real GNP and GDP to create a real time series of the estimated output gap.

[7] For a brief discussion of output gap measures see Orphanides (2003). It has been argued that historically the Fed has not actually used the output gap but tended to focus more on the unemployment gap. However, Orphanides found that the output gap did feature in the FOMC policy discussions. He also found that official estimates and Federal Reserve staff estimates of the output gap were generally close.

Figure 2 presents a graphical representation of the output gap data. Figure 2 shows the now familiar fact that historically, particularly during the 1970s and early 1980s, real-time perceptions of the U.S. output gap were substantially more negative than they are today. Obviously these different perceptions should be taken into account when we are re-examining historical policy decisions.

FIGURE 2 Comparison of current and real-time output gap



Note: Current output gap data are based on the CBO potential output estimate (vintage August 2010). Real-time output gap data are based on first-release GNP/GDP data and potential output estimates of the CEA, BEA and CBO.

Equilibrium r and* π^T

The Taylor rule includes an important role for the equilibrium real interest rate and the inflation target, both of which are in the case of the U.S. Fed not directly observed. For some other countries, such as Germany, central banks have long published inflation targets which could be used in the estimated policy rule. More commonly, r* and π^T are estimated indirectly as part of the intercept of an estimated Taylor equation. Of course, this approach is only valid if we can assume that both r* and π^T are on average constant over the sample period. The literature on both real interest rates and monetary policy's historical struggle with periods of inflation and deflation suggests that constancy is a heroic assumption and a likely cause of structural breaks in the estimated policy rule. In the absence of further independent information on equilibrium real interest rates and U.S. policy inflation targets the best way to approach the problem appears to be to examine subperiods for the implied inflation target.

Further specification issues

Besides the question of possible additional information variables, some economists have suggested that real world monetary policy is (or should be) more forward looking than the basic Taylor rule. Specifically, policy makers may respond to expected inflation and/or the expected output gap. However, limited data availability usually prevents an appropriate examination of this issue.[8]

Another specification issue that has appeared in the literature is the possibility of smoothing and momentum effects in the policy target rate and the presence of partial adjustment dynamics in the policy rate.[9] Although it is, for example, common to include lagged policy rates in the policy rule, interpretation of the empirical results is confounded by the possibility of autocorrelated shocks and autocorrelated missing indicator variables.

The previous comments suggest that there is much room for debate on the appropriate details of any estimated policy rule. Without wanting to belittle any of the issues, the empirical analysis in the next section will take a simple approach. The objective is to obtain a simple but general characterization of the main policy features, using only inflation and the output gap as the major explanatory variables. The objective is not to obtain a complete description of policy actions on a high data frequency.

3. EMPIRICAL RESULTS

In this paper I follow Judd and Rudebusch (1998) and proceed under the assumption that the Fed's policy rule is affected by changes in the Fed Chairman. Table 1 presents the various tenures of Fed Chairmen, starting in the early 1950.

Table 1 Federal Reserve Chairmen

Chairman	**Tenure**
William M. Martin, Jr.	Apr 1951 – Jan 1970
Arthur F. Burns	Feb 1970 – Jan 1978
G. William Miller	Mar 1978 – Aug 1979
Paul A. Volcker	Aug 1979 – Aug 1987
Alan Greenspan	Aug 1987 – Jan 2006
Ben S. Bernanke	Feb 2006 -

Judd and Rudebusch found that their sample of quarterly data from 1970Q1 to 1997Q4 can be divided into three structurally different regimes, with the subperiods identified by the terms of Chairmen Burns (1970Q1-1978Q1), Volcker (1979Q3-1987Q2) and Greenspan (1987Q3-1997Q4). The Miller term (1978Q2-1979Q2) was excluded from their analysis because of the relatively short time span. At this point, more formal statistical breakpoint tests could be used and would probably result in somewhat different break points, but the empirical results in the literature suggest that the breakpoints are close to the change in Fed Chairman.[10]

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[8] See McNees (1986) for an early investigation of policy responses to economic forecasts. The forward-looking nature of an optimal Taylor rule was stressed by many; see for example Svensson (1997).

[9] The debate on interest rate smoothing, or its extreme version of interest rate targeting, has a long history and a large literature. Common in the Taylor rule literature is the partial adjustment model $\Delta i_t = \rho\ (i_t^* - i_{t-1})$, where i* and i are the Taylor rule target rate and the actually observed rate. Very similar in effect is the error correction model $\Delta i_t = \rho\ (i_{t-1}^* - i_{t-1})$. For a critical perspective on the issues and debate see for example Rudebusch (2002).

[10] For example, Fuhrer (1996) identified breakpoints in 1974Q1, 1980Q1 and 1986Q1. Estrella and Fuhrer (2003) found breakpoints in 1969Q2, 1980Q3, and 1984Q4. Other studies have focused on breaks in the time series behavior of the short-term (real) interest rate instead of policy rule coefficients. Estimates of breakpoints appear to be sensitive to the variables included in the analysis (see the analysis of Walsh, 1988).

Contrary to Judd and Rudebusch, who employ an expanded and dynamic estimation equation, I estimate the following basic Taylor rule equation.

$$i_t = \alpha + \beta\,\pi_t + \gamma\,y_t$$

Here, in terms of the original Taylor rule parameters, the estimated coefficients are defined as $\alpha = (r^* - \beta_\pi\,\pi^T)$, $\beta = (1+\beta_\pi)$ and $\gamma = \beta_y$. It can be seen that the coefficient estimates from the Taylor rule are not able to pin down both the equilibrium real interest rate (r^*) and the inflation target rate (π^T). Following established practice, I will calculate r^* as the average of the real federal funds rate observed over the relevant sample period. Because the maturity of the fed funds rate is very short the current, backward looking inflation rate is used rather than actual inflation expectations. In practice, any divergence between actual or ex post and expected or ex ante inflation rates is more important for long maturity interest rates. Following the estimate of r^*, the inflation target π^T is calculated as $-(\alpha - r^*) / (\beta - 1)$.

Estimating the Taylor rule model requires discussion of some econometric issues. First, there are questions with respect to the stationarity of the variables. Interest rates and inflation are frequently considered to be non-stationary variables, although the empirical results are mixed and depend on the choice of test statistics and sample periods. For all practical purposes, we assume here that we can effectively view the basic Taylor rule equation as a cointegration equation. At the same time, in view of the relatively short sample periods the use of special cointegration estimation methods, relying on asymptotic properties, does not appear to provide much benefit. Second, the absence of dynamics in our Taylor equation introduces residual serial correlation and the basic model raises questions about possible missing variables bias. Aware of the issues related to these problems, I nevertheless proceed to estimate the Taylor rule model using basic ordinary least squares and will use Newey-West HAC standard errors to correct for residual correlation.

Table 2 Taylor rule estimates for Federal Reserve Chairman periods using real time data

	α	β	γ	adjR^2	SEE	DW
Burns	4.271 (0.700)a	0.827 (0.144)a	0.440 (0.116)a	0.689	1.224	0.836
	$r^* = 0.49$ $\pi^T = 21.88$					
Volcker	4.366 (0.986)a	1.128 (0.166)a	-0.005 (0.099)	0.658	2.131	1.806
	$r^* = 5.11$ $\pi^T = 5.79$					
Greenspan	0.758 (0.496)	1.714 (0.138)a	0.501 (0.065)a	0.786	1.046	0.343
	$r^* = 2.49$ $\pi^T = 2.43$					

Estimated Taylor rule equation: $i_t = \alpha + \beta\,\pi_t + \gamma\,y_t$ where $\alpha = (r^* - \beta_\pi\,\pi^T)$, $\beta = (1+\beta_\pi)$ and $\gamma = \beta_y$.
The estimation periods are Burns: 1970Q1-1978Q1, Volcker: 1979Q3-1987Q2 and Greenspan: 1987Q3-2006Q1. Full period is 1970Q-2006Q1. Real time data on inflation and output gap as discussed in the main text. Newey-West HAC standard errors. a, b, c denote significance at 1, 5, 10 percent levels.

Table 2 presents the estimation results using real time data on the policy relevant (i.e. mixed measure of) inflation and the real time output gap. These data were already discussed earlier.

For comparison, alternative results based on a commonly used dataset of current inflation and current output gap data is provided in the appendix Table A1. When we compare current and real time data estimations, the results for each of the subperiods turn out to be very similar. As mentioned before, examination of the current data and real time data suggests that the major difference lies in the average level of the output gap, particularly in the first two subperiods of our sample. The data differences therefore affect primarily the constant term of the estimated Taylor rules. Perhaps worth specific mention is the substantial increase in explanatory power of the real time data for the Greenspan period, with the adjusted R^2 of the equation almost doubling in size.

The most important differences in the empirical estimates are found in the comparison between the subperiods. One remarkable result is the extremely high implied inflation target found for the Burns policy regime, estimated at 22 percent. This result is unlikely to reflect a true policy target value. Examination of the inflation and output gap coefficients shows that the policy regimes have to be interpreted very carefully. First, both the Burns and Volcker regimes suggest that the inflation coefficient is not significantly different from 1. Therefore, these estimates suggest that policy makers did not adhere to the so-called Taylor principle, i.e. raising the real interest rate when inflation is above its target. This in fact calls into doubt the existence of any inflation target. Second, in the Volcker regime there is also no significant (positive) response of the policy rate to the output gap.

Whereas the estimated policy rule for the Greenspan period is clearly very close to the Taylor rule (with suggested policy rule coefficients of 1.5 and 0.5), the Burns and Volcker periods suggest that a different interpretation is more likely. In the Burns regime, the policy rule appears to have been to respond with changes in the real funds rate (β=1) to the observed output gap (γ>0). Further interpretation based on the value of the constant term suggests that the Burns regime does not appear to have had an inflation target at all. The value of the constant term appears to capture mostly the value of the equilibrium real interest rate. However, the estimated policy rule may be interpreted as reflecting a classical, fixed Phillips-curve tradeoff between levels of the output gap and levels of corresponding inflation. According to the fixed Phillips curve hypothesis, responding to the output gap should be sufficient to control inflation as well. On the other hand, the Volcker period policy rule appears to have been to keep the real funds rate (β=1) constant and at a relatively high level, but not respond to the real economy (γ=0). The high target real funds rate in the Volcker period, implied by the constant term, may be interpreted as a function of the communicated Fed objective of achieving disinflation in the early 1980s.

To summarize, a likely interpretation of the three policy regimes could be as follows:

- Burns: real funds rate = f(output gap), no inflation target.
- Volcker: real funds rate = f(disinflation target), no output gap effect.
- Greenspan: Taylor rule model.

It is possible to combine the three policy regimes into one comprehensive but relatively simple interest rate equation, using dummy variables for the Burns-Miller, Volcker and Greenspan periods (DBM, DV, DG). Following some preliminary estimates and tests on significance of the dummy variables, a workable real funds rate equation for the full sample period would take the following form:

$$i_t - \pi_t = c_{00} + c_{01} DV + c_{02} DG + c_1 \; DG * \pi_t + c_{21} DBM * y_t + c_{22} DG * y_t$$

Here, c_{00} is interpreted to represent the long-run equilibrium real rate common to the three policy regimes. Coefficient c_{01} captures the increase in the target real rate in the Volcker regime, aimed at reducing inflation. Coefficient c_{02} captures the implied target inflation rate in the Greenspan regime.

Now, one further addition is made to the interest rate equation. Two dummy variables are used for the second and third quarter in 1980 (D80Q2, D80Q3). This captures most of the sharp short-run policy reversal in 1980 with respect to interest rate policy and the policy of credit controls. The results show that these dummies do not in fact have a large effect on the overall equation, except the measure of explanatory power.

Table 3 shows the estimates for the simple Federal Reserve policy rule spanning the period 1970Q1-2006Q1. We find an estimate for the long-run equilibrium real interest rate of 3.44 percent. For the Greenspan policy regime the average inflation target is estimated at 3.75 percent, which is substantially higher than the previous subperiod-only estimate of 2.43 percent reported in Table 2.[11] For the Greenspan period we again confirm the Taylor rule hypothesis with respect to inflation gap and output gap coefficients (β =1.5 and γ = 0.5).

Table 3 Federal Reserve policy rule estimate using real time data

	c_{00}	c_{01}	c_{02}	c_1	c_{21}	c_{22}
Full period	3.440 (0.582)a	1.947 (0.726)a	-2.683 (0.794)a	0.714 (0.149)a	0.480 (0.107)a	0.501 (0.068)a
	adjR^2 = SEE = DW = Greenspan π^T =	0.729 1.285 0.991 3.75				

Estimated equation $i_t - \pi_t = c_{00} + c_{01}DV + c_{02}DG + c_1\ DG * \pi_t + c_{21}DBM * y_t + c_{22}DG * y_t$

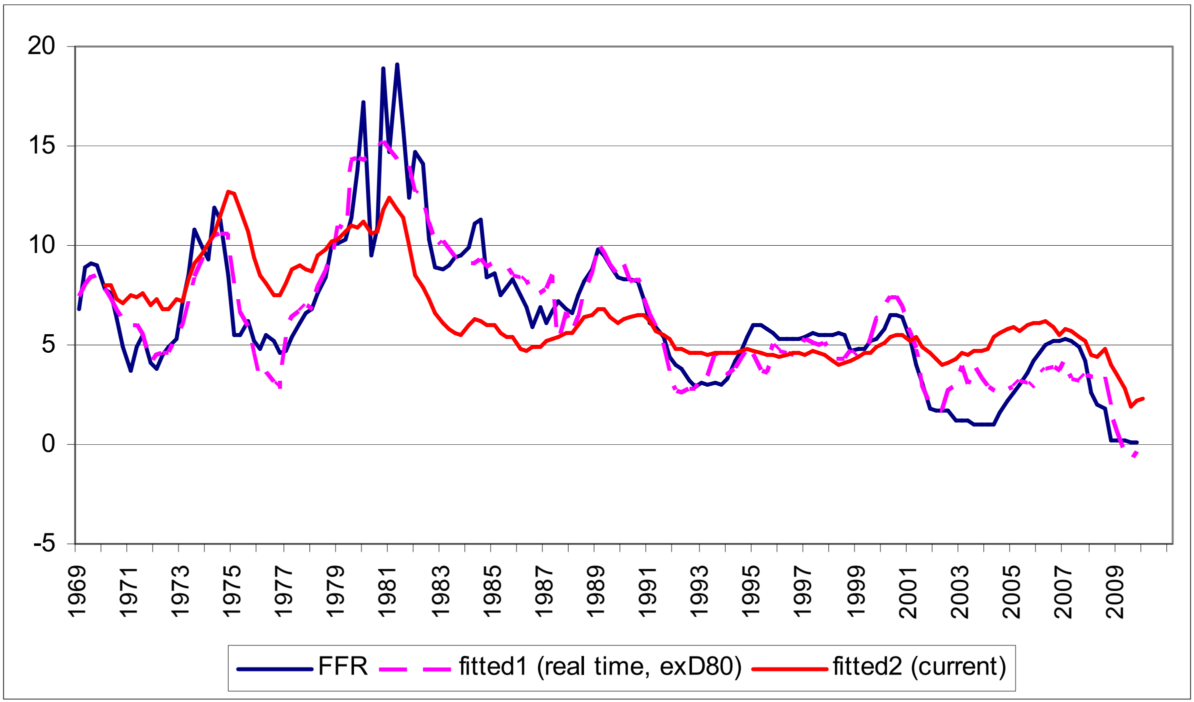
Additional included coefficients D80Q2, Q3 not shown. Estimation period is 1970Q1-2006Q1. Greenspan period inflation target is calculated as $-c_{02}/c_1$.

Figure 3 is a graphical representation of the explanatory performance of two estimated policy rules. The first policy rule is the preferred estimate using real time data and includes the effects of regime shifts. The other policy rule is the full period estimate of the Taylor equation using current data that would frequently be used in other studies. The substantial difference in explanatory performance is shown clearly.

The small out-of-sample expansions of the policy rule into 1969Q1-1969Q4 and 2006Q2-2009Q4 are difficult to evaluate, but at first glance there seems little indication of any further regime changes. As a result we may assume that the estimated equation of Table 3, using real time data and taking into account the Burns-Miller, Volcker and Greenspan regime changes presents a simple but effective representation of Federal Reserve policy for the period 1969-2009.

[11] Examination of the inflation rate time series suggests that there may have been a shift in the Greenspan inflation target around 1991-92. The average level of inflation moves from around 4 percent to 2.5-3 percent.

Figure 3 Observed and fitted federal funds rate, 1969Q1-2009Q4



Fitted excl.D80: fitted value for the policy rule from Table 3, using real time data, but D80Q2-Q3=0.
Fitted curr full: fitted value for the policy rule from Table 2, estimated and fitted using current data and no regime shifts. Out-of-sample fitted values for 1969Q1-1969Q4 and 2006Q2-2009Q4 are also shown, assuming that the Burns-Miller and Greenspan regimes can be extended backward and forward respectively.

4. CONCLUSION

In this paper I have shown the different results for a basic Taylor rule equation estimated for three Federal Reserve monetary policy regimes. The empirical results suggest fundamental changes in policy between the tenure periods of Fed Chairman Arthur Burns (1970Q1-1978Q1), Paul Volcker (1979Q3-1987Q2) and Alan Greenspan (1987Q3-1997Q4). The Burns regime seems to have focused on changing the real funds rate in response to the output gap, without a clear consideration of any inflation target. The Volcker regime consisted of keeping the real funds rate at a high constant level, without consideration of the output gap. The Greenspan regime closely follows the now familiar Taylor rule principles: increase the real funds rate in response to both the inflation gap and output gap.

Despite the fundamental regime shifts, Federal Reserve funds rate policy can still be effectively described by a simple equation using only inflation and the output gap, although dummy variables are needed to capture the changes in coefficient values.

The cautionary note from this paper is that regime shifts in monetary policy can seriously affect several strands of economic analysis. Many empirical studies include monetary policy functions at some point in the analysis and their results depend on the accuracy of the policy description. It is a problem that so many empirical studies rely on one uniform policy equation estimated over the entire sample period and thus ignore the problem of structural breaks due to policy regime shifts. Results and conclusions of these simplified empirical analyses must be treated with caution. Failure of economic theories in certain empirical tests may reflect not so much the value of the theory but the appropriateness of the model assumptions.

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APPENDIX Table A1 Taylor rule estimates for various periods using current data

	α	β	γ	adjR^2	SEE	DW
Burns	0.952 (1.211)	0.952 (0.195)a	0.796 (0.134)a	0.641	1.315	0.932
	$r^* = 0.11$ $\pi^T = 17.70$					
Volcker	4.778 (0.710)a	1.098 (0.125)a	0.023 (0.117)	0.702	1.989	1.928
	$r^* = 5.26$ $\pi^T = 4.89$					
Greenspan	1.277 (1.065)	1.467 (0.438)a	0.649 (0.140)a	0.407	1.739	0.068
	$r^* = 2.35$ $\pi^T = 2.31$					
Full period	2.820 (0.864)a	0.939 (0.215)a	0.151 (0.205)	0.418	2.662	0.290
	$r^* = 2.46$ $\pi^T = 5.82$					

Estimated Taylor rule equation: $i_t = \alpha + \beta\ \pi_t + \gamma\ y_t$ where $\alpha = (r^* - \beta_\pi\ \pi^T)$, $\beta = (1+\beta_\pi)$ and $\gamma = \beta_y$.

The estimation periods are Burns: 1970Q1-1978Q1, Volcker: 1979Q3-1987Q2 and Greenspan: 1987Q3-2006Q1. Full period is 1970Q-2006Q1. Current data for inflation and output gap are based on GNP/GDP deflator and CBO potential output (vintage August 2010).
Newey-West HAC standard errors. a, b, c denote significance at 1, 5, 10 percent levels.