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THORBECKE, Willem
RIETI

Hanjiang ZHANG
University of Texas

RIETI
Research Institute of Economy, Trade & Industry, IAA

The Research Institute of Economy, Trade and Industry
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Monetary Policy Surprises and Interest Rates: Choosing between the Inflation-Revelation and Excess Sensitivity Hypotheses.

Willem Thorbecke*
RIETI and George Mason University

Hanjiang Zhang**
University of Texas

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Abstract

Romer and Romer (R&R) reported that federal funds rate increases may raise expected inflation by revealing the Fed's private information about inflation. Gürkaynak, Sack, and Swanson (GSS) presented evidence that funds rate increases lowered long-term expected inflation. To choose between these hypotheses we examine how monetary policy surprises affect daily traded commodity prices, term interest rates, and forward interest rates. We find that funds rate increases in the 1970s raised gold and silver prices and that increases after 1989 lowered gold and silver prices. We also find that funds rate hikes over both sample periods primarily affected short-term interest rates and near-term forward rates. For the 1970s, these results suggest that R&R's explanation is correct. For recent years, they indicate that funds rate increases affect real rates and may also be consistent with GSS's findings.

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* Corresponding Author: Associate Professor, George Mason University, and Senior Fellow, RIETI, 1-3-1 Kasumigaseki, Chiyoda-ku, Tokyo 100-8901, Japan. Tel.: 81-3-35018286; Fax: 81-3-35018416; E-mail: .

** Visiting Scholar, Department of Finance, McCombs School of Business, University of Texas at Austin, 1 University Station B6000, Austin, TX 78712. Tel.: (512)329-9010 ; Fax: (512)471-5073 ; E-mail:

1. Introduction

Why do increases in the Fed's target for the federal funds rate raise interest rates on long-term Treasury securities? One might expect that contractionary monetary policy would raise short-term rates because of a liquidity effect and reduce long-term rates by lowering expected inflation. Yet Cook and Hahn (1989) reported that increases in the Fed's target for the federal funds rate during the September 1974 – September 1979 period raised interest rates at all horizons. Similarly, Kuttner (2001) found that unanticipated increases in the federal funds rate target over the June 1989 – February 2000 period increased interest rates at all maturities.

One interpretation of Cook and Hahn's (1989) and Kuttner's (2001) results is that contractionary monetary policy raises longer-term real interest rates. The nominal interest rate equals the real interest rate plus the expected inflation rate. If contractionary monetary policy lowers expected inflation or leaves it unchanged, then evidence that it increases the nominal interest rate implies that it must be increasing the real interest rate also.

Romer and Romer (2000) provided an alternative explanation for these findings. They showed that the Fed has substantially more information about future inflation than is available from commercial forecasts. Their results imply that the optimal strategy for individuals with access to both the Fed's forecasts and commercial forecasts would be to rely exclusively on the Fed's forecasts. They also demonstrated that Federal Reserve policy actions reveal some of the Fed's private information about inflation. An increase in the federal funds rate target could thus increase interest rates by raising expectations of future inflation.

Gürkaynak, Sack, and Swanson (2005a) presented evidence indicating that increases in the federal funds rate target have the opposite effect, lowering expected inflation over the 1990 – 2002 period. They found that unexpected increases in the funds rate target lower the one-year forward rate ten years ahead. They also found that real long-term forward rates derived from inflation-indexed Treasury securities do not respond to monetary policy surprises, while the compensation for inflation responds with a significant negative coefficient to positive innovations in the federal funds rate target. They interpreted these findings to mean that surprise increases in the federal funds rate target lower future expected inflation. Their conclusion is thus exactly the opposite of Romer and Romer's (2000) information-revelation explanation.

Ellingsen and Söderström (2001) presented a model that encompasses the models of Romer and Romer and Gürkaynak, Sack, and Swanson. In their model unanticipated changes in the central bank rate can occur because the central bank has private information about the economy or because the central bank changes its preferences for inflation stabilization relative to output stabilization. Romer and Romer focused on the first effect and Gürkaynak *et al*. on the second.

Campbell (1995) noted that the effect of funds rate increases on inflation expectations should depend on the Fed's credibility in fighting inflation. If the Fed's anti-inflationary policies are credible, then they should forestall increases in longer run expected inflation. If they are not credible, then they may increase both shorter-term real rates and longer-term expected inflation.

Bernanke and Mishkin (1997) have argued that central bank credibility in financial markets depends on delivering low inflation. Inflation in the U.S. in the 1970s

was high and volatile while inflation since 1990 has been quiescent. Thus, as Yellen (2006) discussed, the Federal Reserve's credibility was much weaker in the 1970s than it is now.[1]

The response of financial markets to news of funds rate changes might thus have been different in the 1970s than in more recent years. In the 1970s a funds rate increase, in addition to raising short-term real rates, might have increased expected inflation through the channel that Romer and Romer (2000) discussed. In the 1990s and the first decade of the 21st century a funds rate increase, rather than leading investors to anticipate higher inflation, might have led them to believe that the Fed would be tougher on inflation. It could thus have lowered expected inflation.

One way to test whether monetary policy surprises affected inflation expectations differently in recent years than in the 1970s is to look at how they impacted daily traded commodity prices.[2] Commodities such as gold and silver are widely regarded as hedges against inflation. The evidence of Gürkaynak, Sack, and Swanson (2005a) implies that unexpected increases in the federal funds rate after 1990 lowered longer-term expected inflation and raised short-term real interest rates. Frankel and Hardouvelis (1985), Hardouvelis and Barnhardt (1989), Frankel (2008) and others have shown that if monetary policy actions are expected to increase real interest rates they will lower commodity prices and if they are expected to lower inflation they will also lower

[1] Paul Volcker (2006) discussed how financial markets were roiled by Federal Reserve interest rate hikes in 1979 because the Fed lacked credibility.

[2] It is also possible to test for this by examining the response of exchange rates to monetary policy surprises (see, e.g., Engel and Frankel 1984). However, in the 1970s funds rate increases were sometimes accompanied by interventions in the foreign exchange market designed to strengthen the dollar. These interventions would bias our estimates of the effects of federal funds target changes on exchange rates. In addition, daily Federal Reserve exchange rate data report noon values rather than closing values. These are less useful since some of the funds rate changes were made before noon and some after noon. We thus focus on the effects of funds rate changes on commodity prices.

commodity prices. Thus, if positive federal funds rate innovations are having the effects posited by Gürkaynak *et al.*, they should unambiguously lower commodity prices. On the other hand, the evidence of Romer and Romer (2000) indicates that funds rate increases raise short-term real interest rates and raise longer-term expected inflation. Higher short-term real interest rates would lower commodity prices and higher expected inflation would raise them. Thus, if funds rate hikes are having the effects posited by R&R, they may either raise or lower commodity prices.[3]

In addition to commodity prices we also investigate how monetary surprises affect term interest rates and forward interest rates. Looking only at term interest rates, as Cook and Hahn (1989) did, does not indicate whether long-term yields increase because far-ahead forward rates increase or because short-term rates increase a lot with constant or even lower forward rates.[4] Looking at forward rates can help resolve this issue. Using nominal forward and term rates together with commodity prices then allows us to determine whether funds rate target changes affect real rates or the compensation for inflation.[5]

We find that positive funds rate innovations raised gold and silver prices during the 1970s and lowered them after 1989. In addition, funds rate hikes over both sample periods primarily affected short-term interest rates and near-term forward rates. These

[3] Frankel and Hardouvelis (1985) and Hardouvelis and Barnhart (1989) examined the response of gold and silver and other commodities to weekly money supply announcements before and after the Fed changed its monetary policy operating procedures in October 1979 in order to fight inflation. After the middle of 1980 they found that news of unexpected increases in the money supply lowered metals prices but before this time they found that news of positive money supply innovations raised metals prices. They interpreted these results to mean that the Fed gained credibility as an inflation fighter only starting in 1980.

[4] We are indebted to an anonymous referee for this point.

[5] In principle, there should be a close relationship between short-term nominal interest rates and commodity prices because of the arbitrage condition linking commodity price changes, short-term interest rates, and storage costs (see, e.g., Frankel, 2008). Increases in longer term expected inflation can also raise commodity prices by increasing the demand for commodities as a hedge against inflation.

results indicate that Romer and Romer's (2000) information-revelation explanation applied in the 1970s, when the Fed lacked credibility. They also imply that funds rate increases in recent years affected short-term real rates. The findings for commodity prices in recent years are consistent with the conclusions of Gürkaynak, Sack, and Swanson (2005a). The statistically insignificant response of far-ahead forward rates is inconsistent with GSS's findings, however, and may occur because we lack data to test for a response over a narrow (thirty-minute) window.

The next section discusses the data and methodology that we employ. Section 3 presents the results. Section 4 concludes.

2. Data and Methodology

Cook and Hahn (1989) collected a sample of 76 changes in the Fed's target for the federal funds rate over the September 1974 – September 1979 period. They argued that the Fed controlled the funds rate so closely over this period that investors could perceive changes in the target on the day that they were implemented. These changes were then reported in the *Wall Street Journal* on the next day. They found that in 71 of the 76 cases, changes recorded in the *Wall Street Journal* correspond to changes recorded in the Federal Reserve's Record of Open Market Operations.

Cook and Hahn (1989) regressed interest rate changes for Treasury securities of all maturities on the size of the federal funds rate target change:

$$\Delta R_t = b_1 + b_2 \Delta FF_t + u_t, \qquad (1)$$

where ΔFF_t is the change in the funds rate target and ΔR_t is the change in the bill or bond rate over the 24-hour period bracketing the news of the funds rate target change.[6]

They argued that changes in the target were decided by the Federal Open Market Committee or the Account Manager of the Federal Reserve Bank of New York more than a day before they were implemented. They are thus predetermined variables and causality will be unidirectional from changes in the federal funds rate target to changes in bill and bond rates.

One problem with the Cook and Hahn approach is that their right hand side variable is the total (unanticipated plus anticipated) change in the funds rate target while only the unanticipated change should affect interest rates. To measure the anticipated change in monetary policy we use an unrestricted ordinary least squares prediction equation. We regress changes in the funds rate target on a constant and monthly changes in the unemployment rate, the inflation rate, the 3-month Treasury bill rate, the log of the trade weighted nominal exchange rate, and the log of the price of gold for each of the two months before the target change. We use real time data on unemployment and inflation available from the Federal Reserve Bank of St. Louis ALFRED database, data on interest and exchange rates available from the Federal Reserve Bank of St. Louis FRED database, and data on gold prices available from the Commodity Research Bureau. The adjusted R-squared from the regression is about 0.40. We then calculate the unanticipated change in the funds rate target as the actual change minus the expected change calculated using our prediction equation.[7]

[6] Cook and Hahn exclude one observation, giving them a sample of 75 funds rate changes.
[7] The results reported below do not change much when we follow Cook and Hahn by using total changes in the federal funds rate target rather than unanticipated changes in the target. These results are available on request.

The equation we estimate thus has the form[8]:

$$\Delta R_t = b_1 + b_2 (\Delta FF_t - \Delta FF^E_t) + u_{t.} \quad (2)$$

For dependent variables we use term interest rates, forward interest rates, and commodity price data. The term interest rates are the 3-month, 1-year, 3-year, and 5-year Treasury rates obtained from Cook and Hahn (1989). The forward rates are 1-year forward rates 1, 4, and 9 years ahead obtained from Gürkaynak, Sack, and Wright (2007). The commodity price data are the changes in the log of the closing spot prices of gold and silver obtained from the Commodity Research Bureau.[9]

We use gold and silver because Hardouvelis and Barnhart (1989) noted that the Frankel and Hardouvelis (1985) framework applies better to metals than to other commodities. They stated that metals such as silver and gold should be more sensitive to macroeconomic and monetary policy news than other commodities such as sugar and soybeans.

We report results for gold and silver separately and for gold and silver stacked into a single regression. Frankel and Hardouvelis (1985) argued that stacking the commodities provides more efficient estimates. For the regressions with gold and silver included separately there are 75 observations and for the regression with gold and silver together there are 150 observations.

[8] Pagan (1984) showed that standard errors will remain consistent when employing estimated residuals as a right hand side variable provided that the corresponding predicted values are not also included in the regression. We thus do not include the expected change in the federal funds rate target as a separate explanatory variable.

[9] The file names from the Commodity Research Board database are gc----y for gold and si----y for silver.

Kuttner (2001) constructed a series of daily monetary policy surprises for the period from 1989 to 2000. Using data from the federal funds futures market, he decomposed changes in the funds rate target into anticipated (ΔFF^E_t) and unanticipated (ΔFF^U_t) components. He found that unanticipated changes in the fund rate target are positively correlated with changes in nominal interest rates at all horizons.

We use Kuttner's series of monetary policy surprises as our right-hand-side variable over the more recent sample period.[10] We do not include anticipated funds rate changes in our regressions, since Kuttner reported that these did not affect interest rates. We also extend his series for ΔFF^U_t from February 2000 until June 2006, giving us 65 observations over the 1989 to 2006 period.[11]

3. Results

Table 1 presents the results using the Cook and Hahn data and Table 2 the results using the Kuttner data. In both cases unexpected federal funds rate changes have the largest effect on shorter-term interest rates. Over the Cook-Hahn period a 100 basis point unexpected increase in the funds rate target raises the 3-month Treasury rate by 48 basis points, the 1-year Treasury rate by 43 basis points, the 3-year rate by 27 basis points, and the 5-year rate by 19 basis points. Over the more recent period a 100 basis point positive innovation in the funds rate target raises the 3-month Treasury rate by 56 basis points, the

[10] We do not include the 1980-1989 period because, as Jones (1994) discussed, the Fed abandoned funds rate targeting in 1979. From 1979-1982 it targeted non-borrowed reserves. After this it followed a borrowing guideline. Jones argued that it was only after the appointment of Alan Greenspan as Fed Chairman in the late 1980s that the funds rate again became the best indicator of Fed policy.

[11] We thank Andrew Swiston of the International Monetary Fund for providing us updated data on unexpected changes in the fed funds target calculated from the fed funds futures market.

1-year Treasury rate by 51 basis points, the 3-year rate by 37 basis points, and the 5-year rate by 33 basis points.

In both Tables 1 and 2 monetary policy surprises only affect near-term forward rates. An unexpected 100 basis point increase in the target raises the 1-year forward rate 1-year ahead by 23 basis points over the Cook-Hahn period and by 32 basis points over the 1989-2006 period. Consistent with Gürkaynak, Sack, and Swanson (2005a), we do find a negative coefficient when using 1-year forward rates 9 years ahead. The coefficient is not statistically significant however.

Gürkaynak, Sack, and Swanson (2005b) also found that monetary policy surprises do not have a highly statistically significant effect on far-ahead forward rates. Using a thirty-minute window and the 5-year forward rate 5-years ahead they reported a negative coefficient that was significant at the 10 percent level. However, using a one-hour or daily window, they reported statistically insignificant negative coefficients. In our case monetary policy surprises may have a statistically significant effect on the 1-year forward rate 9 years ahead over a thirty-minute period. Unfortunately we do not intra-day data to test for this.

Unexpected federal funds rate changes have a statistically significant effect on commodity prices in Tables 1 and 2. It is noteworthy, though, that the signs of the coefficients change between the two periods. In Table 1 the coefficients range from 2.55 to 3.19, implying that a 100 basis point unexpected increase in the funds rate raised commodity prices by about three percent. The coefficients are statistically significant for gold and silver individually and gold and silver together. In Table 2 the coefficients range from -1.31 to -1.91, implying that a 100 basis point positive innovation in the funds

rate lowered commodity prices by about one and a half percent. The coefficients are statistically significant for gold individually and for gold and silver together but not for silver individually.

Frankel and Hardouvelis (1985) also reported that coefficients on individual commodities are sometimes not statistically significant or only marginally so but the coefficients on the commodities combined together are highly statistically significant. This pattern could reflect the fact that individual commodities are influenced not only by macroeconomic news but also by commodity-specific noise.

The results in Table 1 for the 1970s indicate that federal funds rate target increases primarily raised short run expected inflation. Contractionary monetary policy raised shorter-term interest rates, near-term forward rates, and commodity prices but did not affect more distant forward rates. These findings indicate that the effect of monetary policy on short-term expected inflation outweighted the effect on short-term real interest rates in the 1970s. Evidently Federal Reserve policy actions caused investors to revise their forecasts of inflation over the next couple of years.

The results in Table 2 for the period since 1989 indicate that federal funds rate target increases primarily raised short-term real interest rates. Contractionary monetary policy raised shorter-term interest rates and near-term forward rates, lowered commodity prices, and did not affect more distant forward rates. These findings indicate that the effect of monetary policy on short-term real interest rates outweighted any effect on short run expected inflation through the channel that Romer and Romer (2000) discussed. Apparently funds rate target changes in recent years caused real interest rates to move in

the same direction and for this reason affected commodity prices. This effect has been emphasized by Frankel (2008).

Funds rate target changes may also have been affecting longer-term expected inflation in the manner that GSS posited. We can not establish this from our data set because we do not have evidence that far-ahead forward rates responded to monetary policy. The absence of a statistically significant response may occur because we do not have higher frequency (e.g., thirty-minute) data on changes in distant forward rates.

The important implication of the results presented here is that changes in the funds rate target had asymmetric effects on commodity prices in the 1970s as compared to the 1989-2006 period. In the 1970s investors responded to target increases by increasing their demand for commodities, evidently as a hedge against inflation. Over the 1989-2006 period they responded to target increases by decreasing their demand for commodities, indicating that they expected real interest rates to increase. These results indicate that the Fed lacked credibility in the 1970s but has gained credibility since then.

4. Conclusion

Romer and Romer (2000) and Gürkaynak, Sack, and Swanson (2005a) have investigated the response of financial markets to monetary policy surprises. Romer and Romer presented evidence suggesting that increases in the federal funds rate target may increase interest rates partly by raising expected inflation. Gurkaynak, Sack, and Swanson presented evidence that funds rate target increases lowered long-term expected inflation. Campbell (1995) argued that if the Fed's anti-inflationary policies are credible, they should forestall increases in longer run expected inflation. If they are not credible,

however, they may increase expected inflation. Since the Fed has gained credibility in recent years but lacked credibility in the 1970s, the effect of funds rate increases on expected inflation may have varied over time.

To test for this we examine the response of gold and silver prices to changes in the funds rate target in the 1970s and from 1989 to 2006. Frankel and Hardouvelis (1985), Frankel (2008), and others have shown that if monetary policy is expected to increase real interest rates it will lower commodity prices and if it is expected to lower inflation it will lower commodity prices. Thus, if positive federal funds rate innovations have the effects posited by GSS, they should unambiguously lower commodity prices. On the other hand, if funds rate increases have the effects posited by Romer and Romer (2000), they should either raise commodity prices or have a mixed effect on them.

We find that funds rate hikes over both sample periods primarily affected short-term interest rates and near-term forward rates. In addition, positive funds rate innovations raised gold and silver prices during the 1970s and lowered commodity prices after 1989. These results imply that in the 1970s investors responded to target rate hikes by increasing their demand for commodities, evidently as a hedge against inflation. Over the 1989-2006 period they responded to target rate increases by bidding down commodity prices, evidently because they expected short-term real interest rates to increase. These results support Romer and Romer's hypothesis for the 1970s. The findings for commodity prices in recent years are also consistent with the conclusions of Gürkaynak, Sack, and Swanson (2005a), although the results for distant forward rates are not.

The findings reported here underscore the importance of credibility for monetary policy. Federal funds rate changes can affect economic activity if they move longer-term

real interest rates and the value of the dollar in the same direction. However, if funds rate increases raise expected inflation then the link between funds rate changes, real interest rates, and the dollar will be attenuated. To maintain the effectiveness of monetary policy, the Fed thus needs to preserve its inflation-fighting credibility.

Table 1
The Effect of Changes in the Federal Funds Rate Target on Interest Rates and Commodity Prices Over the 1974-1979 Sample Period[1]

	Dependent Variable	Constant	Change in federal funds rate target	Adjusted R-squared
Term Interest Rates				
	3-month Treasury	0.03 (1.17)	0.48*** (3.06)	0.19
	1-year Treasury	0.03* (1.67)	0.43*** (3.66)	0.21
	3-year Treasury	0.02** (2.01)	0.27*** (3.31)	0.21
	5-year Treasury	0.01 (1.42)	0.19*** (3.14)	0.15
One-Year Forward Rates				
	1-year ahead	0.02* (1.67)	0.23*** (2.76)	0.15
	4-years ahead	0.01 (1.35)	0.04 (1.64)	0.01
	9-years ahead	0.01** (2.11)	-0.01 (-0.33)	-0.01
Commodity Prices				
	Gold and Silver	0.15 (1.43)	2.87*** (4.41)	0.07
	Gold	0.12 (0.75)	2.55*** (2.77)	0.08
	Silver	0.17 (1.41)	3.19*** (3.99)	0.06

[1] Sample: 9/13/74-9/19/79. The sample includes 75 unexpected changes in the federal funds rate target over this period. For gold and silver stacked together there are 150 observations. t-statistics are in parentheses. Heteroscedasticity-consistent standard errors are used to calculate the t-statistics.
*** (**) [*] denotes significance at the 1% (5%) [10%] level.

Table 2
The Effect of Changes in the Federal Funds Rate Target on Interest Rates and Commodity Prices Over the 1989-2006 Sample Period[1]

	Dependent Variable	Constant	Change in federal funds rate target	Adjusted R-squared
Term Interest Rates				
	3-month Treasury	-0.02* (-1.84)	0.56*** (3.41)	0.36
	1-year Treasury	-0.02** (-2.29)	0.51*** (3.47)	0.38
	3-year Treasury	-0.01 (-0.66)	0.37*** (2.93)	0.21
	5-year Treasury	-0.01* (-1.24)	0.33*** (2.76)	0.14
One-Year Forward Rates				
	1-year ahead	-0.01 (-0.69)	0.32** (2.15)	0.14
	4-years ahead	-0.02 (-1.33)	0.13 (1.09)	0.03
	9-years ahead	-0.02* (-1.70)	-0.05 (-0.51)	0.00
Commodity Prices				
	Gold and Silver	0.07 (0.70)	-1.61** (-2.45)	0.02
	Gold	-0.06 (-0.12)	-1.91*** (-2.86)	0.06
	Silver	0.20 (0.17)	-1.31 (-1.03)	0.00

[1]Sample: 6/6/89-6/29/06. The sample includes 65 changes in the federal funds rate target over this period. For gold and silver stacked together there are 130 observations. t-statistics are in parentheses. Heteroscedasticity-consistent standard errors are used to calculate the t-statistics.
*** (**) [*] denotes significance at the 1% (5%) [10%] level.

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