Assessing The Role of Systematic Monetary Policy*

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Abstract

Identifying exogenous monetary policy shocks is the most popular approach used to estimate the causal effects of monetary policy. However, monetary policy is increasingly being conducted in a systematic manner making these shocks rare and their identification difficult. In this paper we focus directly on the systematic component of monetary policy decisions. Using a variety of non-monetary shocks from the empirical macroeconomic literature, we perform a counterfactual analysis in an identified vector autoregression to document the role that monetary policy plays in the propagation of these shocks. We find that monetary policy reaction has differential effects on shock propagation with sizeable mitigating effects on news shocks (especially news about future tax changes) but not much effect on technology shocks.

Keywords: Systematic Monetary Policy, Macroeconomic Shocks

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1 Introduction

Research on evaluating the effects of monetary policy has focused on the identification of monetary policy shocks. This focus has been motivated by the fact that to capture the casual effect of monetary policy on the economy, one must identify exogenous variation in monetary policy. Moreover, until recently this large literature using identified monetary policy shocks appeared to have converged to an agreement on the effects of monetary policy on economic activity, see Romer and Romer (2004), Christiano, Eichenbaum, and Evans (1999), Coibion (2012) and Gertler and Karadi (2015).

However, research in the past few years has found results that appear to question the validity of this consensus, at least in the more recent sample.[1] For example, these studies have found expansionary effects of a "contractionary" monetary policy shock (i.e. a shock that unexpectedly raises interest rates). In a recent survey of shocks in the Handbook of Macroeconomics, Ramey (2016) provides one suggestion for these surprising results. She posits that monetary policy is being conducted in a more systematic manner and thus the occurrence of monetary policy shocks is more rare in the past few decades. We confirm this idea using a simple VAR by showing that the variation of economic activity explained by monetary policy shocks has declined since the start of the great moderation in the early 1980s. Thus if monetary policy is to matter for economic activity, and monetary policy shocks have become less important then it must be the case that the systematic (or endogenous) component of monetary policy is important.

In this paper we focus on studying the systematic component of monetary policy. We start with the observation that if monetary policy shocks are not the main drivers of economic activity then other non-monetary shocks must be important. Thus our analysis will hinge on finding reliable measures of non-monetary shocks from the large empirical macroeconomic literature on identified structural shocks. Fortunately, in recent work Ramey (2016) conducts an excellent survey of shocks and finds an improved understanding in the macro literature of the shocks that are important in explaining the variation of economic activity. Based on this paper's recommendation, for our baseline results in this paper we consider six shocks that are found to be the main drivers of economic activity. These include news shocks about government spending and tax changes, unanticipated tax shocks, medium-horizon restriction total

[1] See for example Barakchian and Crowe (2013), Nakamura and Steinsson (2015), Campbell, Fisher, Justiniano, and Melosi (2016) and Lakdawala (2017)

factor productivity shocks, news about investment specific technology shocks and a marginal efficiency of investment shock.

The main contribution of this paper is to document the role of monetary policy in affecting the propagation of the important non-monetary shocks hitting the economy. We perform our analysis in an identified VAR setting with a little bit of structure. Specifically, we use the framework of Bernanke, Gertler, and Watson (1997) to construct a counterfactual exercise that computes the effects of the non-monetary shocks in the hypothetical scenario of "shutting off" the monetary policy response. In other words the question we explore is the following: how would the economy react if monetary policy were non-reactive to economic shocks?

We consider a standard monetary VAR with macroeconomic variables and financial market variables. To this VAR we add two measure of longer-term interest rates to capture the term structure of interest rates. The key assumption, following the Bernanke, Gertler, and Watson (1997) framework, is that monetary policy affects only affects the economy through its effect on the term structure. This assumption in addition with the breakdown of the long term interest rates into an expectation component and term premium component allows us to compute our desired counterfactual exercise. This counterfactual builds on the earlier work of Sims and Zha (2006) by partially accounting for the Lucas critque. This is done by allowing the financial markets to correctly anticipate our counterfactual policy of shutting off the federal funds rate response.

We find an important role of the monetary policy reaction in the propagation of the non-monetary shocks. The counterfactual responses of output, hours and prices lie outside the confidence intervals from the baseline case. For the shocks that we consider in the baseline case we find that generally the direction of the counterfactual responses means that monetary policy is acting to mitigate the effects of these shocks on the economy. But there are important differences in the quantitative effect of monetary policy reaction on the shocks. The biggest effect of shutting off monetary policy is observed in response to the shock that captures news about future tax changes. After 5 years, output and hours would be more than 10% higher (prices would be 3% higher) if the fed funds rate had not been increased in response to a news about future tax cuts. The smallest effect of monetary policy is on the total factor productivity shock. In this case the difference between the cumulated counterfactual and baseline impulse responses never goes above 0.5%. The importance of monetary policy for the other four shocks lies in between these two extremes. Our results suggest that the effect of monetary policy is state-dependent, being critically influenced by the particular sequence of shocks hitting the economy.

2 Estimated Effects of Monetary Policy Shocks from a simple VAR

We start by documenting the estimated effects of monetary policy shocks from a simple VAR. The main point of this section is to show how the estimated impulse responses and forecast variance decomposition owing to monetary policy shocks have changed in the post great moderation sample.

We consider a quarterly VAR with the following macroeconomic variables: real per capita GDP, per capita total hours, the GDP deflator, the federal funds rate and commodity prices. All the variables enter the VAR in log form expect for the federal funds rate which is expressed in levels. The VAR has four lags and we include both a linear and quadratic time trend. The monetary policy shock is identified using a recursive assumption that is common in the literature with the ordering of the variable as specified above. Thus the federal funds rate can react to the all the macro variables contemporaneously except for commodity prices. Moreover all the variables other commodity prices react with a lag to changes in the federal funds rate.

Figure 1 shows the impulse responses to a contractionary one standard deviation monetary policy shock from this simple VAR. The blue lines show the responses for the full sample that goes from 1954Q3 to 2005Q4, with the corresponding blue shaded region showing the 90% bootstrapped confidence intervals. Output and hours have a hump-shaped response, with the peak fall occurring roughly two and half years after the shock. Prices are mostly flat in response (showing a slight price puzzle) before displaying a more protracted fall after two years. These results are consistent with the consensus that had emerged from both the VAR literature (see for example CEE 1999) and the DSGE literature (see for example SW).

However, as we can see from the red lines, the results are quite different when we focus on the more recent part of the sample. The red line shows the responses restricting the sample from 1984Q3 to 2005Q4. These sample dates are picked to correspond to the "great moderation" period of low macroeconomic volatility. The red lines show a remarkably different response of economic activity. Output and hours display a much smaller but immediate fall in response that peaks much sooner (around a year and half). But by around the 2 and a half year mark the response of both output and hours turns positive. The GDP deflator response is essentially flat for the entire duration and commodity prices actually rise in response this contractionary monetary policy shock. Note that the standard deviation of the estimated shock is lower in this sample, consistent with this being the great moderation sample. Thus a one standard deviation monetary policy shock results in roughly 25 basis point increase in the federal funds rate, whereas the full sample estimates imply a almost a 75 basis point rise in the federal funds rate. Importantly, this difference in the scale of the shock is not the only difference in the estimated responses. Specifically the shape of the responses are distinctly different as can be seen most easily from the response of output and hours.

Table 1 shows the forecast error variance decomposition of output and hours that is attributable to the monetary policy shock for the two samples considered above. We see that in the more recent sample the importance of monetary policy shocks in explaining the variation in output and hours is dramatically lower. For output, at the 12 quarter horizon, monetary policy shocks explain only 5% of variation in the recent sample relative to 16% in the full sample estimates. For hours this drops to 3% for the recent sample compared to 23% in the full sample. Clearly, monetary policy shocks matter less for explaining variation in economic activity. This low forecast error variance attributed to the monetary policy shock is not necessarily an indictment of the identified monetary policy shocks literature. As pointed out by Ramey, the search for identified monetary policy shocks is more akin to a search for instruments. Thus the lower forecast error variance is only a concern insofar as it may lead to a weak instruments problem. What is concerning, however, is that the effects of these monetary policy shocks tend to give results in the latest sample that are not consistent with the leading structural macroeconomic models. In light of this point, the lower share of variation in economic activity explained raises a concern about whether we are correctly identifying monetary policy shocks. Overall, this forms a major motivating point for the analysis in this paper. In this paper we take the view that it is worth spending more time trying to analyze the effects of systematic monetary policy. A natural implication of lower share of economic activity explained by monetary policy shocks, is that other shocks are important for driving economic activity. Thus, it seems natural to ask how systematic monetary policy has contributed to the propagation of these other non-monetary shocks.

3 The Baseline Model

How much does monetary policy contribute to the response of economic activity to shocks? This is the main question taken up in this paper. In this section we provide an answer to this question using a counterfactual analysis. We compare the impulse response, forecast error variance decomposition and historical decomposition results from a baseline VAR specification to a counterfactual scenario that "turns off" the response of monetary policy. In other words, how would the economy react if monetary policy were non-reactive to economic shocks? In section 4 we provide details about this counterfactual analysis including how we make the counterfactual exercise consistent with market expectations from the model following the approach of BGW. In this section we first discuss the setup of the baseline model we use in the analysis, the various measures of macroeconomic shocks and some results from this baseline model.

We consider a quarterly VAR with the following macroeconomic variables: real per capita GDP, per capita total hours, commodity prices and the GDP deflator. All these variables enter the VAR in log form. We also include three measures of interest rates: the fed funds rate, 3 month Treasury bill rate and the 10 year Treasury bond rate, all expressed in levels. We will also include various different measures of identified shocks as explained in detail in section 3.1 below. The VAR has four lags and we include a linear and quadratic time trend. The specification of this VAR differs in one important way from an unrestricted VAR as we explain below.

Let Y_t represent the macroeconomic variables and the exogenous shocks. Let FF_t represent the federal funds rate and $R_t = \left[R_t^s, R_t^l\right]$ represent the longer-term market interest rates, we will use the 3 month (R_t^s) and the 10 year (R_t^l) Treasury bond rates.

$$Y_t = \sum_{i=1}^{p} (\pi_{yy,i} Y_{t-i} + \pi_{yr,i} R_{t-i}) + G_{yy}\varepsilon_{y,t} \tag{3.1}$$

$$FF_t = \sum_{i=1}^{p} (\pi_{fy,i} Y_{t-i} + \pi_{fr,i} R_{t-i} + \pi_{ff,i} FF_{t-i}) + \varepsilon_{ff,t} + G_{f,y}\varepsilon_{y,t} \tag{3.2}$$

$$R_t = \sum_{i=1}^{p} (\pi_{ry,i} Y_{t-i} + \pi_{rr,i} R_{t-i} + \pi_{rf,i} FF_{t-i}) + \varepsilon_{r,t} + G_{ry}\varepsilon_{y,t} + G_{rf}\varepsilon_{ff,t} \tag{3.3}$$

A noteworthy assumption is that the lags of the federal funds rate do not appear on the right hand side of the macro variables. This implies that any effect that monetary policy has on economic activity must work through the term structure of interest rates, i.e. through the indirect effect of FF_t on R_t. There may be other channels through which a change in the interest rate can affect economic activity, in which case our setup would be a conservative estimate of the total effect of monetary policy. First, the shock measures are constructed to be exogenous, thus ordering them above the macro variables is consistent with their construction, since we would not expect macro variables to contemporaneously affect the shocks. The ordering only matters for the macro variables in the system, but we show that changing the order of the macro variables in the system does not affect the results.

3.1 Macroeconomic Shocks In section 2 we documented the small role that monetary policy shocks play in explaining fluctuations of economic activity. Thus if we think that monetary policy can have non-negligible effects on the economy, then it must be due to the systematic (or endogenous) component of monetary policy. In other words, the reaction of monetary policy to other non-monetary policy shocks is important. In this section we provide details on the different non-monetary policy shock measures we use in the analysis.

Since the main focus of this paper is not on the identification of the various non-monetary policy shock measures, we will rely on the vast literature on identified shocks. Specifically, we use the shock measures discussed in the recent survey of macroeconomic shocks by Ramey (2016). Ramey characterizes the non-monetary policy shocks broadly into the two categories of fiscal policy shocks and technology shocks. Within the fiscal shocks category are both government spending and tax shocks. Within the technology shocks category are neutral and investment specific technology shocks. Moreover for both the fiscal and technology shocks categories include news shocks that contain information about future changes in fiscal policy or technological innovation. For the main analysis in this paper we use the six specific shocks that Ramey outlines as being the most important in section 7 of the paper. They are as follows: i) bzp-gov: military news shock from Ben Zeev and Pappa (2017) ii) lrw: news shock about future tax changes from Leeper, Richter, and Walker (2012), iii) rrtaxu: unanticipated tax shock from Romer and Romer (2010), iv) ford-tfp: total factor productivity shock from Francis, Owyang, Roush, and DiCecio (2014), v) bzk-ist-news: investment specific technology news shock from Ben Zeev and Khan (2015) and vi) jpt-mei: marginal efficiency of investment shock from Justiniano, Primiceri, and Tambalotti (2011).

Ben Zeev and Pappa (2017) follow the strategy of Barsky and Sims (2011) to identify news shocks to defense spending that best explains future movements in defense spending over a horizon of 5 years but is uncorrelated to current defense spending. Leeper, Richter, and Walker (2012) use information from bond prices to identify their news shock. They rely on the assumption that the spread between treasury bonds and tax-exempt municipal bonds should contain information about expected future changes in tax rates. Romer and Romer (2010) use a narrative approach to identify tax shocks from presidential speeches and congressional reports. We use only the unanticipated component of their measure as constructed by Mertens and Ravn (2012) who separate the Romer and Romer (2010) shocks based on the delay between the passing of the legislation and the implementation of the legislation. Francis, Owyang, Roush, and DiCecio (2014) identify a total factor productivity shock as the shock that maximizes the forecast error variance share of labor productivity at medium-horizons. Ben Zeev and Khan (2015) identify news shock about investment specific technological changes using the the Barsky and Sims (2011) approach together with Fisher (2006)'s relationship between the relative price of investment goods and the investment specific technological changes. Finally, the Justiniano, Primiceri, and Tambalotti (2011) marginal efficiency of investment shock is estimated from a structural DSGE model. This shock is supposed to represent disturbances to the process by which idle investment goods are turned into capital ready for production or in other words the rate of transformation between investment goods and installed capital. Table 2 provides the correlation structure for these six shocks. As we would expect the correlation between the various shocks is cloze to zero. Overall, this is clearly not an exhaustive list and leaves out some important categories of shocks such as oil shocks, credit shocks, labor supply shocks and uncertainty shocks. We leave these extensions for future research.

3.2 Results from the baseline model

Overall, our baseline VAR is similar to the one considered in section 7 of Ramey with two differences. First, we add the 3 month and 10 year bond rates to the VAR. Second, the fed funds rate is not allowed to affect the macro variables directly, but can only affect it through these two market interest rates. Both these modeling choices are made to aid in the counterfactual analysis that we discuss below. We now discuss some results from this baseline VAR.

3.2.1 Impulse Response Analysis

For the impulse response analysis we add the shocks one at a time in the VAR. This is done to control the number of parameters in the VAR from growing too much. However, we have checked that the impulse responses to the shocks are very fairly similar if we include all the shocks in the VAR at the same time. The impulse responses to a one standard deviation shock are presented in figure 2. The responses of economic activity to the siz shocks are similar to that reported in the original papers and as more recently reported in Ramey (2016).

The response of the economy to the two shocks that capture news about fiscal policy (the bzp-gov news about government spending shock from Ben Zeev and Pappa (2017) and the lrw news about tax changes from Leeper, Richter, and Walker (2012)) is similar. Output and hours start rising when news arrives at period 0 that fiscal policy will change in the future. Prices start rising slowly and peak several quarters after the shock. In response to the unantcipated tax increase (rrtaxu of Romer and Romer (2010)), output and hours falls significantly on impact and slowly come back to normal after around 3 years. The ford-tfp shock of Francis, Owyang, Roush, and DiCecio (2014) leads to an increase in output on impact but a fall in hours. Both variables go back to normal within a year and a half. The bzt-ist-news shock of Ben Zeev and Khan (2015) causes a hump shaped increase in output and hours while not having much of a significant effect on prices. Output and hours jump immediately (and significantly) on impact in response to the jpt-mei shock of Justiniano, Primiceri, and Tambalotti (2011) before coming down in around 3 years. Prices on the other hand have a delayed slow rise.

The federal funds rate rises on impact following the bzp-gov, and jpt-mei shock but has a more hump shaped reaction in response to the lrw and jpt-mei shock. Finally, the ford-tfp and rrtaxu shock do not elicit a significant response of the federal funds rate.

3.2.2 Forecast Error Variance Decomposition

We now investigate the role of these six shocks in explaining the forecast error variance of the macroeconomic variables. For comparison purposes we also consider the monetary policy shock identified following the specification in section 2. For this analysis we include all the shocks in the VAR at the same time. The top panel of table 3 the variance decomposition for the full sample from 1954Q3 to 2005Q4. For this sample the six shocks combined explain over 70% of the variation in output and hours at short horizons and over 50% of the variation 20 quarters out. The three technology (or news about technology) shocks are more important than the fiscal policy shocks (or news about fiscal policy changes), especially at short horizons. They capture over 60% of the contemporaneous variation of output and hours relative to less than 10% explained by the fiscal shocks. At the longer horizon fiscal shocks explain around 15% of the variation in output and hours.

Comparing these full sample results to the more recent sample from 1984Q3 to 2005Q4, we see a similar pattern with a few notable differences. The technology shocks are still more important than the fiscal shocks but by not as large a margin, especially for hours. The pattern of fiscal shocks mattering more for longer horizon variability in output and hours still holds in this sample. One key difference in the samples is that the bzt news shock about investment specific technological change plays a much smaller role, while the ford total factor productivity shock explains a much larger share of the variation (over 20% for both output and hours for longer horizons). On the fiscal side, we notice a bigger share of variation explained by the Romer and Romer unanticapted tax shocks.

Finally, notice that the monetary policy shock plays a small role for explaining variation in hours and an even smaller role in explaining variation in output. Moreover, in the recent sample this role of monetary policy shocks is diminished further, consistent with the analysis from the simple model in section 2. Next we consider the counterfactual analysis.

4 The Role of Systematic Monetary Policy: A Counterfactual Analysis

How much does monetary policy contribute to the response of economic activity to shocks? This is the main question taken up in this paper. In this section we provide an answer to this question using a counterfactual analysis. We compare the impulse response, forecast error variance decomposition and historical decomposition results of the baseline VAR specification from section 3 to a counterfactual scenario that "turns off" the response of monetary policy. In other words, how would the economy react if monetary policy were non-reactive to economic shocks?

We will perform two different counterfactual exercises based on the work of SZ and BGW. The key idea for both these approaches is to evaluate the response of the economy to a variety of shocks by "shutting off" the response of the federal funds rate. As pointed out by SZ & BGW, one way to perform this computation is to first estimate the unrestricted system and then simulate the system by feeding in a sequence of innovations to the federal funds rate that keeps it fixed at the desired counterfactual level. This is the approach taken in SZ. One issue with this simulation is that the economy will repeatedly make forecast errors in a systematic manner. In other words, the forecast for the future behavior of the fed funds rate is formed from the unrestricted model while the actual behavior in the simulation fixes or shuts off the response of the fed funds rate. This simulation can be informative if we believe that it would take agents some time to understand that a change is happening in how the Fed is responding relative to its historical pattern. BGW extend this analysis by arguing that this assumption about how quickly agents learn about the policy change is more reasonable for some markets relative to others. Specifically they argue that agents in the financial markets will typically respond much faster in revising expectations than other markets. BGW provided a way in which the financial markets completely understand this proposed counterfactual policy response and their expectations are formed rationally, i.e. their forecasts take into account the future innovations to the federal funds rate. This works by including longer term market interest rates in the model and isolating the component of these interest rates that depends on expectations of future federal funds rate movements.

For convenience, we present here the equations of the baseline model again

$$Y_t = \sum_{i=1}^{p} (\pi_{yy,i} Y_{t-i} + \pi_{yr,i} R_{t-i}) + G_{yy} \varepsilon_{y,t} \tag{4.1}$$

$$FF_t = \sum_{i=1}^{p} (\pi_{fy,i} Y_{t-i} + \pi_{fr,i} R_{t-i} + \pi_{ff,i} FF_{t-i}) + \varepsilon_{ff,t} + G_{f,y} \varepsilon_{y,t} \tag{4.2}$$

$$R_t = \sum_{i=1}^{p} (\pi_{ry,i} Y_{t-i} + \pi_{rr,i} R_{t-i} + \pi_{rf,i} FF_{t-i}) + \varepsilon_{r,t} + G_{ry} \varepsilon_{y,t} + G_{rf} \varepsilon_{ff,t} \tag{4.3}$$

To understand the counterfactual simulation, we decompose the longer term interest rates R into an expectations component $\overline{R}$ and term premium component S with $R = \overline{R} + S$. The expectations component for the two interest rates (3 month and 10 year) can be written as

$$R_t^s = E_t \left(\sum_{i=0}^{ns-1} \omega_{s,i} FF_{t+i} \right) \tag{4.4}$$

$$R_t^l = E_t \left(\sum_{i=0}^{nl-1} \omega_{l,i} FF_{t+i} \right) \tag{4.5}$$

where the parameters $\omega_{s,i}$ and $\omega_{l,i}$ correspond to a monthly discount factor of 0.997. Using this simple decomposition of the longer interest rates it is possible to rewrite the VAR represented above such that the longer interest rates are replaced by the respective term premia. This can be done because the expectations component of the longer interest rates is just a projection of the current and lagged variables in the VAR. This alternative representation shown below aids in the computation of the counterfactual simulation.

$$Y_t = \sum_{i=1}^{p} \left(\pi_{yy,i} Y_{t-i} + \pi_{yr,i} \left[\bar{R}_{t-i} + S_{t-i}\right]\right) + G_{yy}\varepsilon_{y,t} \tag{4.6}$$

$$FF_t = \sum_{i=1}^{p} \left(\pi_{fy,i} Y_{t-i} + \pi_{fr,i} R_{t-i} + \pi_{ff,i} FF_{t-i}\right) + \varepsilon_{ff,t} + G_{fy}\varepsilon_{y,t} + G_{fs}\varepsilon_{s,t} \tag{4.7}$$

$$S_t = \sum_{i=1}^{p} \left(\lambda_{sy,i} Y_{t-i} + \lambda_{sr,i} R_{t-i} + \lambda_{sf,i} FF_{t-i}\right) + \varepsilon_{s,t} + G_{sy}\varepsilon_{y,t} + G_{sf}\varepsilon_{ff,t} \tag{4.8}$$

4.1 Counterfactual Impulse Responses and Forecast Error Variance Decompositions

We are now ready to perform our counterfactual exercise. We first start with impulse responses which are shown in figure 3. The solid blue line and corresponding shaded areas plot the impulse responses and 90% bootstrapped confidence intervals from the baseline case. The dotted red line shows the impulse responses from the counterfactual case. Notice that the response of the federal funds rate has been turned off, i.e. fixed at zero as seen in the last column in the figure. In line with what we should expect, whenever a particular shock causes an increase in the fed funds rate in the baseline case, we see that the counterfactual response of output, hours and prices is above the corresponding baseline case. Thus, if there is no contractionary response of monetary policy to the shock, then economic activity would have been higher. The counterfactual response of all three macroeconomic variables moves outside the confidence intervals from the baseline case for all the shocks except for the ford-tfp shock. This suggests that the response of monetary policy is crucial in how the economy responds to these shocks. The direction of the counterfactual responses means that monetary policy is acting to mitigate the effects of these shocks on the economy. For example, in response to the jpt-mei (investment specific technology shock), output and hours worked would remain higher for around 1-2 years more if not for the contractionary response of monetary policy. Additionally, the counterfactual series for output and hours move outside the confidence intervals earlier than for inflation. This is consistent with the more delayed response of inflation (relative to output) that occurs in response to a monetary policy shock in section 2.

To get a better quantitative sense of the role of monetary policy in the propagation of the six shocks, we calculate the difference in the cumulated responses of the counterfactual case relative to the baseline case. These results are presented in table 4. For example, the number 1.0 in the second row under the bzp-gov shock implies that the cumulated counterfactual impulse response is 1% higher than the cumulated baseline impulse response after 8 quarters. The biggest effect of shutting off monetary policy is observed in response to the lrw shock that captures news about future tax changes. After 5 years, output and hours would be more than 10% higher (prices would be 3% higher) if the fed funds rate had not been increased in response to a news about future tax cuts. The smallest effect of monetary policy is on the ford-tfp technology shock. In this case the difference between the cumulated counterfactual and baseline impulse responses never goes above 0.5%. The importance of monetary policy for the other four shocks lies in between these two extremes. For the two news shocks about fiscal policy (bzp-gov and bzk-ist-news), output and hours would have been roughly 4% higher after 5 years, while prices would have been 2% higher. For the marginal efficiency of investment shock, output, hours and prices would have been 5%, 6.5% and 1.4% higher respectively. Finally, for the rrtaxu unanticipated tax increase, we see the difference in output and hours is around 1.5% and 0.6% for prices.

5 Conclusion

In this paper we try to argue that the analysis of the systematic or endogenous component of monetary policy has not gotten enough attention in the literature. While the focus of the literature on identifying monetary policy shocks is understandable given the clear casual interpretation of the resulting estimates, it is becoming increasingly difficult to identify monetary policy shocks. To fill this gap in the literature, we conduct an evaluation of the systematic component of monetary policy using a counterfactual exercise. We take some of the most important non-monetary policy shocks identified in the literature and consider the role of monetary policy actions in the propagation of these shocks. We find significant effects of the systematic component of monetary policy, but that this effect is more important for some shocks relative to others. Specifically, we find that the propagation of unanticipated technology shocks is not much affected by the response of monetary policy. On the other hand, monetary policy actions work to mitigate the effects of investment specific technology shocks and news shocks, especially news about future tax changes.

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	Output		**Hours**	
Horizon	1954:Q3 to 2005.Q4	1984:Q3 to 2005:Q4	1954:Q3 to 2005.Q4	1984:Q3 to 2005:Q4
4	4.28	8.86	2.69	1.35
8	12.50	7.73	13.62	2.03
12	16.48	5.42	22.58	2.86
16	16.67	4.27	25.68	3.68
20	15.90	3.18	26.12	2.97

Table 1: This table shows the forecast error variance decomposition of output and hours attributable to a monetary policy shock from the simple model of section 2

	bzp-gov	lrw	rrtaxu	ford-tfp	bzk-ist-news	jpt-mei
bzp-gov	1.00					
lrw	0.09	1.00				
rrtaxu	0.09	-0.07	1.00			
ford-tfp	0.01	-0.01	-0.08	1.00		
bzk-ist-news	0.00	0.02	-0.04	0.04	1.00	
jpt-mei	0.29	0.11	-0.07	0.01	0.18	1.00

Table 2: Correlation structure of the non-monetary policy shocks for the sample 1954:Q3 to 2005:Q4. Abbreviations: bzk, Ben Zeev and Khan; bzp, Ben Zeev and Pappa; ffr, federal funds rate; ford, Francis, Owyang, Roush, DiCecio; lrw, Leeper, Richter, Walker anticipated future tax; ist, investment-specific technology; Jpt, Justiniano, Primiceri, Tambolotti; mei, marginal efficiency of invest; rrtaxu, RomerRomer unanticipated tax; tfp, total factor productivity.

1954:Q3 to 2005.Q4

Output

Horizon	bzp-gov	lrw	rrtaxu	ford=tfp	bzk-ist-news	jpt-mei	ffr
0	5.2	0.2	2.6	16.1	13.4	40.9	0.0
4	1.4	7.1	2.1	15.7	28.3	22.3	0.5
8	1.3	6.4	2.3	13.5	23.9	15.3	3.5
12	2.7	5.9	1.9	11.9	19.2	12.2	4.8
16	3.7	8.2	1.7	10.6	17.2	10.8	4.5
20	3.9	10.0	1.7	10.2	16.4	10.2	4.3

Hours

Horizon	bzp-gov	lrw	rrtaxu	ford=tfp	bzk-ist-news	jpt-mei	ffr
0	2.2	0.9	0.3	15.0	15.6	20.2	0.0
4	0.5	7.9	0.8	3.2	41.0	19.4	0.5
8	1.1	7.7	1.1	2.1	38.7	12.8	5.2
12	4.5	6.1	0.9	1.6	31.0	9.8	9.7
16	7.4	6.8	0.8	1.5	26.5	8.4	11.0
20	8.6	7.9	0.9	1.9	24.7	7.8	10.9

1984:Q3 to 2005:Q4

Output

Horizon	bzp-gov	lrw	rrtaxu	ford=tfp	bzk-ist-news	jpt-mei	ffr
0	1.4	3.3	4.8	25.3	0.0	40.9	0.0
4	4.0	3.5	3.7	19.2	2.3	12.3	0.6
8	2.8	4.8	8.3	12.2	8.4	6.0	7.9
12	5.1	3.0	7.7	25.0	8.7	3.6	5.1
16	6.5	2.0	6.7	29.5	9.4	4.2	3.6
20	5.2	2.1	13.9	25.8	7.8	4.9	2.8

Hours

Horizon	bzp-gov	lrw	rrtaxu	ford=tfp	bzk-ist-news	jpt-mei	ffr
0	2.8	4.5	1.9	24.4	0.5	12.8	0.0
4	2.3	9.8	23.7	16.3	1.3	5.4	3.1
8	1.6	10.8	13.9	9.5	8.6	2.8	5.7
12	3.5	8.3	9.7	13.8	7.0	3.1	4.1
16	5.8	5.1	6.6	24.4	7.2	4.1	2.7
20	4.8	4.0	12.2	21.2	6.1	5.1	2.4

Table 3: This table shows the forecast error variance decomposition for the various shocks from the baseline VAR. Abbreviations: bzk, Ben Zeev and Khan; bzp, Ben Zeev and Pappa; ffr, federal funds rate; ford, Francis, Owyang, Roush, DiCecio; lrw, Leeper, Richter, Walker anticipated future tax; ist, investment-specific technology; Jpt, Justiniano, Primiceri, Tambolotti; mei, marginal efficiency of invest; rrtaxu, RomerRomer unanticipated tax; tfp, total factor productivity.

			Output			
Horizon	bzp-gov	lrw	rrtaxu	ford-tfp	bzk-ist-news	jpt-mei
4	0.0	0.0	0.0	-0.1	0.1	0.0
8	1.0	2.5	-0.2	-0.2	1.3	1.5
12	2.4	6.5	-0.7	-0.2	2.7	3.3
16	3.5	9.9	-1.2	-0.1	3.7	4.5
20	4.2	11.9	-1.5	0.2	4.1	4.9
			Hours			
Horizon	bzp-gov	lrw	rrtaxu	ford-tfp	bzk-ist-news	jpt-mei
4	-0.1	-0.1	0.0	0.0	0.1	0.0
8	0.6	1.7	-0.1	-0.1	0.9	1.3
12	2.1	5.5	-0.6	-0.2	2.4	3.4
16	3.6	9.8	-1.2	0.0	3.8	5.3
20	4.8	13.1	-1.7	0.3	4.7	6.5
			Prices			
Horizon	bzp-gov	lrw	rrtaxu	ford-tfp	bzk-ist-news	jpt-mei
4	-0.1	-0.2	0.0	0.0	-0.1	-0.2
8	-0.2	-0.7	0.0	0.1	-0.3	-0.7
12	0.0	-0.9	0.1	0.1	-0.2	-0.9
16	0.9	0.4	-0.1	0.0	0.6	-0.1
20	2.6	3.1	-0.6	0.0	2.0	1.4

Table 4: This table shows the difference in the cumulated counterfactual impulse responses relative to the baseline impulse responses. Abbreviations: bzk, Ben Zeev and Khan; bzp, Ben Zeev and Pappa; ffr, federal funds rate; ford, Francis, Owyang, Roush, DiCecio; lrw, Leeper, Richter, Walker anticipated future tax; ist, investment-specific technology; Jpt, Justiniano, Primiceri, Tambolotti; mei, marginal efficiency of invest; rrtaxu, RomerRomer unanticipated tax; tfp, total factor productivity.

1954:Q3 to 2005:Q4						
				Output		
Horizon	bzp-gov	lrw	rrtaxu	ford=tfp	bzk-ist-news	jpt-mei
0	1.0	0.1	0.0	-0.1	-2.9	2.3
4	0.6	-0.4	-0.8	4.0	-6.3	2.5
8	1.7	1.9	-1.1	5.0	0.8	2.0
12	0.3	1.0	-0.6	8.8	4.6	2.1
16	-0.9	-2.3	-0.5	11.7	3.2	1.7
20	-0.6	-3.9	-0.8	11.6	-0.2	0.7
				Hours		
Horizon	bzp-gov	lrw	rrtaxu	ford=tfp	bzk-ist-news	jpt-mei
0	1.9	-0.2	0.0	-2.6	-5.4	4.7
4	3.0	-0.1	-0.5	-1.5	-19.7	7.8
8	5.4	4.4	-0.7	-1.2	-17.1	7.7
12	4.4	7.8	-0.4	-0.7	-12.6	7.3
16	3.2	7.6	-0.2	-0.1	-11.7	6.1
20	2.8	6.2	-0.2	0.2	-12.9	4.3
1984:Q3 to 2005:Q4						
				Output		
Horizon	bzp-gov	lrw	rrtaxu	ford=tfp	bzk-ist-news	jpt-mei
0	0.3	6.1	1.3	-0.3	0.1	-5.0
4	-2.4	19.5	-0.9	-1.5	-0.4	13.6
8	0.0	26.0	-2.6	-0.4	-5.5	11.6
12	-3.2	30.8	-1.4	-16.8	-6.5	10.4
16	-4.1	32.3	-3.2	-21.8	-6.2	5.1
20	-3.6	31.3	-6.7	-21.2	-4.6	0.7
			Hours			
Horizon	bzp-gov	lrw	rrtaxu	ford=tfp	bzk-ist-news	jpt-mei
0	1.7	-1.2	1.9	-9.1	0.1	1.1
4	-1.1	-2.1	-7.4	-4.1	6.3	15.4
8	-1.8	5.3	3.9	0.6	-6.3	7.3
12	-2.9	17.3	3.2	-6.9	-6.2	4.0
16	-3.8	23.0	1.8	-16.5	-4.7	-0.1
20	-3.5	24.5	-3.6	-16.1	-3.6	-3.9

Table 5: This table shows the difference in the counterfactual forecast error variance decomposition relative to the baseline case. Abbreviations: bzk, Ben Zeev and Khan; bzp, Ben Zeev and Pappa; ffr, federal funds rate; ford, Francis, Owyang, Roush, DiCecio; lrw, Leeper, Richter, Walker anticipated future tax; ist, investment-specific technology; Jpt, Justiniano, Primiceri, Tambolotti; mei, marginal efficiency of invest; rrtaxu, RomerRomer unanticipated tax; tfp, total factor productivity.

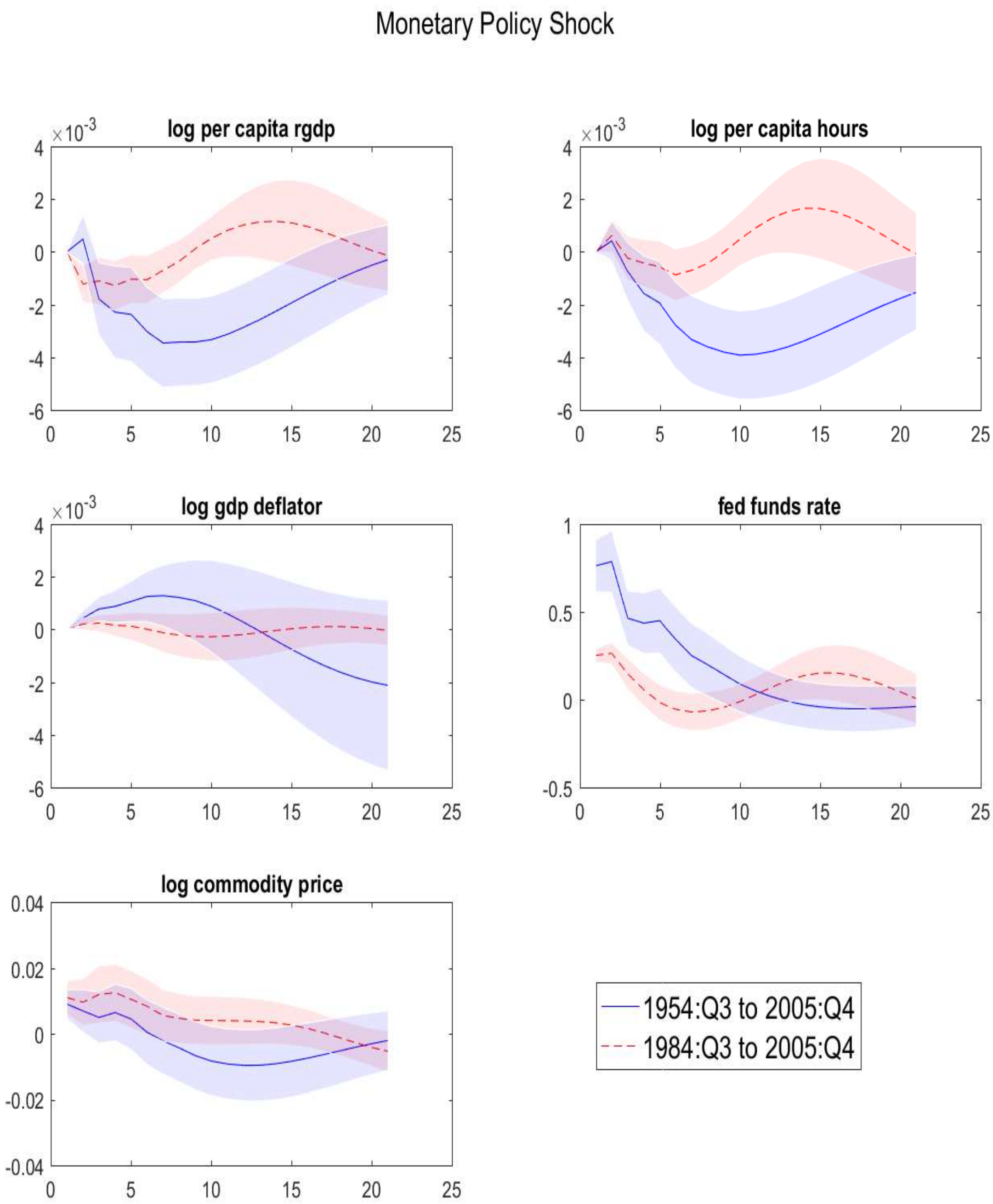

Figure 1: The impulse responses to a one standard deviation monetary policy shock with 90% confidence intervals. The blue lines show responses for the full sample from 1954:Q3 to 2005:Q4 and the dashed red lines show the responses for the great moderation sample from 1984:Q3 to 2005:Q4.

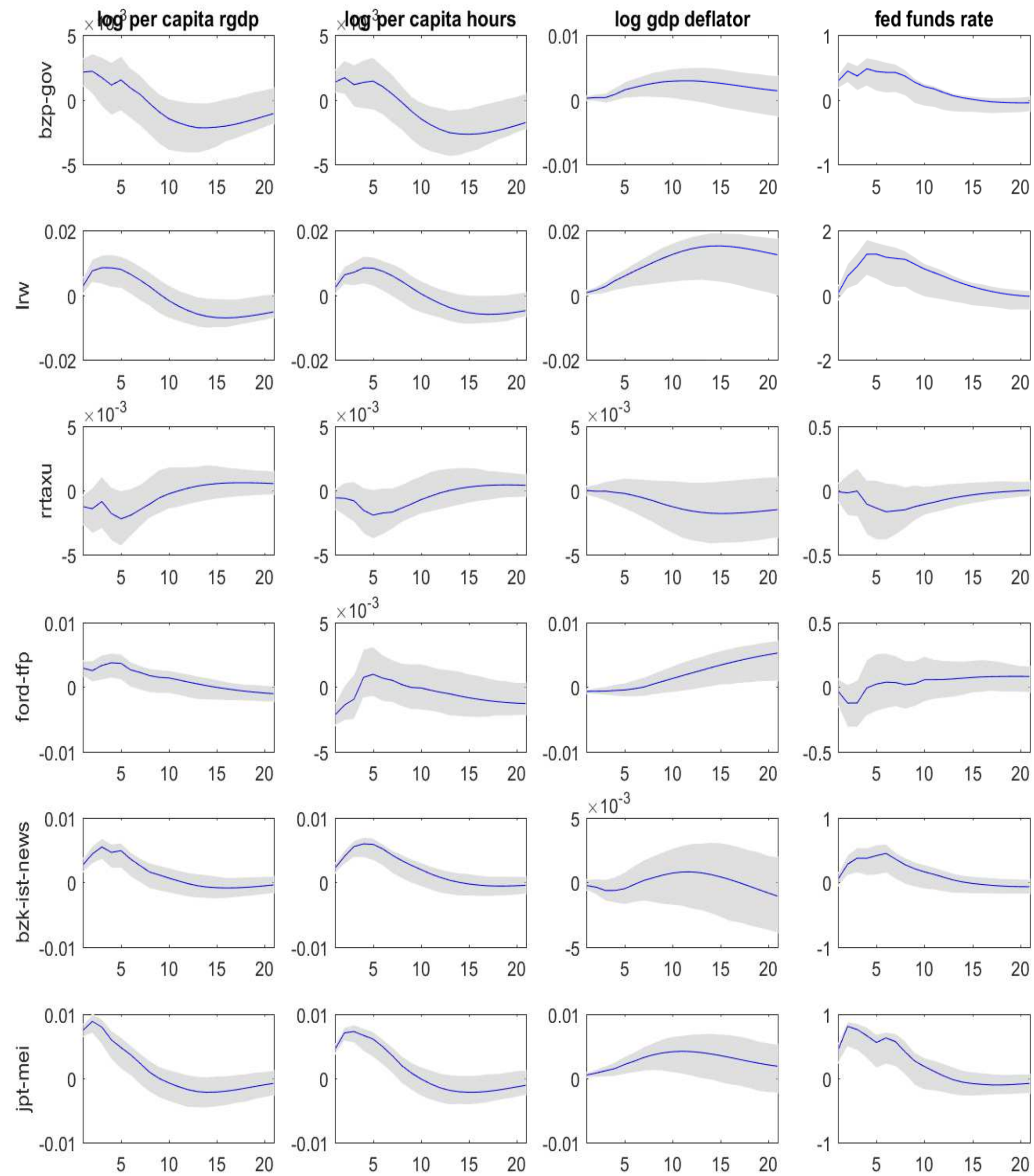

Figure 2: The impulse responses to a one standard deviation shock with 90% confidence intervals for the sample from 1954:Q3 to 2005:Q4. Abbreviations: bzk, Ben Zeev and Khan; bzp, Ben Zeev and Pappa; ffr, federal funds rate; ford, Francis, Owyang, Roush, DiCecio; lrw, Leeper, Richter, Walker anticipated future tax; ist, investment-specific technology; Jpt, Justiniano, Primiceri, Tambolotti; mei, marginal efficiency of invest; rrtaxu, RomerRomer unanticipated tax; tfp, total factor productivity.

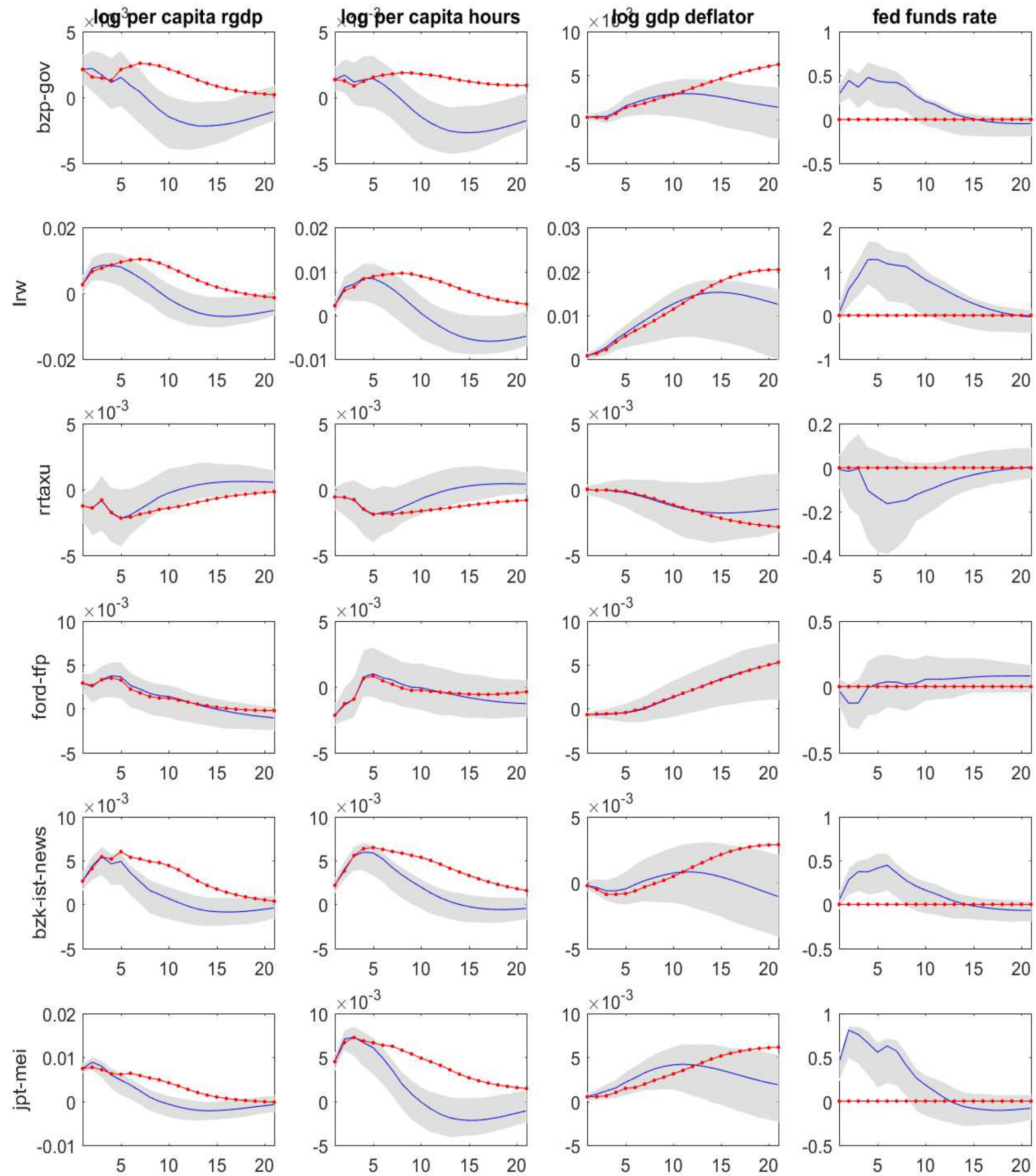

Figure 3: The blue lines show the impulse responses to a one standard deviation shock with 90% confidence intervals for the baselines model for the sample from 1954:Q3 to 2005:Q4. The dotted red lines show the counterfactual responses, as explained in section 4. Abbreviations: bzk, Ben Zeev and Khan; bzp, Ben Zeev and Pappa; ffr, federal funds rate; ford, Francis, Owyang, Roush, DiCecio; lrw, Leeper, Richter, Walker anticipated future tax; ist, investment-specific technology; Jpt, Justiniano, Primiceri, Tambolotti; mei, marginal efficiency of invest; rrtaxu, RomerRomer unanticipated tax; tfp, total factor productivity.