

Monetary Policy and Asset Prices: Does the Federal  
Reserve Practice Asset Price Targeting?

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April 26, 2009

# 1 Introduction

One of the more frequent discussions in monetary economics is the evaluation of central bank policy, specifically the actions of the United States Federal Reserve (the Fed). Among various tools for analysis, the simple Taylor Rule is very popular. Using graphical evidence, Taylor (1993) models the Federal Funds Rate as a linear function of inflation and the output gap. Clarida, Gali and Gertler (2000) and Orphanides (2001) modernize the Taylor Rule. These authors construct a rule which better describes the actions of the Fed and provides a deterministic system for the macroeconomy. However, although both inflation and the output gap are widely accepted as components of this reaction function, there is no consensus as to whether additional variables should be included.

Consider that some papers, such as Hayford and Malliaris (2004) and Rigobon and Sack (2003), argue for the inclusion of asset prices in the reaction function. Similar to Taylor's analysis, these arguments are predominantly empirically motivated. By comparison, theoretically driven reaction functions, like those found in Clarida, Gali and Gertler (1999), fail to suggest a relationship between the Federal Funds Rate

and asset prices. In fact, some authors, including Benjamin Bernanke, construct theoretical arguments against a central bank's consideration of asset prices. Thus, the necessity for including asset prices in a reaction function is questionable, and in this thesis, I employ formal statistical tests to determine whether asset prices have indeed played a major role in Fed policies.

## 2 The Policy Rule

As summarized in Clarida et al. (1999), a policy rule is a course of action chosen by a central bank for an indefinite time horizon. The policy rule is typically chosen through some type of optimization. The alternative to a policy rule is discretion, defined as the formulation of a new policy action in each and every time period. That is, a policy rule requires a commitment to an action while discretion does not require commitment, and this distinction results in drastically different outcomes. This paper will not consider discretionary actions, however, since a policy rule tends to generate more effective monetary policy. Such effectiveness is largely driven by credibility gained from holding to the policy rule<sup>1</sup>.

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<sup>1</sup>Clarida et al. (1999) provides an excellent summary of the macroeconomic consequences of both discretionary-based and rule-based monetary policy.

There are several formulations of policy rules, or reaction functions, with the first such rule proposed by Taylor (1993). In his paper, Taylor observed that inflation and the output gap tends to drive, or predict, the short-term interest rate set by the Fed. As demonstrated in Figure (1), there appears to be linear relationships among these variables over the period from 1987 to 1992. Based on this graphical evidence, Taylor (1993) suggests the following reaction function for the short-term interest rates set by the Fed

$$r = p + .5y + .5(p - 2) + 2 \tag{1}$$

where  $r$  denotes the Fed Funds Rate,  $p$  is the percentage change in inflation, and  $y$  is the annualized percent change in the difference between GDP and potential GDP. This elegant rule still serves as a baseline suggestion for monetary policy. Over time, however, certain refinements have been suggested to create a more effective rule.

Although Taylor (1993) takes an atheoretical approach to the reaction function, subsequent monetary economic literature provides a theoretical derivation of the reaction function. Under a New Keynesian framework, Clarida et al. (1999) demonstrates that the optimal path,

as per the objective function of a central bank, is that of a Taylor-like rule<sup>2</sup>. The New Keynesian assumption is paramount to this construction since it allows for nominal price rigidities. Without sticky prices, monetary policy has no effect on the real short-term real interest rate, and hence cannot stabilize prices when inflation deviates from its target.

### 3 Modern Reaction Functions

Although the modern reaction function still relates the short-term interest rate with inflation and output, current adaptations of the policy rule are far from simple. Taking advantage of more advanced statistical techniques, the modern empirical reaction function is forward-looking and dynamic. Additionally, the inflationary and output variables have been reinterpreted.

#### 3.1 Time Horizon

Consider that Taylor (1993) formulates a backward-looking rule such that the Federal Funds Rate in quarter  $t$  is a function of inflation and

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<sup>2</sup>Clarida et al. (1999) assumes that the central bank's objective function is quadratic. Although this assumption is often made throughout the literature, Surico (2007) and Cukierman and Muscatelli (2002) explore non-quadratic objective functions. Ultimately, they derive reaction functions which are biased against inflation or recession.

the output gap in quarter  $t - 1$ . In contrast, a forward-looking rule is one in which the Fed Funds Rate for quarter  $t$  is a function of variables dated in quarter  $t + k$ , for some integer  $k$ . The literature favors forward-looking rules since it is well accepted that the actions of a central bank have a lagged affect. Although the structure of the reaction function is flexible with respect to the time horizon, the current consensus is that monetary policy is most effective when  $k = 4$ . As a result, expected values of inflation and output are used in the modern reaction function in the place of past values of these variables.

### **3.2 Inflation Targeting**

Although many controversies exist in the literature on monetary economics, almost all agree that inflation targeting is important if policy is to be effective. Indeed, Bernanke and Mishkin (1997) provide a very compelling argument for inflation targeting, and Clarida et al. (2000) and Orphanides (2001) attempt to integrate inflation targeting into their model. However, in spite of its importance, an inflation target is troublesome to identify. Consider that the Fed never publicly states their inflation targets (or even whether they actively practice inflation targeting), and as such, any target is merely surmised from actions of

the Fed. There are, however, clever solutions to this problem that I will address later in this thesis.

### **3.3 The Output Gap**

Essential to constructing the output gap is the approximation of potential output. Taylor (1993), Hayford and Malliaris (2004), Clarida et al. (2000) and Orphanides (2001) first project the log of Real GDP on a polynomial function of time to obtain Potential GDP. The output gap is then calculated as the difference between Real GDP and Potential GDP.

In contrast, some authors prefer to derive Potential GDP from a structural equation like a Cobb-Douglas Production Function or the Philip's Curve (for Potential GDP and NAIRU respectively). Descriptions of these methods can be found in Judd and Rudebusch (1998). Additionally, Potential Output can be derived from Okun's Law by using the rate of change of unemployment. Clark (1982) and Braun (1990) provide a detailed description of this process.

### 3.4 The Implied Policy Rule

Although the original Taylor Rule is empirically appealing, given the discussion in the preceding section and the theoretical work of Clarida et al. (1999), it is evident that the Taylor Rule can be expanded and generalized. Under the New Keynesian framework, the nominal short-term interest rate affects the real short-term interest rate. Hence the equivalence relation

$$rr_t^* \equiv r_t - E[\pi_{t,k} | \Omega_t] \quad (2)$$

where  $rr_t^*$  is the target real rate in quarter  $t$ ,  $r_t$  is the actual interest rate in quarter  $t$ , and  $E[\pi_{t,k} | \Omega_t]$  is the expected inflation in quarter  $k$  conditional upon the information known in quarter  $t$  ( $\Omega_t$ ).

I wish to construct a rule that incorporates real rates. I equate the target level of the real short-term interest rate to its equilibrium level in terms of desired output and inflation. As above, I incorporate the expected levels of output and inflation, such that

$$rr_t^* = rr^* + (\beta - 1)(E[\pi_{t,k} | \Omega_t] - \pi^*) + \gamma E[x_{t,q} | \Omega_t] \quad (3)$$

where  $rr^*$  is the equilibrium target short-term interest rate,  $E[x_{t,q} | \Omega_t]$  is the expected output gap in quarter  $t + q$ , and  $rr^* \equiv r^* - \pi^*$ .

Furthermore, I assume that  $rr^*$  is independent of monetary factors in the long-run, as such,  $rr^*$  is constant.

By equations 2 and 3, it is evident that the Fed sets the nominal Fed Funds rate each period in an attempt to achieve the optimal Fed Funds rate. That is, equation 3 is a difference equation that the Fed commits to so that  $rr_t^* \rightarrow rr^*$  as  $t \rightarrow \infty$ . Additionally, by setting  $k = q = -1$ , equation 3 reduces to the real equivalent of equation 1 with arbitrary coefficients. Thus, equation 3 generalizes the Taylor Rule and provides a means for a central bank to obtain economic equilibrium.

An immediate consequence of equation 3 is stable monetary policy. As described in Clarida et al. (2000), effective monetary policy requires a positive relationship between the interest rate and both inflation and the output gap. Thus, it is ideal for  $\gamma > 0$  and  $\beta > 1$ , and this provides us a benchmark for evaluating reaction functions with  $\gamma = 0$  and  $\beta = 1$ .

### **3.5 Short-term Interest Rate**

As Clarida et al. (2000) observe, the above policy rule is still too limiting because it “assumes an immediate adjustment of the actual Funds rate to its target level, and thus ignores the Federal Reserve’s tendency to smooth changes in interest rates.” In other words, the rate set

by the Fed is not the nominal target in quarter  $t$ , but rather a linear combination of the nominal target rate and interest rates from previous quarters. As in Clarida et al. (2000), the rule for setting the Federal Funds rate is assumed to be:

$$r_t = \rho(L)r_{t-1} + (1 - \rho)r_t^* \quad (4)$$

where  $r_t^*$  is the target nominal rate in quarter  $t$ ,  $\rho(L)$  is a lag operator polynomial of order  $n - 1$ , and  $\rho \in [0, 1]$ , which can be interpreted as a degree of smoothing. Hence, through augmenting 3 with equation 4, the Fed commits to a dynamic process of setting the Fed Funds rate, though the rate change is no longer immediate.

Parenthetically, Rudebusch (1995) provides empirical evidence of the serial correlation in interest rates, and Goodfriend (1991) and Sack (1998) provide theoretical justification that one lag is sufficient to smooth interest rates.

Equations 2, 3, and 4 all contain some form of a target interest rate. As the Fed's main instrument of policy, implicitly there exists such a target. However, the target short-term interest rate is never stated by the Fed, and thus it is difficult to empirically identify the true target

level of the Fed's instrument.

To combat this identification problem, Judd and Rudebusch (1998) suggests the combination of the equilibrium short-term interest rate and the inflation target and their coefficients into some constant, that can be empirically estimated. From there, Judd proposes a simple benchmark for the equilibrium short-term interest rate as the average of the rate that prevailed historically over periods where the start and end inflation rates were similar. Hence, with this assumption for  $rr^*$  and an estimate for  $\beta$  and the aforementioned constant, an inflation target can be identified.

### 3.6 The Modern Reaction Function

Although equation 3 provides a functional form for the real short-term interest rate, for empirical purposes, the modern reaction function is given in nominal terms. Hence, I rewrite equation 3 in nominal terms as:

$$r_t^* = r^* + (\beta - 1)(E[\pi_{t,k} | \Omega_t] - \pi^*) + \gamma E[x_{t,q} | \Omega_t] \quad (5)$$

By substituting equation 5 into equation 4 and recalling that  $rr^* + \pi^* \equiv r^*$ :

$$r_t = (1 - \rho)[\alpha + \beta\pi_{t,k} + \gamma x_{t,q}] + \rho(L)r_{t-1} + \epsilon_t \quad (6)$$

$$\epsilon_t = -(1 - \rho)\{\beta(\pi_{t,k} - E[\pi_{t,k} | \Omega_t]) + \gamma(x_{t,q} - E[x_{t,q} | \Omega_t])\} \quad (7)$$

$$\alpha = rr^* - (\beta - 1)\pi^* \quad (8)$$

Equations 6 – 8 define the modern reaction function and are the baseline for the rest of this paper. Clarida et al. (2000) use equations 6 and 7 to establish an orthogonality condition and estimate the parameters using the Generalized Method of Moments (GMM).

## 4 Asset Prices

Pivotal to Clarida et al. (1999) is the assumption that a central bank only targets output and inflation. The bulk of the monetary economics literature reflects this assumption; however, it is plausible to consider additional targets. Asset prices are an intuitive third target, and, as such, their relevance to monetary policy is the focus the remainder of this paper. Alan Greenspan has even mused the issue. In Greenspan (1996), he ponders,

But what about future prices or more importantly prices of claims on future goods and services, like equities, real estate, or other earning assets? Is stability of these prices essential to the stability of the economy?

Although there does not exist a derivation of an asset price augmented reaction function along the lines of Clarida et al. (1999), there is a wealth of theoretical and empirical evidence both for and against an alternative reaction function. Additionally, we can distinguish between normative and positive discussions on the relevancy of asset prices to monetary policy.

#### **4.1 Normative Arguments**

Of the normative literature, there are two distinct groups. Headed by Bernanke and Gertler (1999) and Bernanke and Gertler (2001), the detractors argue that asset price targeting is unnecessary. They claim that inflation targeting is optimal no matter the state of the financial sector. The proponent group, led by Cecchetti (1998), argues that asset price targeting can improve the efficacy of monetary policy.

#### 4.1.1 Opponents

Bernanke and Gertler (1999) argue that inflation targeting sufficiently stabilizes asset prices and thus any targeting of asset prices by a central bank is useless. Their argument is that maintaining constant levels of current and expected inflation is equivalent to sustaining output at its natural level. However, when a bubble exists, either there is no effect on aggregate demand or the bubble causes an increase in aggregate demand through the wealth effect. In both scenarios, the monetary policy prescribed through inflation targeting is the optimal response. They further critique that due to the difficulty in observing a stock market bubble *a priori*, any such asset price targeting is misguided.

Bullard and Schaling (2002) take a different approach. They construct a macroeconomic model under which the central bank targets equity prices in addition to output and inflation. With this model, they find that asset price targeting can interfere with the minimization of inflation and output variation. Further, under certain conditions, asset price targeting can lead to indeterminacy. They conclude that the targeting of equity prices leads to supraoptimal levels of inflation and the output gap.

#### 4.1.2 Proponents

At odds with Bernanke and Gertler (1999) is Cecchetti (1998), who argues for the targeting of asset prices. Cecchetti and et al (2000) claim that by considering asset prices, a central bank can improve economic performance. Cecchetti, Genberg and Wadhvani (2003) examine how the end of a bubble can lead to unnatural levels of either inflation or deflation.

Blanchard (2000) directly addresses Bernanke and Gertler (1999) and makes a case for asset price targeting. He asserts that stock market bubbles can lead to increased capital accumulation, an economic condition which inflation targeting cannot combat. Therefore, in this case, asset price ought to be included as a third target of monetary policy.

In addition to Blanchard (2000), Bordo and Jeanne (2001) take exception to Bernanke and Gertler (1999). They find that in cases of extreme financial instability, as in the United States in 1929 and Japan during the 1990's, ignorance of asset prices can worsen already grim levels of output. Mishkin (2000) agrees with Bordo and Jeanne (2001) and claims that monetary policy should attempt to prevent financial

collapses.

## 4.2 Positive Arguments

In contrast to the preceding subsection, Rigobon and Sack (2003) explore whether the Federal Reserve did target asset prices. They surmise that monetary policy reacts significantly to changes in the stock market. They found that a 5 percent rise (fall) in the S & P 500 increases the likelihood of a 25 basis-point tightening (easing) of the Fed Funds rate by about 50 percent. Rigobon and Sack attribute this result to monetary policy anticipating stock market movements; however, they admit that this conclusion should be taken cautiously.

Hayford and Malliaris (2004) test the relationship between stock market bubbles and the Fed Funds rate. They construct an asset price augmented reaction, similar to Clarida et al. (2000), where they include the P/E ratio as their financial variable. Hayford and Malliaris find a significant, negative relationship between the P/E ratio and the Federal Funds rate. Thus, they conclude that through the 1990's, the Federal Reserve accommodated the formulation of stock market bubbles.

## 5 Empirical Strategy and Results

Given the mixed normative arguments and limited positive arguments, the role of asset prices in monetary policy is still unclear. Therefore, this paper estimates a forward-looking reaction function similar to Clarida et al. (2000) and Hayford and Malliaris (2004).

I take equations 6, 7, and 8 and incorporate asset prices

$$r_t = (1 - \rho)[\alpha + \beta\pi_{t,k} + \gamma x_{t,q} + \delta s_{t,j}] + \rho(L)r_{t-1} + \epsilon_t \quad (9)$$

$$\epsilon_t = -(1 - \rho)\{\beta(\pi_{t,k} - E[\pi_{t,k} | \Omega_t]) + \gamma(x_{t,q} - E[x_{t,q} | \Omega_t]) + (\delta s_{t,j} - E[s_{t,j} | \Omega_t])\} \quad (10)$$

$$\alpha = rr^* - (\beta - 1)\pi^* - \delta s^* \quad (11)$$

where  $s_{t,j}$  is the level of asset prices in quarter  $t + j$  and  $s^*$  is the target asset price level, or the fundamental price. I thus assume that the Fed can compute the fundamental price. Of course, there is no consensus as to whether the Fed can observe the fundamental price *a priori*, though, Blanchard (2000) does argue that the Fed can actually recognize the existence of a bubble.

Equations 9 and 10 provide conditions for the empirical reaction function. In equation 10, each grouping of variables — output, infla-

tion, and asset prices — are each the difference of observed levels from expected levels. Therefore  $\epsilon_t$  is orthogonal to any variable in  $\Omega_t$ .

Then by letting  $\mathbf{z}_t$  be a vector of instruments known in quarter  $t$ , i.e.  $\mathbf{z}_t \in \Omega_t$ , equations 9 and 10 establish the orthogonality condition

$$E\{[r_t - (1 - \rho)(\alpha + \beta\pi_{t,k} + \gamma x_{t,q} + \delta s_{t,j}) + \rho(L)r_{t-1}]\mathbf{z}_t\} = \mathbf{0} \quad (12)$$

Equation 12 allows for the estimation of  $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\delta$ , and  $\rho$  using the Generalized Method of Moments (GMM) procedure of Hansen (1982). By construction,  $\epsilon_t$  follows an  $MA(a)$  process, where  $a = \max[k, q, j] - 1$ . Therefore, unless  $k = q = j = 1$ ,  $\epsilon_t$  will be serially correlated. As such, for GMM estimation, an optimal weighting matrix which accounts for this serial correlation should be employed.

The data used are quarterly time series from 1981:1 to 2008:3. All financial data are obtained from Yahoo Finance and all other data is obtained from FRED. For the short-term interest rate, I use the average of the Federal Funds rate in the first month of each quarter. Inflation is measured using the annualized rate of change between two quarters of the GDP Deflator. The output gap is calculated using real and potential GDP. FRED determines potential GDP in accordance with the CBO

Table 1: Descriptive Statistics

Variable	Mean	St. Dev.	Min	Max
$r_t$	6.08	3.52	1.00	19.08
$\pi_t$	2.98	1.62	1.10	10.20
$x_t$	-0.77	2.23	-7.67	4.54
$s_t$	0.11	0.16	-0.25	0.53

method described earlier. The financial variable is the annualized rate of change of the average level of the S&P 500 index in the first month of each quarter<sup>3</sup>. The set of instruments includes lags of the Fed Funds rate, inflation, the output gap, the S&P 500, and lags of M2 growth and the spread between long-term bonds and three month T-Bills. Table 1 provides descriptive statistics of the Federal Funds rate and the three target variables.

I first estimate the reaction function without asset prices. Equations 6 – 7 produce the orthogonality condition

$$E\{[r_t - (1 - \rho)(\alpha + \beta\pi_{t,k} + \gamma x_{t,q} + \rho(L)r_{t-1})\mathbf{z}_t]\} = \mathbf{0} \quad (13)$$

<sup>3</sup>Orphanides (2001) shows that ex ante data can lead to misspecified reaction functions. Since most major macroeconomic time series – especially GDP – tend to be revised quarters after they are published, the use of “real-time” data in estimation results in different predicted rates. Clarida et al. (2000) and Hayford and Malliaris (2004) show that although revised data prescribes inaccurate short-term interest rates, there is no significant difference in the estimated coefficients. Additionally, this “real-time” data is published with a seven-year lag. As such, this paper opts to only consider revised data.

Table 2: Results for 1981:1 – 2006:1 Without Asset Prices

Coefficient	$(k, q, j)$		
	(1, 1, 1)	(4, 4, 4)	(-1, -1, -1)
$\alpha$	-3.99*	-13.05***	3.41*
	[-1.77]	[-2.76]	[1.73]
$\beta$	3.72***	7.06***	0.62
	[4.16]	[4.04]	[0.85]
$\gamma$	1.32***	2.89***	0.45
	[3.99]	[3.71]	[1.16]
$\rho$	0.91***	0.91***	0.89***
	[52.91]	[41.02]	[20.60]
$\pi^*$	3.70	3.16	–
$R^2$	0.96	0.94	0.94
Hansen J-Statistic p-value	0.37	0.16	–

z & t statistics in brackets

\*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$

just like the asset price augmented function, where  $\alpha$  is defined by equation 8 instead of equation 11. Table 2 presents regression results for the period of 1981:1 to 2006:1. The two forward-looking specifications – in the first two columns – employ GMM estimation.

Since in a backward-looking rule all targets are known, there is no need for instruments, and hence I employ OLS. Under both of the forward-looking specifications, the reaction function meets the stability requirement – that is,  $\beta > 1$  and  $\gamma > 0$ . However, in the backward-looking model,  $\beta < 1$ .

Table 2 also includes the implied inflation target, calculated by using

the sample average of the Fed Funds rate as a first approximation to  $rr^*$ . The values of 3.16 and 3.70 are consistent with the findings in Clarida et al. (2000). In all three models,  $R^2$  is at least 0.94 and for both GMM estimations, the J-Statistic p-values are large enough to fail to reject the null of over identification.

Table 3 presents the estimation results for the asset price augmented reaction function specifications. In the first two specifications, both  $\beta$  and  $\gamma$  are greater than 1 and 0 respectively. By comparison, in the backward-looking specification,  $\alpha$  and  $\gamma$  fail to be significant. In all three specifications, there is a great deal of inertia in rate changes, as  $\rho > 0.80$  in each case. Hence, interest-rate changes are largely a function of the interest rate in the previous quarter, as opposed to the target for the current quarter. As with the reaction functions estimated in Table 2, the estimated asset prices augmented reaction function have  $R^2$  values near one and large p-values for the J-statistic. Largely, these results are consistent with the specifications that do not include asset prices.

For both the forward and backward-looking models,  $\delta$  is highly significant and surprisingly large. Furthermore, the  $R^2$ 's from Table 2 indicate that the specifications without asset prices have just as good

Table 3: Results for 1981:1 – 2006:1 With Asset Prices

Coefficient	$(k, q, j)$		
	(1, 1, 1)	(4, 4, 4)	(-1, -1, -1)
$\alpha$	-3.36**	-9.16***	1.41
	[-2.12]	[-3.05]	[1.03]
$\beta$	3.04***	4.94***	0.99**
	[5.04]	[4.74]	[2.04]
$\gamma$	1.12***	1.73***	0.31
	[4.73]	[3.67]	[1.10]
$\delta$	7.84**	16.38***	10.10**
	[2.35]	[2.64]	[2.50]
$\rho$	0.88***	0.89***	0.85***
	[37.93]	[39.88]	[19.55]
$R^2$	0.95	0.94	0.94
Hansen J-Statistic p-value	0.45	0.65	–

z & t statistics in brackets

\*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$

a fit as those which do include asset prices.

It is a bit more difficult to obtain estimates of the implied target. In particular, when including asset prices, the method found in Judd and Rudebusch (1998) can no longer be used. In other words, estimates for  $\alpha$  and  $rr^*$  are not sufficient to identify *both*  $\pi^*$  and  $\delta^*$ .

Table 4 presents a loci of plausible values for  $\pi^*$  and  $s^*$  for the two forward-looking models. I ignore the backward-looking model since  $\alpha$  and  $\gamma$  are not significant from zero. Given  $\pi^*$ ,  $s^*$  is increasing in  $\pi^*$  for the one-quarter-ahead model, and decreasing for the four-quarter-

Table 4: Loci Results

	(1, 1, 1)	(4, 4, 4)
$\pi^*$	$s^*$	
0	0.98	0.94
1	1.04	0.70
3.5	1.20	0.10
5.0	1.29	-0.26
10.0	1.61	-1.47

ahead model. These values seem quite reasonable. Observe that when  $\pi^*$  is near  $\bar{\pi}_t = 2.98$ ,  $s^*$  is near  $\bar{s}_t = 0.11$ .

To further test the asset price augmented reaction function, I forecast both the original estimated reaction function and the asset price augmented reaction function into the first six quarters of Chairman Bernanke's term<sup>4</sup>. As documented in Section 4, Chairman Bernanke's publication record suggest a tempered, if not absent, enthusiasm for asset price targeting. Table 5 explores these forecast results, presenting the mean absolute deviation of the forecasted results from the vintage rates. As indicated in this table, the mean absolute deviations are not significantly different across specification. This is not especially surprising, considering the similarly high  $R^2$ 's for each specification.

<sup>4</sup>I use the four quarter-ahead specification in both cases.

Table 5: Forecast Results

Mean Absolute Deviation	
Without	0.54
With	0.59

## 6 Conclusion

The results from Table 3 provide optimistic results; however, evidence of asset price targeting is ambiguous at best. Although the results suggest that the asset price augmented reaction function is a good fit for the data, it does not appear to provide additional explanatory power when compared to the reaction function found in Clarida et al. (2000).

As a corollary to the results, there are at least two related research questions. First, given a larger sample of economic data from Chairman Bernanke's term, observe that with sufficient sample sizes, proper standard errors can be constructed. This allows for a Chow Test.

Second, Clarida et al. (2000) provides a simple macroeconomic model derived through inflation and output gap targeting. Under a New Keynesian framework and given a reaction function as described in 6 and 7, the following is their deterministic model for macroeconomic equi-

librium:

$$\pi_t = \eta E[\pi_{t+1} | \Omega_t] + \lambda(y_t - z_t) \quad (14)$$

$$y_t = E[y_{t+1} | \Omega_t] - (1/\sigma)r_t - E[\pi_{t+1} | \Omega_t] + g_t \quad (15)$$

$$r_t^* = \beta E[\pi_{t+1} | \Omega_t] + \gamma x_t \quad (16)$$

$$r_t = \rho r_{t-1} + (1 - \rho)r_t^* \quad (17)$$

where  $y_t$  is the log of output,  $z_t$  is potential output,  $g_t$  is an exogenous demand factor, and  $x_t = y_t - z_t$  (i.e. the output gap). The parameters  $\beta$ ,  $\gamma$ , and  $\rho$  are identical to the coefficients found in equation 6, though  $\eta$ ,  $\lambda$ , and  $\sigma$  are non-policy parameters that must be set *a priori*. As indicated by equation 3, the reaction function provides conditions for economic equilibrium. In contrast, equations 14 – 17 provide a structural description of the implications of monetary policy on the economy. Through time, a central bank commits to a recursive process of setting  $r_t$  in an attempt to achieve  $r_t = rr^*$ ,  $\pi_{t,k} = \pi^*$ , and  $y_t = z_t$ . Clarida et al. (2000) simulate this model, choosing  $\eta$ ,  $\lambda$ , and  $\sigma$  and using their various estimates for  $\beta$ ,  $\gamma$  and  $\rho$  to investigate how various policy rules impact the macroeconomy. Future research could augment equation 16 to include asset prices to simulate the impact of asset price reac-

tion functions on the macroeconomy. This allows for a more insightful comparison of the two classes of reaction functions.

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