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Research article

Uncertainty regarding the effectiveness of Federal Reserve monetary policies over time in the U.S.: an exploratory empirical assessment

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Abstract: In the present study, we empirically investigate the uncertainty of the effectiveness of *recent* monetary policies in lowering the real mortgage rate in the U.S. In particular, we have an eye towards determining whether the Fed's policies have been consistently effective or whether, instead, there is uncertainty regarding whether, when, and to what extent these policies achieve their ostensible goal of lowing the mortgage rate. Based upon empirical estimates of a loanable funds model, it is shown that the consistency of recent monetary policies, as reflected in the ratios of the M2 money supply to GDP and quantitative easing to GDP, has varied considerably between the study periods 1974–2009, 1974–2010, 1974–2011, 1974–2012, 1974–2013, 1974–2014, and 1974–2015, implying that there exists uncertainty regarding how consistent monetary policy effectiveness really is. This monetary policy uncertainty is even more apparent when the periods 1974–2008 and 1974–2016 are considered. Moreover, it is observed that elevated interest rate risk is a collateral effect of recent monetary policies. Interest rate risk seriously endangers the health of the macro-economy and throws future monetary policy effectiveness even further into question and yields further economic uncertainty.

Keywords: monetary policy in the U.S.; inconsistent policy outcomes; uncertain effects of monetary policy; fed funds rate; M2 money supply; quantitative easing

JEL Codes: E43, E52, E58

1. Introduction

The effectiveness of monetary policy has long been debated, with widely divergent views and assessments being expressed. This has especially been the case since the appearance of *The General*

Theory of Employment, Interest and Money by Keynes (1936). In more recent times, this debate can be seen taking the form of uncertainty regarding the effectiveness of monetary policy tools, including managing the money supply *per se* on the one hand and the undertaking of "quantitative easing (QE)" on the other hand, although certainly other debates about the usefulness and dependability of monetary policy in the U.S. could be explored. Indeed, beginning in November, 2008 and continuing for the next several years, the Federal Reserve in the U.S. used QE (supplemented by near zero lower bound, ZLB, interest rates with the Fed Funds rate) to drive down the interest rate yields and keep them very low during and subsequent to the Great Recession. The Fed implemented QE by purchasing MBSs (mortgage backed securities) and other longer term financial instruments and thereby, given the high degree of capital mobility among U.S. bond markets, was able to lower mortgage interest rates. Ostensibly, this policy had as its objective the stimulation of the real estate sector of the economy by lowering mortgage interest rates and thereby elevating the growth rate of real GDP. Further elaboration on quantitative easing is provided in the Section 2 of the text of this study.

In the current exploratory study, we empirically investigate the uncertainty of the effectiveness of recent monetary policies in lowering the real mortgage rate. In particular, we have an eye towards determining whether the Fed's policies, be it through changing the M2 money supply (expressed as a percent of GDP) per se using traditional tools or through quantitative easing perse, have been consistently effective or whether, instead, there is uncertainty regarding whether, when, and to what extent these policies achieve their ostensible goal of lowing the mortgage rate in different time periods. Based upon empirical estimates of a loanable funds model, it is shown that the consistency of recent monetary policies has indeed varied over time, implying that there does exists a genuine uncertainty regarding how dependable monetary policy effectiveness really is. Moreover, it is observed that elevated interest rate risk is a collateral effect of recent monetary policies, an effect that seriously endangers the usefulness of monetary policy in promoting the health of the macro-economy, a consideration that throws monetary policy effectiveness even further into question yet again.

Previous studies have also focused on monetary policy effectiveness and the uncertainty thereof for the U.S.; furthermore, they assume a variety of forms. For example, Wheeler and Chowdhury (1993) investigate the relationship between residential expenditure and macroeconomic activity, with the empirics involving the study period 1959–1991. Part of their results implies that shocks to nominal interest rates, output, and the money supply significantly impact residential expenditures. Vargas-Silva (2008) also considers the uncertainty of the impact of monetary policy on the housing market while imposing certain sign restrictions. Among the extensions of the Wheeler and Chowdhury (1993) and Vargas-Silva (2008) analyses found in the current study are the following: (1) the focus on ex post real rather than nominal interest rates, which enables us to address the issue of inflation directly; (2) the consideration of eight sub-periods for the years from 1974–2016, making the present study more current; and (3) the absence of arbitrary imposed sign restrictions. Moreover, the present study differs even more markedly from the compelling yet quite different analysis by Marfatia (2014), which focused upon stock market responses to Fed policy surprises, and the also rather different analysis also by Marfatia (2015), the focus of which was financial stress and risks in bond markets.

2. Model

In the U.S., "quantitative easing" (QE) took the form of three rounds of policy actions, QE (1), QE (2), and QE (3), such that QE was a monetary policy staple for effectively six full years, from 2009

through 2014. In November of 2008, the Fed announced that it was going to pursue QE (1), which principally involved Fed purchases of mortgage-backed securities, ultimately amounting to a total of approximately $1.75 trillion (Krippner, 2012; Wu and Xia, 2016). Further purchases were stopped in June, 2010, as the economy started to improve, but resumed again in August of 2010 when the Fed decided the economy was not growing robustly, with the Fed suggesting the possibility of a second stage of quantitative easing, i.e., QE (2). In November of 2010, the Fed announced a second round of quantitative easing, QE (2), which was to involve the purchase of some $600 billion worth of Treasury debt by the end of the second quarter of 2011. QE (2) was a response to the evaluation by the Fed that the U.S. economy was experiencing slowing economic growth (Krippner, 2012).

The third round of quantitative easing, QE (3), which was announced in September of 2012, initially involved the adoption of a $40 billion per month, open-ended bond purchasing program of agency mortgage-backed securities. Additionally, the Fed declared that it would probably keep the Fed Funds Rate (FFR) at near zero levels. During December of 2012, the FOMC (Federal Open Market Committee) announced an increase in the targeted volume of open-ended purchases from $40 billion to $85 billion per month. Finally, in June of 2013, the Fed openly declared the intention of cutting back on the degree of quantitative easing, suggesting that the Fed would reduce its monthly bond purchases and that the QE (3) policies could largely be terminated by the middle of 2014. The policy of quantitative easing technically came to an actual close by the end of October of 2014, with the Fed having accumulated a total of approximately $4.5 trillion in assets, a sum equal in magnitude to roughly one-fourth of the economy's GDP.

Wu and Xia (2016) observe that since December 2008, the federal funds rate has been very near zero. When zero rates had been found to be insufficient to eliminate the negative effects of the Great Recession, the Fed introduced the new recession-fighting tool, i.e., quantitative easing. Wu and Xia (2016) take the view that the impact of this new policy measure has made it difficult to determine what the exact overall stance of monetary policy is at any given moment in time. In an effort to clarify this issue, they develop the "Shadow Fed Funds Rate" concept, which was previously considered and discussed less formally by Krippner (2012). Their mathematically determined rate takes into account both the actual federal funds rate and the impact of QE, as well as other non-traditional policy tools, the objective being to establish a more accurate measure of the Fed's impact on the economy. In the present study, despite not having a shadow interest rate, we explicitly include three monetary policy tools: an explicit measure of the magnitude of quantitative easing (QE), scaled by GDP, the real fed funds rate, and the magnitude of the M2 money supply, scaled by GDP.

The three hypotheses being examined in this study, albeit at an exploratory level, are, as follows:

1. During the post-Bretton Woods era in the U.S., the ex post real mortgage rate had been a decreasing function of the M2 measure of the money supply, scaled by GDP, i.e., expressed as a percent of GDP (so that is can be judged relative to the size of the economy), M2/Y, ceteris paribus;
2. During the 2008–2014 portion of the post-Bretton Woods era in the U.S., the ex post real mortgage rate had been a decreasing function of the quantitative easing policies pursued by the Fed, where quantitative easing is expressed as a percent of GDP so that it can be judged relative to the size of the economy (QE/Y),[1] ceteris paribus. It is noteworthy of emphasis that, based on the history of quantitative easing provided below, that the effect of this policy approach is measured for the years 2008–2014.

[1] Scaling by GDP is needed for proper specification (Ostrosky, 1990; Ewing and Yanochik, 1999; Cebula, 2013, 2014).

3. The statistical significance of hypotheses 1 and 2 varies over time, which thereby implies uncertainty regarding the effectiveness of the monetary policy tools involved.

Predicated on the studies by Al-Saji (1993), Barth et al. (1985), Hoelscher (1986), as well as Zahid (1988), Cebula (2013, 2014), and Cebula et al. (2014), a loanable funds model is adopted in this study. In this context, the ex post real interest rate yield on new home mortgages in the U.S. is, assuming all other bond markets are in equilibrium, determined by (1).

$$D+MS/Y+QE/Y=S. \tag{1}$$

where D is private domestic demand for 30 year fixed-rate mortgages, MS/Y stands for the ratio of the money supply to the GDP level, QE/Y is the ratio of quantitative easing net purchases to the GDP level; and S represents the private sector supply of 30 year fixed-rate mortgages.

Based on the studies by Barth et al. (1985), as well as Hoelscher (1986), Zahid (1988), Cebula (2013, 2014) and Cebula et al. (2014), it is expected that:[2]
$D=D(EPRMORT, EPRBAA, EPRTF, UNR)$, and

$$D_{EPRMORT}>0, D_{EPRBAA}<0, D_{EPRTF}<0, D_{UNR}<0. \tag{2}$$

$S=S(EPRMORT, Y, EPRFFR)$, and

$$S_{EPRMORT}<0, S_Y>0, S_{EPRFFR}<0. \tag{3}$$

where $EPRMORT$ is the annual average *ex post real* interest rate yield on new 30 year fixed-rate home mortgages; $EPRBAA$ is the annual average *ex post real* interest rate yield on Moody's Baa-rated corporate bonds; $EPRTF$ stands for the annual average *ex post real* interest rate yield on high grade tax-exempt municipal bonds; UNR is the percentage civilian unemployment rate; Y is the annual percentage growth rate of real GDP; and $EPRFFR$ represents the *ex post* real Fed Funds Rate.

The value of any *ex post real* interest rate yield in this study is the nominal interest rate yield in question in year t minus the actual inflation rate P_t. The real Fed Funds Rate, $EPRFFR$, is treated as a *de facto* "control variable", along with $EPRBAA$, $EPRTF$, UNR and Y.

Substituting equations (2) and (3) into equation (1) and solving for $EPRMORT$ yields the fully expressed form of the model:

$$EPRMORT=g(M2/Y, EPRFFR, EPRBAA, EPRTE, QE/Y, UNR, Y). \tag{4}$$

where, based on the hypothesized partials from equations (2) and (3), as well as the mainstream literature as reflected in the studies by Barth et al. (1985), Hoelscher (1986), Findlay (1990), Johnson (1992), Gissey (1999), Gale and Orszag (2003), Swamy et al. (1990), Madura (2008), and Zahid (1988), it is hypothesized that:

$$g_{M2/Y}<0, g_{EPRFFR}<0, g_{EPRBAA}>0, g_{EPRTE}>0, g_{QE/Y}<0, g_{UNR}>0, g_Y<0. \tag{5}$$

[2] See also Findlay (1990), Johnson (1992), Gissey (1999), Gale and Orszag (2003), and Swamy et al. (1990).

3. Empirical results

Based on the model expressed in equation (4), the following equation is to be estimated by AR/2SLS:

$$EPRMORT_t = a_0 + a_1(M2/Y)_{t-1} + a_2 EPRFFR_{t-1} + a_3 EPRBAA_t + a_4 EPRTE_t +$$

$$a_5(QE/Y)_{t-1} + a_6 UNR_{t-1} + a_7 Y_{t-1} + a_8 INTERTFBAA_t + a_9 AR(1) + \varepsilon_t. \quad (6)$$

where $EPRMORT_t$ is *ex post* real interest rate yield on 30 year fixed-rate mortgages and expressed as a percent per annum; a_0 is a constant; $(M2/Y)_{t-1}$ is M2 money supply in year t as a percent of GDP in year t−1; $EPRFFR_{t-1}$ is real Fed Funds rate in year t−1 and expressed as a percent per annum; $EPRBAA_t$ is real interest rate yield on Moody's Baa-rated corporate bonds in year t, expressed as a percent per annum; $EPRTE_t$ stands for real interest rate yield on high grade tax-exempt municipal bonds in year t, expressed as a percent per annum; $(QE/Y)_{t-1}$ is the ratio of net QE acquisitions in year t−1 to the GDP in year t−1, expressed as a percent; UNR_{t-1} is the percentage unemployment rate of the civilian labor force in year t−1; Y_{t-1} is the percentage growth rate of real GDP in year t−1; $INTERTFBAA_t$ is interaction term between $EPRBAA_t$ and $EPRTE_t$, $AR(1)$ is autoregressive term; and ε_t is error term.

Interestingly, Belton and Cebula (1994, p. 461) observe that "Most time series studies show that there is a relationship between the state of the economy and electoral outcomes". Studies like those by Kiewiet (1983) and Grier (1991) have found compelling evidence suggestive of political monetary cycles, although Belton and Cebula (1994) did not find compelling evidence of a political monetary cycle. Consequently, in this study, the principal political cycle in the U.S. is acknowledged. In particular, the focus of one of the estimates involves a year that coincides with Presidential election cycles. Accordingly, the issue of monetary policy effectiveness in terms of the impacts of $(M2/Y)_{t-1}$, $(QE/Y)_{t-1}$, and $EPRFFR_{t-1}$ on $EPRMORT_t$ was estimated for the one post-Bretton Woods Presidential election study period that occurred during the midst of quantitative easing, namely: 2012. The temporal closeness of this Presidential election cycle to the other study periods considered here makes it suitable for comparison with the other estimation results. The choice of the AR/2SLS technique is based on the applicability of the $AR(1)$ process to volatile time series, such as interest rates, and the contemporaneous structure of the model, i.e., the presence of unlagged explanatory variables in the specification in equation (6). The instruments are the two-year lags of both the non-binary variables and the binary variables; in each estimate, a constant is added to the instrument list. Two stage least squares (2SLS) is a standard time series tool for addressing endogeneity and requires the identification and use of instrumental variables (Greene, 1997). The instruments for variables $EPRTE_t$ and $EPRBAA_t$ were the two-year lags of the real interest rate yield on three-month Treasury bills, $EPRTBR_{t-2}$, and the real interest rate yield on Moody's Aaa-rated corporate bonds, $EPRBAA_{t-2}$. The variables $EPRTE_t$ and $EPRTBR_{t-2}$ are highly correlated (r = 0.752) as are $EPRBAA_t$ and $EPRBAA_{t-2}$ (r = 0.991), whereas the instruments are uncorrelated with the error term.

The results for the initial seven study periods are provided in Tables 1–7, where, overall, the estimated coefficients exhibited the expected signs in nearly every case. In addition, the coefficients were significant at the 5% level or beyond for 27 out of 49 variables (excluding the interaction term) across the

seven estimations, with four more coming in as significant at the 10% level. However, it is the pattern of estimated coefficients for the three monetary policy variables identified in this study, namely, $(M2/Y)_{t-1}$, $(QE/Y)_{t-1}$, and $EPRFFR_{t-1}$, that is of central interest here. Interestingly, in all seven estimates (respectively, .16, .17, .17, .15, .17, .21, and .26, for Tables 1, 2, 3, 4, 5, 6, and 7), the inverted AR roots are indicative of a stationary autoregressive process, so that there are no significant concerns regarding non-stationarity. In addition, the *J*-statistics are all significant at the 10% or better, implying that the instrument choices are exogenous. The coefficients on the $EPRTE_t$ and $EPRBAA_t$ variables all exhibit the hypothesized signs, with all 14 being significant at the 5% level or beyond. The unemployment rate variable, UNR_{t-1}, has the expected sign in all seven estimates, while being significant at beyond the 5% level in four case and beyond the 10% level in a fifth case. Furthermore, in five of the seven estimates, the interaction terms, $INTERTFBAA_t$, is significant at the 10% level or better.

Of far more relevance are the results for the main monetary policy tool variables, as reflected in $(M2/Y)_{t-1}$ and $(QE/Y)_{t-1}$ (although the results for the Fed Funds rate variable may be of some interest). First, we take an overview of the results. For the 2009, 2010, and 2011 estimates, the coefficients on $(M2/Y)_{t-1}$ are negative, as hypothesized, and significant at the 5% level, whereas those for $(QE/Y)_{t-1}$ are also negative, as hypothesized, but significant at far beyond the 1% level. Regarding the 2012, 2013, and 2014, estimates, the $(M2/Y)_{t-1}$ coefficients are in all cases negative but not significant at the 5% level. However, for these same years, the quantitative easing coefficients, $(QE/Y)_{t-1}$, are all negative, with two being significant at far beyond the 1% level, one being significant at the 5% level. Finally, for the 2015 estimate, neither of these two monetary policy tools was significant at the 5% level. It can be inferred that there were no dramatic changes in monetary policy effectiveness in the transition from QE (1) to QE (2); however, there appears to have been a degradation in the effectiveness of monetary policy in the QE (2) to QE (3) transition.

Table 1. AR/2SLS estimate, 1974–2009.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$EPRFFR_{t-1}$	0.242685	0.076150	3.186927	0.0037
$EPRBAA_t$	0.526917	0.153219	3.438985	0.0020
$(M2/Y)_{t-1}$	−0.043380	0.020923	−2.073272	0.0482
a_0	2.193953	1.217753	1.801641	0.0832
$(QE/Y)_{t-1}$	−0.011524	0.001621	−7.108601	0.0000
UNR_{t-1}	0.166389	0.089903	1.850765	0.0756
$INTERTFBAA_t$	0.012564	0.011488	1.093584	0.2842
Y_{t-1}	0.004229	0.049873	0.084787	0.9331
$EPRTE_t$	0.058348	0.053904	1.082440	0.2890
$AR(1)$	0.156176	0.283604	0.550683	0.5866
R-squared	0.979495	Adjusted R-squared		0.972397

4. A more detailed look

As shown in Table 1 for the study period through 2009, the variable $(M2/Y)_{t-1,}$ which may be viewed as reflecting the exercise of "standard" monetary policy insofar as it reflects the traditional

use of reserve requirement changes (which while typically limited did in fact occasionally assume large proportions, such as in 1992), and net open market operations involving principally Treasury debt issues, is negative and significant at the 5% level, which attests to the effectiveness of standard monetary policy. Interestingly, real Fed Funds rate changes were also effective in influencing the real mortgage rate. Moreover, the effectiveness as well of quantitative easing is also affirmed by the significant (1% level) coefficient on $(QE/Y)_{t-1}$.

Refer now to Tables 2 and 3. In each of these cases, the coefficients on both $(M2/Y)_{t-1}$ and $(QE/Y)_{t-1}$ are negative and significant; the real Fed Funds rate also is significant. This implies that traditional monetary policy, including the real Fed Funds rate, supplemented by quantitative easing were both effective in lowering interest rates. Clearly, the lowering of interest rate was consistent with the goal of attempting to stimulate the economy as a whole through, in this case, the stimulating of the housing market. Moreover, the significance of these tools appears to have been instrumental in helping to end the Great Recession in the U.S.

Table 2. AR/2SLS estimate, 1974–2010.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$EPRFFR_{t-1}$	0.265525	0.085344	3.111239	0.0044
$EPRBAA_t$	0.493829	0.166479	2.966317	0.0062
$(M2/Y)_{t-1}$	−0.048099	0.020966	−2.294112	0.0298
a_0	2.391504	1.171081	2.042134	0.0510
$(QE/Y)_{t-1}$	−0.009269	0.001509	−6.141362	0.0000
UNR_{t-1}	0.194999	0.087567	2.226845	0.0345
$INTERTFBAA_t$	0.015268	0.012338	1.237460	0.2266
Y_{t-1}	−0.002198	0.050860	−0.043216	0.9658
$EPRTE_t$	0.043055	0.046351	0.928901	0.3612
$AR(1)$	0.166308	0.260677	0.637986	0.5289
R-squared	0.978334	Adjusted R-squared		0.971112

Table 3. AR/2SLS estimate, 1974–2011.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$EPRFFR_{t-1}$	0.256620	0.082335	3.116796	0.0042
$EPRBAA_t$	0.500129	0.161014	3.106123	0.0043
$(M2/Y)_{t-1}$	−0.047726	0.020940	−2.279111	0.0305
a_0	2.446073	1.127378	2.169700	0.0387
$(QE/Y)_{t-1}$	−0.010001	0.001496	−6.684307	0.0000
UNR_{t-1}	0.181655	0.077646	2.339539	0.0267
$INTERTFBAA_t$	0.016480	0.011555	1.426214	0.1649
Y_{t-1}	−0.010991	0.040640	−0.270448	0.7888
$EPRTE_t$	0.040970	0.043061	0.951443	0.3495
$AR(1)$	0.167736	0.235949	0.710897	0.4830
R-squared	0.978359	Adjusted R-squared		0.971403

Table 4. AR/2SLS estimate, 1974–2012.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$EPRFFR_{t-1}$	0.255866	0.080320	3.185589	0.0034
$EPRBAA_t$	0.518056	0.155977	3.321361	0.0024
$(M2/Y)_{t-1}$	−0.041241	0.020365	−2.025072	0.0522
a_0	2.063620	1.144013	1.803843	0.0817
$(QE/Y)_{t-1}$	−0.008266	0.001764	−4.684674	0.0001
UNR_{t-1}	0.169641	0.075053	2.260278	0.0315
$INTERTFBAA_t$	0.015290	0.010998	1.390261	0.1750
Y_{t-1}	0.002302	0.041798	0.055074	0.9565
$EPRTE_t$	0.033359	0.046104	0.723565	0.4751
$AR(1)$	0.152059	0.244189	0.622712	0.5383
R-squared	0.978678	Adjusted R-squared		0.972061

However, as shown in Tables 4 and 5, for 2012 and 2013, although quantitative easing was still effective [the coefficient on $(QE/Y)_{t-1}$ is negative and significant at the 1% level], the coefficient on standard monetary policy, $(M2/Y)_{t-1}$, fails to be significant at the 5% level, although the real Fed Funds rate retains its statistical significance. Thus, standard monetary policy (other than the Fed Funds tool) lost its effectiveness following 2012, which no doubt was reflected by the lackluster economic growth following the Great Recession, although huge federal budget deficits may have confounded monetary policy during this time period (Council of Economic Advisors, 2018). That, of course, is a subject beyond the scope of this paper.

Table 5. AR/2SLS estimate, 1974–2013.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$EPRFFR_{t-1}$	0.272010	0.082554	3.294950	0.0025
$EPRBAA_t$	0.509641	0.154071	3.307842	0.0024
$(M2/Y)_{t-1}$	−0.033990	0.019446	−1.747951	0.0907
a_0	1.746964	1.166281	1.497893	0.1446
$(QE/Y)_{t-1}$	−0.007525	0.001944	−3.871175	0.0005
UNR_{t-1}	0.155423	0.075074	2.070280	0.0471
$INTERTFBAA_t$	0.015048	0.011216	1.341640	0.1898
Y_{t-1}	0.006864	0.042869	0.160124	0.8739
$EPRTE_t$	0.032618	0.045051	0.724021	0.4747
$AR(1)$	0.171793	0.245156	0.700748	0.4889
R-squared	0.978753	Adjusted R-squared		0.972378

Moreover, of greater concern, as shown in Tables 6 and 7 for the study period through 2014 and 2015, the $(M2/Y)_{t-1}$ dimension of monetary policy failed to be a statistically significant policy tool, although the real Fed Funds rate is still impactful. And whereas the quantitative easing policy,

$(QE/Y)_{t-1}$, was marginally significant in the 2014 estimate, it ceases to exercise statistical significance the next year. The huge federal budget deficit during this period may in part have accounted for this, although that still remains to be determined.

Table 6. AR/2SLS estimate, 1974–2014.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$EPRFFR_{t-1}$	0.281562	0.088738	3.172947	0.0034
$EPRBAA_t$	0.505189	0.146914	3.438678	0.0017
$(M2/Y)_{t-1}$	−0.021199	0.022026	−0.962420	0.3433
a_0	1.276702	1.356297	0.941315	0.3538
$(QE/Y)_{t-1}$	−0.005491	0.002616	−2.098944	0.0441
UNR_{t-1}	0.113766	0.077626	1.465574	0.1528
$INTERTFBAA_t$	0.014673	0.011444	1.282201	0.2093
Y_{t-1}	0.007753	0.043504	0.178211	0.8597
$EPRTE_t$	0.040481	0.048135	0.840987	0.4068
$AR(1)$	0.210005	0.263575	0.796758	0.4317
R-squared	0.976270	Adjusted R-squared		0.969380

Table 7. AR/2SLS estimate, 1974–2015.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$EPRFFR_{t-1}$	0.296336	0.100143	2.959139	0.0058
$EPRBAA_t$	0.491993	0.140657	3.497832	0.0014
$(M2/Y)_{t-1}$	−0.013470	0.023900	−0.563612	0.5769
a_0	1.047184	1.448897	0.722746	0.4751
$(QE/Y)_{t-1}$	−0.004510	0.002636	−1.711303	0.0967
UNR_{t-1}	0.084563	0.077390	1.092689	0.2827
$INTERTFBAA_t$	0.014763	0.011388	1.296375	0.2041
Y_{t-1}	0.006840	0.043756	0.156332	0.8768
$EPRTE_t$	0.046333	0.049661	0.932997	0.3578
$AR(1)$	0.262996	0.258212	1.018530	0.3161
R-squared	0.975443	Adjusted R-squared		0.968537

It may be of value to consider the estimate of the model for the period 1974–2008, an entirely pre-QE and pre-Great Recession period, and for the period 1974–2016, a clearly post-Great Recession and post-QE period, with the emphasis focused on the traditionally characterized core tools of U.S. monetary policy as reflected in the $(M2/Y)_{t-1}$ measure of standard monetary policy actions, i.e., reserve requirement changes and net open market purchases of principally U.S. Treasury securities. These results are provided in Tables 8 and 9, respectively. In Table 8, the monetary policy variable is statistically significant at *only* the 10% level and hence would clearly not be characterized as being effective in lowering the real mortgage rate. By contrast, in Table 9, the monetary policy

variable is shown to be negative and significant at the 1% level, making the measure of traditional monetary policy tool usage appear to be much more effective.

Table 8. Estimation for the period prior to quantitative easing with *EPRFFR* omitted, 1974–2008.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$EPRTE_t$	0.259659	0.113436	2.289041	0.0301
$EPRBAA_t$	0.526015	0.174296	3.017943	0.0055
$(M2/Y)_{t-1}$	−0.043399	0.024920	−1.741508	0.0930
a_0	2.176506	1.223829	1.778440	0.0866
$(QE/Y)_{t-1}$	NA	NA	NA	NA
UNR_{t-1}	0.162084	0.102110	1.587350	0.1241
$INTERTFBAA_t$	0.017928	0.014493	0.237044	0.2267
Y_{t-1}	0.007872	0.052980	0.148589	0.8830
AR(1)	0.188493	0.206142	0.914383	0.3686
R-squared	0.977876	Adjusted R-squared		0.972141

Table 9. Estimation for the Period Following QE with *EPRFFR* Omitted, 1974–2016.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$EPRTE_t$	0.150449	0.086167	1.746013	0.0896
$EPRBAA_t$	0.619463	0.104494	5.928207	0.0000
$(M2/Y)_{t-1}$	−0.052562	0.015356	−3.422804	0.0016
a_0	2.796344	1.257992	2.222862	0.0328
$(QE/Y)_{t-1}$	NA	NA	NA	NA
UNR_{t-1}	0.073416	0.096006	0.764703	0.4496
$INTERTFBAA_t$	0.025054	0.013178	1.901226	0.0655
Y_{t-1}	−0.001892	0.047950	−0.07371	0.9704
AR(1)	0.374969	0.180565	2.076639	0.0452
R-squared	0.969373	Adjusted R-squared		0.963248

5. Conclusion

Thus, considering the nine time periods studied, the effectiveness of monetary policy would seem to range from ineffective to somewhat effective all the way across the spectrum to very effective. Sadly, however, since it is not *a priori* known whether monetary policy is going to prove to be ineffective or only somewhat effective or is going to be very effective in any given time frame, the usefulness/efficacy of monetary policy is suspect due to the "uncertainty" in the results from using each form of policy instrument

The empirical findings summarized in Tables 1–9 establish a reasonable basis for inferring that there exists, at least for the U.S., a non-trivial degree of uncertainty in terms of the effectiveness of

Federal Reserve monetary policies.[3] Arguably, however, the assessment of monetary policy effectiveness uncertainty has a more complex side to it once monetary policy impacts are placed within a non-myopic context, i.e., from a broader perspective, such as the growth rate of real GDP, i.e., the economy as a whole or the perspective of interest rate risk in the bond markets.

To illustrate, the estimates in the present study find that monetary policy (albeit in highly varying degrees) often can be an effective policy tool in terms of reducing the real mortgage rate, ostensibly to stimulate the housing industry and stimulate aggregate economic growth. However, the across-the-board *side effects* of the monetary policies undertaken since 2008 include the lowering of real and nominal interest rates of all maturities to levels not experienced in decades in the U.S. (Council of Economic Advisors, 2004, Table B-73; 2018, Table B-25). With interest rates having been reduced to such extremely low levels, bond prices rose to commensurately higher levels. A major problem with monetary policy now has become one involving immense interest rate risk for bond holders as well as prospective bond holders, be they households, financial institutions, non-financial firms, pension funds, labor unions, and so forth. Any increase in the interest rate acts to diminish the net worth of these bond holders. These negative wealth effects tend to discourage both consumer purchases and firm investment in new plant and equipment. In other words, *future* recession probabilities have been increased by the very same monetary policies of recent years that were aimed at stimulating economic growth. Moreover, uncertainty and speculation regarding when and to what extent the Fed will be raising the Fed Funds Rate complicates monetary policy effectiveness and causes a host of other ramifications, including stock market and bond market volatility increases. And these observations trace just one vector (out of many) of outcomes deriving from recent monetary policies. "Uncertain" does indeed seem an apt description of U.S. monetary policy effects as well as monetary policy effectiveness.[4]

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Conflict of interest

The authors declare no conflict of interest.

References

Al-Saji A (1993) Government budget deficits, nominal and ex ante real long term interest rates in the U.K., 1960.1–1990.2. *Atl Econ J* 21: 71–77.

Barth JR (1991) *The great savings and loan debacle*, Washington, D.C.: AEI Press.

Barth JR, Iden G, Russek FS (1985) Federal borrowing and short term interest rates: Comment. *South Econ J* 52: 554–559.

[3] Interestingly, these results do not provide evidence suggesting the existence of a political business cycle, paralleling the earlier finding in Belton and Cebula (1994).

[4] Moreover, future research should endeavor to account for the effects of banking statutes (Robinson, 1980; Barth, 1991; Grier, 1991; Madura, 2008).

Belton W, Cebula RJ (1994) Does the Federal Reserve create political monetary cycles? *J Macroecon* 16: 461–479.

Breusch TS, Pagan AR (1979) A simple test for heteroscedasticity and random coefficient variation. *Econometrica* 47: 1287–1294.

Carlson KM, Spencer RW (1975) Crowding out and its critics. *Fed Reserve Bank St Louis Rev* 57: 1–19.

Cebula RJ (1997) An empirical note on the impact of the federal budget deficit on ex ante real long-term interest rates, 1973–1995. *South Econ J* 63: 1094–1099.

Cebula RJ (2013) An exploratory inquiry into the impact of budget deficits on the nominal interest rate yield on Moody's Aaa-rated corporate bonds. *Appl Econ Lett* 20: 1497–1500.

Cebula RJ (2014) Impact of federal government budget deficits on the longer-term ex post real interest rate in the U.S.: Evidence using annual and quarterly data, 1960–2013. *Appl Econ Q* 60: 23–40.

Cebula RJ, Angjellari-Dajci F, Foley M (2014) An exploratory empirical inquiry into the impact of federal budget deficits on the expost real interest rate yield on ten-year Treasury notes over the last half century. *J Econ Financ* 38: 712–720.

Choi DFS, Holmes MJ (2014) Budget deficits and real interest rates: a regime-switching reflection on Ricardian Equivalence. *J Econ Financ* 38: 71–83.

Council of Economic Advisors (2004) *Economic report of the president, 2004.* Washington, D.C: U.S. Government Printing Office.

Council of Economic Advisors (2018) *Economic report of the president, 2018.* Washington, D.C: U.S. Government Printing Office.

Ewing BT, Yanochik MA (1999) Budget deficits and the term structure of interest rates in Italy. *Appl Econ Lett* 6: 199–201.

Federal Reserve Bank of St. Louis (2017) Economic research. Available from: https://www.fred.stlouisfed.org/.

Federal Reserve Bank of St. Louis (1980) "Statement by Paul Volker before the Subcommittee on Domestic Monetary Policy of the Committee on Banking & Urban Affairs, House of Representatives".

Findlay DW (1990) Budget deficits, expected inflation, and short-term real interest rates. *Int Econ J* 4: 41–53.

Gale WG, Orszag PR (2003) Economic effects of sustained budget deficits. *Nat Tax J* 49: 151–164.

Gissey W (1999) Net Treasury borrowing and interest rate changes. *J Econ Financ* 23: 211–219.

Greene WH (1997) *Econometric Analysis*, Upper saddle River, NJ: Prentice-Hall, Inc.

Grier K (1991) Congressional influence on U.S. monetary policy. *J Monetary Econ* 25: 201–220.

Hoelscher G (1986) New evidence on deficits and interest rates. *J Money Credit Bank* 18: 1–17.

Johnson CF (1992) An empirical note on interest rate equations. *Q Rev Econ Financ* 32: 141–147.

Keynes JM (1936) *The general theory of employment, interest, and money*, London: Palgrave Macmillan.

Kiewiet DR (1983) *Macroeconomics and micropolitics*, Chicago: University of Chicago Press.

Krippner L (2012) A model for interest rates near the zero lower bound: An overview and discussion. Reserve Bank of New Zealand Working paper Series.

Madura J (2008) *Financial markets and institutions*, 8th ed. Mason, OH: Thomson Higher Education.

Marfatia HA (2014) Impact of uncertainty on high frequency response of the U.S. stock markets to the Fed's policy surprises. *Q Rev Econ Financ* 54: 382–392.

Marfatia HA (2015) Monetary policy's time-varying impact on U.S. bond markets: Role of financial stress and risks. *N Am Econ Financ* 34: 103–123.

Newey WK, West KD (1987) A simple positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. *Econometric*a 55: 703–708.

Ostrosky AL (1990) Federal budget deficits and interest rates: Comment. *South Econ J* 56: 802–803.

Robinson KJ (1980) Depository Institutions Deregulation and Monetary Control Act of 1980. *Fed Reserve Bull* 66: 444–453.

Saltz IS (1998) Exante real long-term interest rates and U.S. federal budget deficits: Preliminary error-correction evidence, 1971–1991. *Econ Int* 51: 163–169.

Swamy PAVB, Kolluri BR, Singamsetti RN (1990) What do regressions of interest rates ondeficits imply? *South Econ J* 56: 1010–1028.

Vargas-Silva C (2008) Monetary policy and the U.S. housing market: A VAR analysis imposing sign restrictions. *J Macroecon* 30: 990–997.

Wheeler M, Chowdhury A (1993) The housing market, macroeconomic activity and financial Innovation: An empirical analysis. *Appl Econ* 25: 1385–1392.

Wu IC, Xia FD (2016) Measuring the macroeconomic impact of monetary policy at the zero lower bound. *J Money Credit Bank* 48: 234–248.

Zahid K (1988) Government budget deficits and interest rates: The evidence since 1971 using alternative deficit measures. *South Econ J* 54: 725–731.

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