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Commodity Prices, Monetary Policy and the Taylor Rule

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Abstract

One way to analyze the impact of commodity price shocks on monetary policy is to think about short-term interest rates set by Fed according to the Taylor rule. Taylor (1993) suggested a policy reaction function for moderating short-term interest rates to achieve the two-fold goals of stabilizing economic growth in the short-term and inflation in the long-term. One important question is why monetary policy makers focus on core inflation instead of headline inflation. Therefore, the main goal of this research article is to study the pattern of monetary policy responses to commodity price shocks derived from an impulse response function (IRF). To do this, we first estimate two individual Taylor rules based on core and headline consumer price index (CPI) inflation by using real-time data of the US economy for the Greenspan years from 1987 to 2006 and predict the residuals. Then, we estimate two regressions for core and headline CPI inflation as our two individual dependent variables against some independent variables including commodity price shocks, and the Taylor rule residuals. At the end, we predict the monetary policy responses to commodity price shocks by using IRF analysis in multivariate systems of a vector autoregression (VAR) model.

Keywords: Monetary Policy, Commodity Prices, Taylor Rule, Core and headline CPI Inflation.

JEL Classification: E31, E37, E43, E44, E52, E58

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1. Introduction

During the first two-decades of the 2000s, the commodity price boom created issues for monetary policy makers, especially for those who have taken inflation targeting policy. Regarding the commodity price shocks, the related question is whether the inflation targeting adopted by several central banks around the world (The Federal Reserve simply the Fed in this article) should be set based on core inflation which excludes two important items subject to volatile prices, including food and energy prices, or headline inflation without exclusion these two items. Because price stability is a priority goal of monetary policy, most monetary authorities target core inflation. In addition, the main question will be arisen whether the food and energy prices have high share in the consumer basket, especially for consumers in emerging countries.

Theoretically, the shocks of food and energy commodity prices influence both core and headline inflation through two major channels. The first-round effect channel refers to the impacts of food and energy commodity price shocks through changes in their own commodity prices in headline inflation. And, the second-round effect channel refers to the indirect impact of food and energy commodity price shocks on other goods and services prices due to cost-push in both core and headline inflation, which would affect the consumer's real income due to inflationary consequences of rising food and energy commodity prices. Therefore, the second-round effect of food and energy commodity prices shocks create an instability of the price level in the long-term. For the US economy, it is expected to observe transitory effects, but for the euro-area economy, it may have a lasting impact on inflation (Yellen, 2011; Draghi, 2015).

On the other hand, the impact of food and energy commodity price shocks are mostly different between a net commodity importer and net commodity exporter country. For instance, in a net commodity importer country, the commodity can be assumed as an intermediate or a final goods, like energy and food, respectively. Therefore, local demand for commodity plays an important role in accelerating inflation which has negative impact on consumer's income. For a net commodity exporter country, the commodity price shocks have a positive effect on wealth, especially for those economies who has more natural resources and less consumption at home. Here, we focus on the commodity importer country case only.

Because the monetary policy makers employ interest rate as an instrument to the conduct monetary policy, the other main question is how much they adjust interest rates in response to the commodity prices shocks. Empirically, they modify interest rates to the output gap and inflation from the target by using Taylor-rule policy as an effective way of achieving two individual objectives: price stability and full employment/steady economic growth. Regarding policy evaluation, there are several rules for maximizing welfare or minimizing of a quadratic loss function by using a dynamic stochastic general equilibrium (DSGE) models (Gali and Gertler, 2007). This research article focuses on reaction function along the lines of Taylor (1993) rule to identify the relevancy of commodity price shocks to the setting of the monetary policy. Taylor (1993) formulated that how inflation and the output gap drive the short-term federal funds rate for the period of 1987 until 1992.

Thereafter, Clarida, Gali and Gertler (2000) argued that the Fed's policy is provided by a forward-looking Taylor rule during the Greenspan period from 1987 to 2006. Because of the Taylor's critique about the large deviations from the Taylor rule, Bernanke (2010) showed that a forward- looking Taylor rule would have implied an interest rate closer to the actual one.

Given the lack of literature focusing on the impacts of commodity prices shocks on monetary policy, this research article explores to improve upon the reaction function proposed by Taylor (1993) based on the existing research via the addition of variables representative food and energy commodity prices shocks.

This paper follows in several main sections. In the current section, we marked the issues of the commodity price shocks on the monetary policy makers. In section II, the theoretical literature review part aimed to provide a critical survey of whether the inflation target should be set based on core inflation or headline inflation, and try to discuss about the monetary policy reaction to the commodity price shocks. Also, in the following, we review the literature on the second-round effects of commodity price shocks. Section III, the data used is described and different measures of output gap and inflation is explored. Section VI provide the estimation methodology. Section V presents the results and section IV provide conclusion.

2. Literature Review

In this section, we focus on the theoretical aspects and empirical evidence.

2.1 Theoretical Literature Review

Regarding the theoretical argument to target core inflation, it is assumed that the prices of a set of items (including energy and food commodity prices) are volatile, while the other goods and services have sticky prices. As monetary authorities are looking to stable prices, then they choose core inflation (Aoki, 2001), and this is without considering the second-round effect of these commodity price shocks. Walsh (2011) argues that targeting core inflation is optimal policy if the second-round effect equals to zero, and then headline inflation and core inflation will have the same long-term mean. But, it is not true in real world, since the effects of food and energy commodity price shocks are different between countries. Furthermore, both food and energy commodity price shocks have different impacts on real economy. As an intermediate good, a rise in energy commodity price should have an impact on core inflation because of the second-round effect, so stabilizing headline inflation prevent the second-round effect of energy commodity price on core inflation. But, this is not the same for food commodity price shocks, as it has significant effects on the level of wage and accelerate inflation pressures, and this varies between countries based on the share of food in consumer's basket, which is less in industrial countries than emerging market economies.

Most literature acknowledges that the Fed only targets inflation and output. Then, the question of whether food and energy commodity price shocks have been considered and its consequent on setting a target for the federal funds rate need to be analyzed. However, there is no derivation of a commodity price augmented reaction function along the lines of Taylor (1993) to examine the relevancy of commodity prices to the setting of the monetary policy over time.

Taylor (1993) proposed a baseline approach for conducting monetary policy by modeling the federal funds rate as a linear function of inflation and output gap. To address the above question, let's suppose the optimal reaction function of monetary policy to commodity price shocks and to describe the monetary transmission mechanism through commodity price shocks. To do this, we assume that Fed minimizes a quadratic loss function as Eq. (1):

$$min\ [\lambda(y-y^*)^2+(1-\lambda)(\pi-\pi^*)^2], \qquad \lambda \epsilon [0,1] \quad (1)$$

where $y-y^*$ is deviations of actual output y from full employment or potential output y^*, and $\pi-\pi^*$ is deviations of inflation π from the target π^*, and λ is the relative weight of output gap regarding inflation. In macroeconomics theory, the inflation process is shown by Philips curve as Eq. (2):

$$\pi = \pi^e + \theta(y - y^*) + \vartheta \qquad (2)$$

where inflation π depends on inflationary expectations of price and wage setters π^e, and output gap $y - y^*$. ϑ is a supply shock. Let's assume that the Fed consider ε as the commodity price shocks before making monetary policy. Then, the first- and the second-round effects of the commodity price shocks influence the Phillips curve through a direct effect on prices and on potential output. Let's assume that the only energy and food commodity prices are volatile. An increase in energy commodity prices has a negative effect on potential output because it reduces the productivity. Therefore, the Phillips curve can be written as Eq. (3) or simplified as Eq. (4)

$$\pi = \pi^e + \theta(y - (y^* - \rho\varepsilon)) + \beta\varepsilon \qquad (3)$$

$$Or \quad \pi = \pi^e + \theta(y - y^*) + \varepsilon(\beta + \theta\rho) \qquad (4)$$

where ρ refers to the impacts of energy commodity price shocks on potential output. For food commodity price shocks, ρ is zero, but for energy commodity price shocks, ρ is positive. The parameter $\beta > 0$, and shows the importance of commodity price shocks on the consumer's basket. However, if the Fed target core inflation, the parameter β would be zero, and we include the second-round effects only, while if the Fed target headline inflation, we consider both the direct and indirect effects. Then, we would have an expression for inflation as a function of the commodity price shocks and expected inflation.

Because the aggregate demand will be influenced by the commodity price shocks, most central banks use aggregate demand to control inflation. For a net commodity importer country, the commodity price shocks have a negative terms of trade shock, which in turn reduces incomes and aggregate demand. Then, the aggregate demand can be written as Eq. (5)

$$y - y^* = A - \emptyset(i - \pi^e) - \delta\varepsilon \qquad (5)$$

where the parameter of δ refers to the strength of the aggregate demand effect. Using the expression for inflation and the output gap we can derive the optimal policy rule as Eq. (6)

$$i = \bar{\imath} + \frac{\theta}{\emptyset(\theta^2+\lambda)}(\pi^e - \pi^*) + \varepsilon(\frac{\beta\theta+\rho\theta^2}{\emptyset(\theta^2+\lambda)} - \frac{\delta}{\emptyset}) \qquad (6)$$

where $\bar{\imath}$ shows the equilibrium nominal interest rate, which is the inflation target plus the equilibrium real interest rate. Eq. (6) provides the optimal interest rate in the presence of commodity price shocks. The supply-side effect makes monetary tightening by rising interest rate, but the demand-side effect reduces the strength of the tightening.

By identifying the second-round effect, we can establish a relation between targeting core and headline inflation by using Eq. (7)

$$\pi = \alpha\pi^c + (1 - \alpha)\,\pi^{COM} \qquad (7)$$

where headline inflation π is a weighted average of core inflation π^c, and food and energy commodity inflation π^{COM}. If a change in commodity price $\Delta\pi^{COM}$ increases core inflation by a factor of σ, meaning that $\Delta\pi^c = \sigma\Delta\pi^{COM}$, then we can describe relation between a commodity price shock and headline inflation by using Eq. (8)

$$\Delta\pi = [\alpha\sigma + (1-\alpha)]\Delta\pi^{COM} \quad (8)$$

where σ measures the second-round effects. When the relative price of food and energy commodity goes up, $\Delta\pi^{COM}$ will be transitory, and no need to the monetary policy reaction. But, due to persistent second-round effects, and the possibility of higher inflationary expectations, it makes necessary for the Fed to react. However, it is expected to have higher σ under core inflation targeting, and then there will be a trade-off between core and headline inflation targeting. Beyond the theoretical assumptions required to support targeting headline inflation, core inflation will not be a strong reaction of monetary policy and leads to more volatility in inflationary expectations, with uncertain impacts on output volatility.

The theoretical approach of interest rate smoothing is also documented by Goodfriend (1987), Lowe and Ellis (1997), English et al. (2003) and Woodford (2003). The reasons for interest rate smoothing include maintaining the credibility of the central bank and stability in financial markets. Furthermore, theoretically driven reaction function did not consider the relationship between interest rate and asset prices (Clarida et al., 1999).

2.1 Empirical Literature Review

Many empirical evidence have investigated the impact of monetary policy shocks on commodity prices (i.e., Bernanke et al., 1997; Ardeni and Freebairn, 2002; Cecchetti and Moessner, 2008; Kilian, 2009; Chen, 2009; Doh, 2010; D'Amico and King, 2010; Gagnon et al., 2010; Hamilton and Wu, 2010; Rigobon, 2010; Joyce et al., 2010; Neely, 2010; Scrimgeour, 2010; Hancock and Passmore, 2011; Krishnamurthy and Vissing-Jorgenson, 2011; Wright, 2011; Gelos and Ustyugova, 2012; Anzuini, 2013, Siami-Namini and Hudson, 2016; Siami-Namini et al., 2017), but there is a vacuum in evaluating the impact of commodity price shocks on monetary policy. For instance, Siami-Namini and Hudson (2016) identified the effect of a positive shock in the short- and long-term interest rates and M2 money stock on the aggregate commodity price index and commodity sub-indices by using a structural vector auto-regression (SVAR) model, and found that a U.S. monetary contraction has a negative significant effect on the aggregate commodity price index and commodity sub-indices. In other study, Siami-Namini et al. (2017) used an autoregressive moving average with an exponential generalized autoregressive conditional heteroscedastic (ARMA-EGARCH) process, and extracted the conditional variance series to identify volatility spillovers between monetary policies and commodity price index. They found that the volatility of agricultural commodity price index and other commodities price indices in their study overshoot the long-term equilibrium in response to an impulse in monetary policy.

Regarding the impact of commodity price shocks to the monetary policy, Taylor (1993) first suggested a baseline for US monetary policy reaction based on his observation about driving the short-term federal funds rate by the inflation and output gap for the period of 1987 to 1992. Clarida et al. (2000) developed Taylor rule model and estimated backward- versus forward-looking monetary policy rules, and found that the monetary policy reaction function varies over time. Orphanides (2001) highlighted the difference between real-time data and ex-post revised data, and estimated monetary policy reaction functions based on ex-post revised data, and suggested that for the analysis of monetary policy rules, it is necessary to make decision in terms of real-time data. Asso et al. (2007) noted that the Taylor-type rule policy has become the main method for analyzing the monetary policy reaction function which is critical for market operators and macroeconomics forecasters.

Bernanke et al. (2005) suggested that central banks operate in a data-rich environment in the conduct of monetary policy. The monetary policy authorities of small open economies (SOE) like Australia or other countries which are dependent on international economies, consider factors setting the monetary policy instrument.

Mehra (2002) estimated Taylor-type policy rule and predicated the federal funds rate for two individual periods 1968Q1 to 1979Q2 and 1979Q3 to 1994Q4 by using real-time estimates of output gap. The results showed that inflation response coefficient was close to unity for the first period and above unity for the second period which confirmed Fed policy violated the Taylor rule during the first period. Furthermore, the funds rate response to its fundamental was complete one year and within one quarter for the first and the second period of study, respectively.

De Brouwer and Gilbert (2005) investigated the stability of Australian monetary policy in the post-float period, and showed that the Reserve Bank of Australia (RBA) is forward-looking, focusing on outcomes 1 year ahead. Because of inflation targeting, the weight on inflation in the RBA reaction function has increased, and this is robust with respect to various definitions of the output gap.

Kendall and Ng (2013) estimated backward-looking Taylor rule for Australia - New Zealand from 1992 to 2012. By considering two pre- and post-global financial crisis periods, they found that the monetary policy conduct of Australia, New Zealand and the US are not different from each other.

Hudson and Vespignani (2015) investigated the deviations of the Taylor rule by using data-rich environment of 229 macroeconomic series of Australian economy. They showed that that about 41.9% and 22.5% of Australia ‘s deviation from the Taylor rule can be explained by international and domestic factors, respectively. They explained that Australian deviation from the Taylor rule is related to the deviation of the US´s Taylor rule.

According to the research findings derived from empirical literature, there is no evidence to discuss about the impact of commodity price shocks on monetary policy of countries which have inflation targeting, and all them moderate interest rate based on inflation and output gap. Most literature noted that monetary authorities target output and inflation only. In the following, we present some empirical evidence on the monetary policy reaction function to the commodity price shock.

Cecchetti et al. (2002) estimated how the end of a bubble in asset price can lead to unnatural levels of inflation or deflation and explained about the potential benefits of targeting asset prices and suggested that policy reactions to asset price misalignments should be different from reactions to asset prices changes driven by fundamentals.

Bernanke and Gertler (1999 and 2001) explained that asset price targeting is not necessary and suggested that inflation targeting stabilizes asset prices. They claimed that maintaining constant levels of current and expected inflation is the equivalent of sustaining output at its natural level. They explained that whenever a bubble exists, the optimal response is the monetary policy prescribed through inflation targeting.

Hayford and Malliaris (2004) and Rigobon and Sack (2003) argued for the inclusion of asset prices in the reaction function. Chen (2012) found initial empirical evidence which confirmed the existence of asset prices in the Fed's policy rule. The results showed the Fed's role in responding to asset prices in changing the monetary policy, and reacting to the consumer expectation.

Catao and Chang (2010) showed that targeting headline inflation is a good measure for the response of monetary policy. They assumed that food commodity price shocks are persistent, and involves a higher share in the consumer's basket in emerging countries, which may result in a food stock appreciating the currency and deteriorating terms of trade. Anand and Prassad (2010) showed that the central bank should consider headline inflation instead of core inflation based on the distributional effects and the spillover from commodity prices to aggregate demand.

Sekine and Tsuruga (2016) investigated the impacts of commodity price shocks on headline inflation by using a monthly panel of 144 countries. They found that the effect of commodity price shocks on inflation were transitory and robust and varied between countries. Using the smooth transition autoregressive models, they explored whether the commodity price shocks are persistence. They found that commodity price shocks are transitory in countries with exchange rate flexibility.

3. Data

The data used in this research article is quarterly series of the US economy for the period of 1958Q1 to 2017Q3, which collected from the Federal Reserve Bank of St. Louis website. It should be noted that the Federal Reserve regularly announce a target range between 1.7% and 2% for the personal consumption expenditure price index as a measure of inflation. In this article, we use CPI inflation.

We collected real-time seasonally adjusted core CPI inflation and headline CPI inflation data from the Federal Reserve Bank of Philadelphia website. The real-time CPI series is created form the diagonal elements of the core and headline inflation matrix that consists of all variable vintages for each observation. Also, we collected real-time seasonally adjusted food and energy commodity inflation data from the Federal Reserve Bank of Philadelphia website.

We collected real gross domestic product (GDP), billions of chained 2009 dollars seasonally adjusted annual rate. To estimate the potential GDP, there are several methods including CBO's method using the Solow model, labor productivity growth accounting, statistical filtering technique, simultaneous econometric models, and multivariate time series models. To estimate the underlying trends of the economic time series that are volatile, there are several issues. Arnold (2009) illustrated to those challenges using labor force growth, the Philips curve and labor productivity growth for estimating the potential GDP.

In this research article, the potential GDP is estimated with a recursive/rolling exponential regression method using a linear model. Figure 1 shows the output gap for the period of 1987: Q4 to 2017Q1. As shown in Figure 1, output gap for boom- and recession- periods had been positive and negative respectively. For instance, during the last global financial recession, the economy drops below its potential level. The Fed use output gap as a measure for conducting monetary policy for boom- and recession- periods.

We collected trade weighted U.S. Dollar index in terms of major currencies and the Effective Federal funds rate as interest rate over the period of 1958: Q1 to 2017: Q3. We collected real export and real import of goods and services and calculated data for openness as percentage of GDP.

Data descriptions are presented in detail in Table 1 in Appendix. Data used is assumed to be stationary.

4. Method

The method used in this article has several steps. As a first step, we consider the Taylor rule (1993) as Eq. (9)

$$i_t = r_t^* + \pi_t + 0.5(\pi_t - \pi_t^*) + o.5(y_t - y_t^*) \quad (9)$$

where i_t is the target short-time nominal Fed funds rate, r^* is the equilibrium real Fed funds rate (usually 2%), π_t is inflation, π^* is target inflation, y_t is the logarithm of real output, y_t^* is the logarithm of potential output. Accordingly, the difference between a nominal and real interest rate is inflation. We use real-time data to estimate the Taylor rule by using rolling ordinary least squares (OLS) regression and calculate its residual as the deviation from the Taylor rule. We assess the model's stability by using a rolling analysis of a time series model over time.

As a second step, to analyze the impact of energy and food commodity inflation on headline and core inflation, we estimate the changes in headline and core inflation as Eq. (10) and Eq. (11)

$$\pi_t^c = \delta_{0c} + \delta_{1c}\pi_t^f + \delta_{2c}\pi_t^e + \delta_{3c}y_t^{GAP} + \delta_{4c}ex_t + \delta_{5c}open_t + \delta_{6c}dev_t + \varepsilon_c \quad (10)$$

$$\pi_t^h = \delta_{0h} + \delta_{1h}\pi_t^f + \delta_{2h}\pi_t^e + \delta_{3h}y_t^{GAP} + \delta_{4h}ex_t + \delta_{5h}open_t + \delta_{6h}dev_t + \varepsilon_h \quad (11)$$

where π_t^c and π_t^h refer to core and headline CPI inflation respectively. π_t^f is food commodity price, π_t^e is energy commodity price, y_t^{GAP} is the output gap, ex_t is the exchange rate, $open_t$ is openness as percentage of actual GDP, and dev_t is the deviation of the Taylor rule. δ_{ic} and δ_{ih} , $i = 0, \ldots, 6$ refer to the coefficient of explanatory variables in core and headline CPI inflation equations respectively. ε_c and ε_h are error term in core and headline CPI inflation equations respectively.

The final step in the methodology involved applying the impulse response function (IRF) in a vector autoregression (VAR) models for the analysis of multivariate time series. The Akaike information criterion (AIC) is used for selecting the lags in VAR model. We can apply this three-step method to a given country with an inflation targeting monetary rule to uncover any deviation of the Taylor rule.

5. Results

In this section, we present and discuss about policy response coefficient from Taylor rule which are estimated using core and headline CPI inflation. It is critical to note that the Fed do not has an explicit inflation targeting. The Fed regularly announced a desired target for personal consumption expenditures (PCE) inflation between 1.7% and 2%. In this research article, we use core and headline CPI inflation.

5.1 The Estimation Results of the Taylor Rule

We estimated the policy response coefficient from the Taylor rule in Eq. (9) during the Greenspan period (1987:04-2006-04) with using the real-time data of core and headline CPI Inflation. All estimated policy response coefficients are significant for both equations. Furthermore, headline CPI inflation response coefficient is greater than one about 1.50, suggesting that Greenspan Fed responded strongly to expected inflation, and the output gap response coefficient is about 0.5. The inflation response coefficient increased from 1.5 to 1.775 when we employed the core CPI inflation, and output gap response coefficient increased from 0.5 to 0.686. Figures 2 and 4 show the actual and prediction of the federal funds rate using Taylor-type policy rule when we used headline and core CPI inflation, respectively. Figures 3 and 5 show the deviation of the Taylor rule or residuals when we use headline and core CPI inflation, respectively. As shown in both figures 3 and 5, the deviation from the Taylor rule is less in headline CPI inflation than core CPI inflation.

5.2 The Estimation Results of the Commodity Price

The regression results for core and headline CPI inflation of Eq. (10) and Eq. (11) are presented in several models in Table 2. As shown in Table 2, the impacts of energy commodity inflation are greater in headline CPI inflation than in core CPI inflation in most regressions. Also, the impacts of food commodity inflation are higher in headline CPI inflation than core CPI inflation. The output gap coefficient has a significant impact on both headline and core CPI inflation with exception in column (2) for both core and headline CPI inflation. A positive output gap indicates that inflation should be high and vice versa, a negative output gap suggests disinflation.

Table 2 provides additional information about the impact of other independent variables on core and headline CPI inflation. The coefficient of exchange rate is positive in all regressions. Also, the coefficients of openness index have negative effect on both core and headline CPI inflation. The more openness index facilitates price adjustment to trade shocks. Furthermore, the deviations of the Taylor rule have negative impact on core and headline CPI inflation. The larger this measure, the higher the interest rate implied by the Taylor rule with respect to the current rate. The adjusted R-squared value of all estimation varies between 45% and 91% showing significant explanation power of independent variables.

5.3 The Impulse Response Function Results

To analyze the impulse response function (IRF), we built two individual VAR models for core and headline CPI inflation using the vector of endogenous variables including energy and food commodity prices, output gap, and the deviation from the Taylor rule. All series is assumed to be stationary. About the scope of this article, we are mainly interested in the impulse responses in these variables.

The response of core CPI inflation to an impulse in energy and food commodity price, output gap, and the deviation from the Taylor rule are presented in the panels of Figure 6. As shown in Figure 6, the panels plot IRF of the core CPI inflation to a one S.D. innovation ($\pm$ 2 S.E.) in energy commodity price in panel (a), food commodity price in panel (b), output gap in panel (c), and the deviations from the Taylor rule in panel (d). Regarding Figure 6, both energy and food commodity price shocks increase core CPI inflation. In addition, output gap and the deviation of the Taylor rule increase core CPI inflation.

The response of headline CPI inflation to an impulse in energy and food commodity price, output gap, and the deviation from the Taylor rule are presented in the panels of Figure 7. As shown in Figure 7, the panels plot IRF of the headline CPI inflation to a one S.D. innovation ($\pm$ 2 S.E.) in energy commodity price in panel (a), food commodity price in panel (b), output gap in panel (c), and the deviations from the Taylor rule in panel (d). Regarding Figure 7, energy and food commodity price shocks reduce and increase headline CPI inflation, respectively. Furthermore, both output gap and the deviation of the Taylor rule reduce headline CPI inflation.

The response of Fed Funds rate to an impulse in energy and food commodity price are presented in the panels of Figure 8. As shown in Figure 8, the panels plot IRF of the Fed Funds rate to a one S.D. innovation ($\pm$ 2 S.E.) in energy commodity price in panel (a), and food commodity price in panel (b). Regarding Figure 8, energy and food commodity price shocks increase Fed Funds rate and clearly suggest, a tight monetary policy.

6. Conclusion

In this article, we argued about the impact of commodity price shocks on monetary policy in line with Taylor rule. Using a three-step econometrics procedure, we first estimate Taylor rule developed an innovation for quantitating the deviations of the Taylor rule using core and headline CPI inflation for the US economy. The Taylor rule was firstly estimated using OLS. Secondly, the residuals from this estimation for both core and headline CPI inflation are used to explain the change in core and headline CPI inflation using many international and domestic factors. The final step in the methodology involved applying the impulse response function to decompose the explanatory power of the estimated factors.

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Appendix

Table 1. Data Description

Data	Description
y	Real Gross Domestic Product, 3 Decimal, Billions of Chained 2009 Dollars, Seasonally Adjusted Annual Rate - Percent Change from Year Ago
y^*	The Potential Gross Domestic Product, 3 Decimal, Billions of Chained 2009 Dollars, Seasonally Adjusted Annual Rate - Percent Change from Year Ago
y^{GAP}	Output Gap
π^h	Headline Inflation: Consumer Price Index for All Urban Consumers: All Items - Percent Change from Year Ago
π^c	Core Inflation: Consumer Price Index for All Urban Consumers: All Items Less Food and Energy - Percent Change from Year Ago
π^f	Food Commodity Inflation: Consumer Price Index for All Urban Consumers: Food - Percent Change from Year Ago
π^e	Energy Commodity Inflation: Consumer Price Index for All Urban Consumers: Energy - Percent Change from Year Ago
i	Effective Federal Funds Rate, Not Seasonality Adjusted
ex	Trade Weighted U.S. Dollar Index: Major Currencies, Not Seasonally Adjusted Annual Rate - Percent Change from Year Ago
xp	Real Exports of Goods and Services, Billions of Chained 2009 Dollars, Seasonally Adjusted Annual Rate
im	Real Imports of Goods and Services, Billions of Chained 2009 Dollars, Seasonally Adjusted Annual Rate
$open$	Exports Plus Imports Divided by GDP is the Total Trade (As a Percentage of GDP)
$devc$	The Deviation of the Taylor Rule Using Core CPI Inflation
$devh$	The Deviation of the Taylor Rule Using Headline CPI Inflation

Table 2. Regression Results for Core and Headline CPI Inflation

	Policy Rule Core CPI Inflation: π^c				Policy Rule Headline CPI Inflation: π^h			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
π^e	0.0527	0.0349	0.0524	0.0474	0.1236	0.1135	0.1261	0.1101
	(3.812)	(2.444)	(5.490)	(5.884)	(12.334)	(10.647)	(17.122)	(13.798)
π^f	0.3990	0.5816	0.2128	0.1611	0.4867	0.6045	0.3373	0.2923
	(9.325)	(10.843)	(4.909)	(4.354)	(15.690)	(15.31)	(10.093)	(8.683)
y^{GAP}	-0.1792	-0.0998	-0.246	-0.301	-0.1242	-0.0630	-0.1691	-0.1914
	(-3.279)	(-1.476)	(-5.38)	(-7.71)	(-3.135)	(-1.252)	(-4.784)	(-5.612)
ex	-	0.04977	0.0508	0.0542	-	0.0378	0.0387	0.0442
		(2.561)	(3.955)	(5.002)		(2.624)	(3.906)	(4.630)
$open$	-	-	-0.256	-0.249	-	-	-0.1854	-0.2033
			(-14.81)	(-17.12)			(-13.88)	(-15.15)
$devc$	-	-	-	-0.2705	-	-	-	-0.1349
				(-8.402)				(-4.228)
$devh$	1.8871	1.4855	7.6243	7.1457	1.2973	1.0271	5.4669	5.8697
	(10.091)	(6.454)	(17.270)	(19.009)	(0.7632)	(5.992)	(16.045)	(17.336)
Constant								
Adjusted R^2	0.451	0.549	0.803	0.860	0.763	0.798	0.905	0.914

Figure 1. The Output Gap

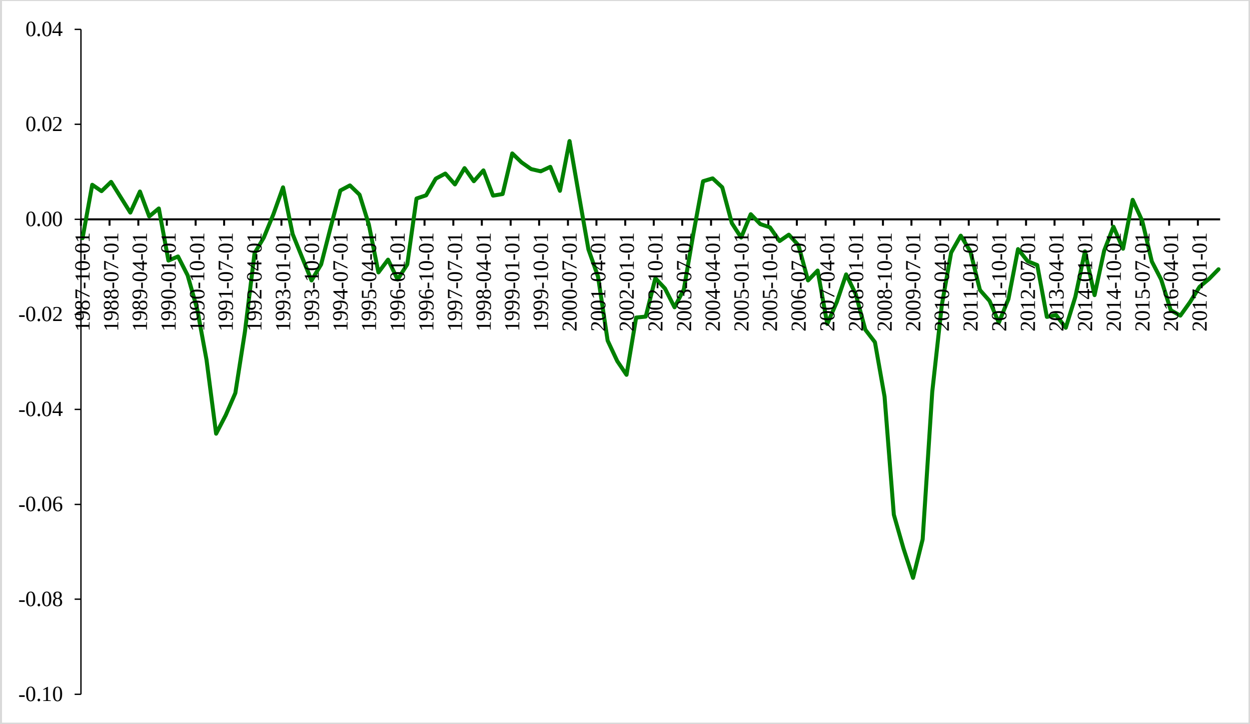


Figure 2. Taylor-Type Policy Rule Using Headline CPI Inflation - Actual and Predicted Fed Funds Rate

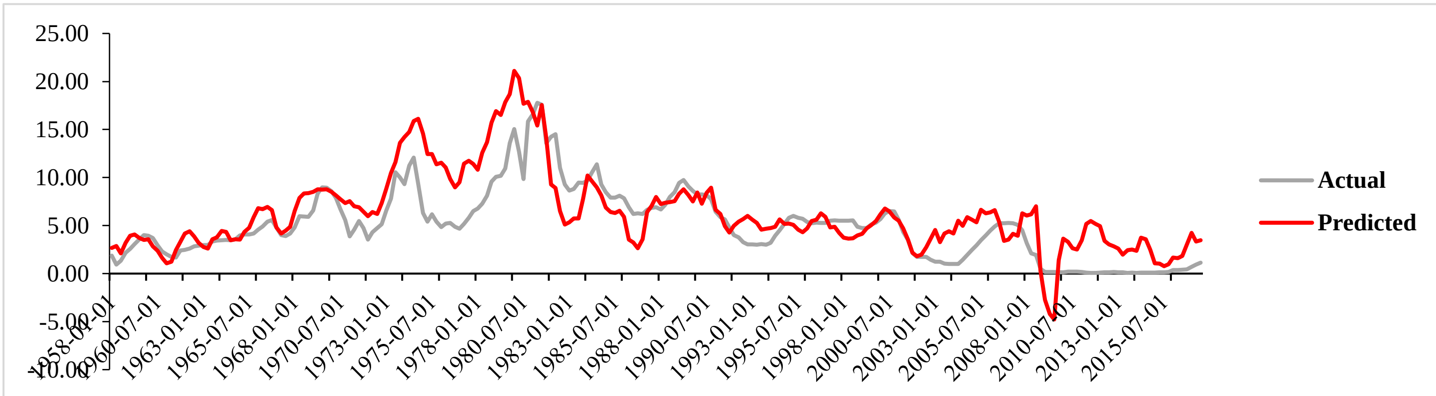


Figure 3. The Deviation from the Taylor-Type Policy Rule - Using Headline CPI Inflation

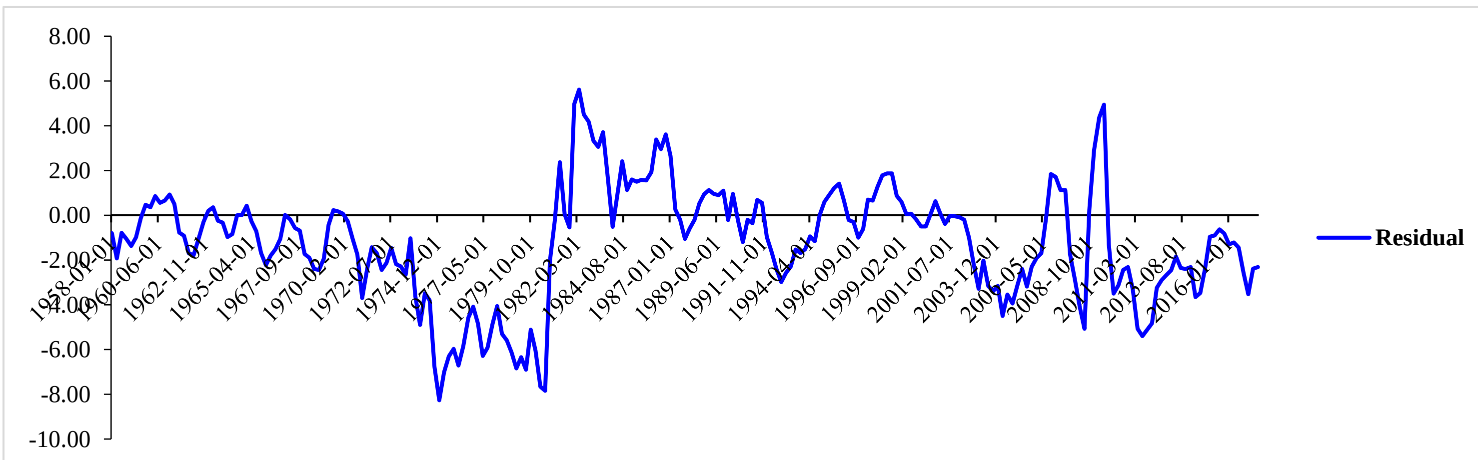


Figure 4. Taylor-Type Policy Rule Using Core CPI Inflation - Actual and Predicted Fed Funds Rate

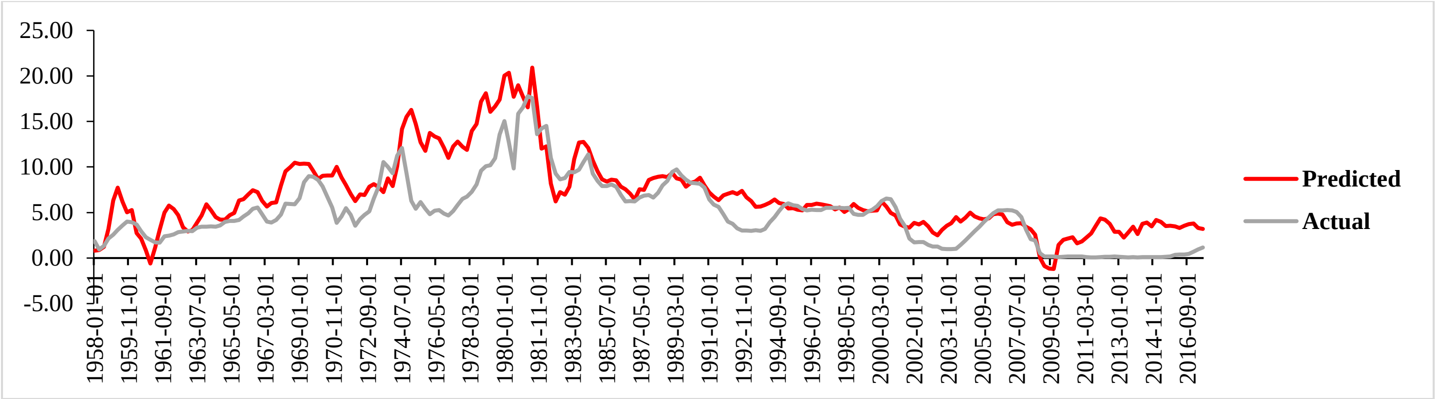


Figure 5. The Deviation from the Taylor-Type Policy Rule - Using Core CPI Inflation

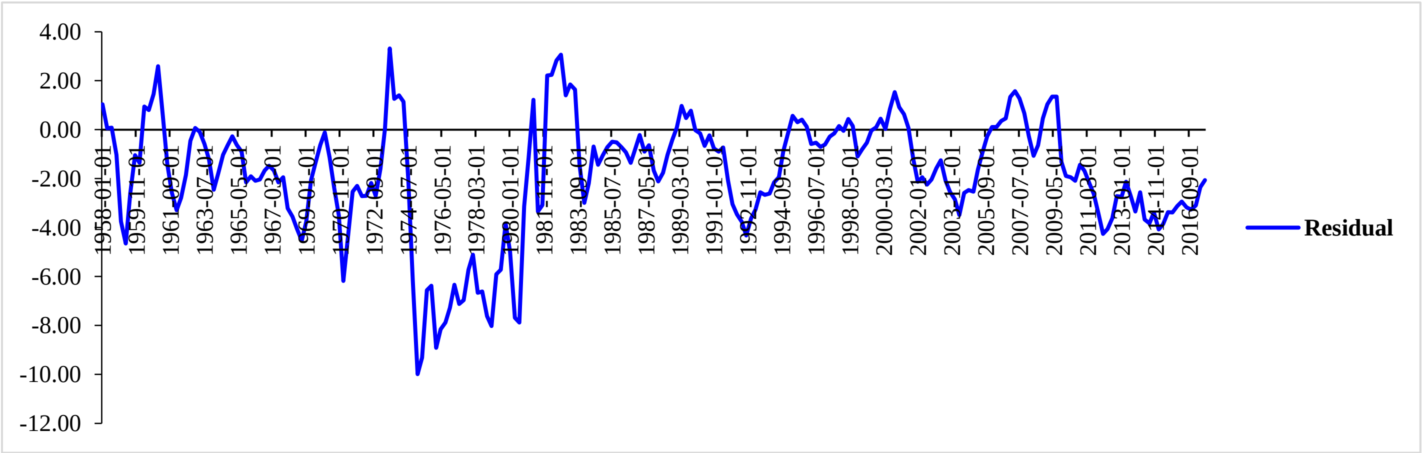


Figure 6. Impulse Responses of the Core CPI Inflation

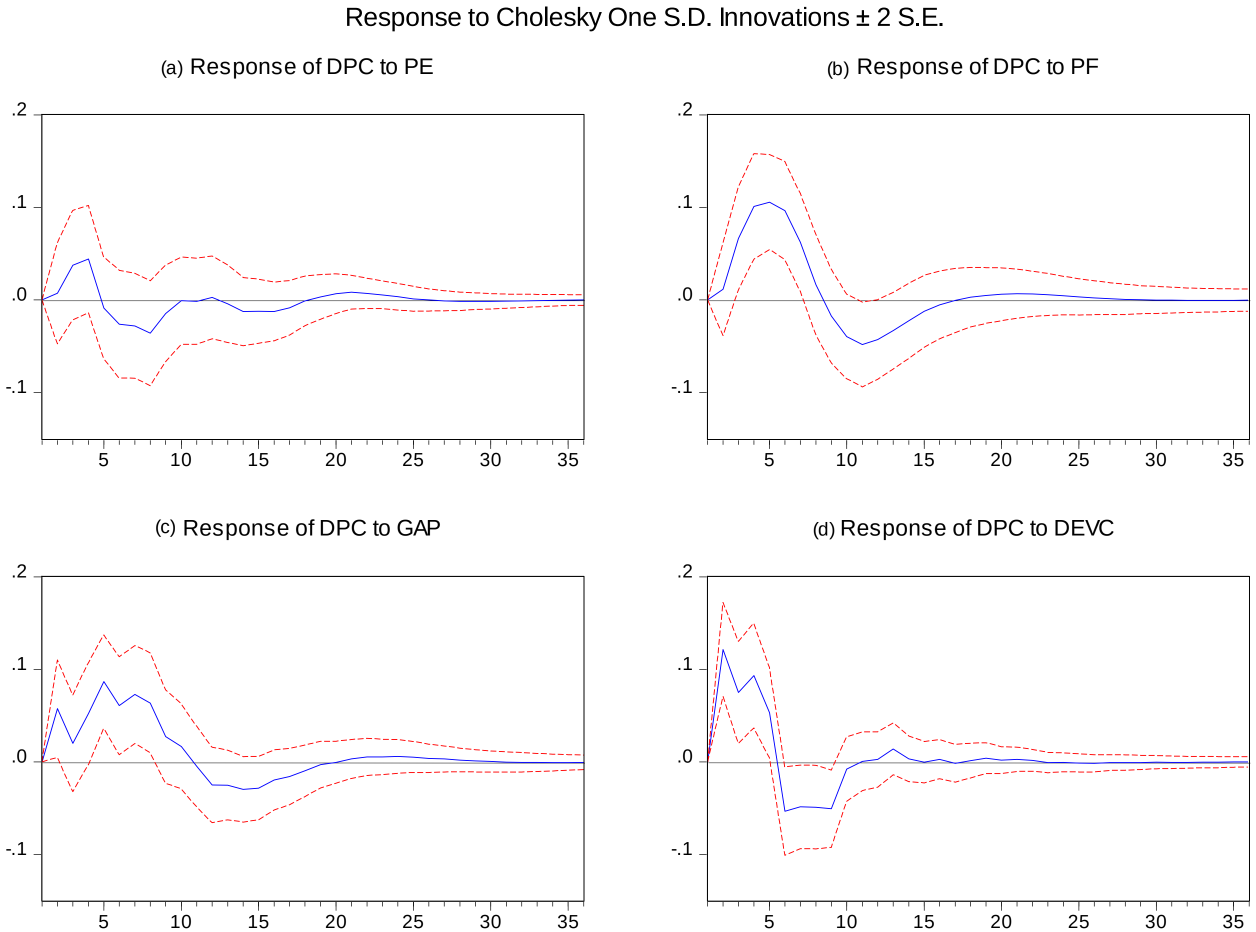


Figure 7. Impulse Responses of the Headline CPI Inflation

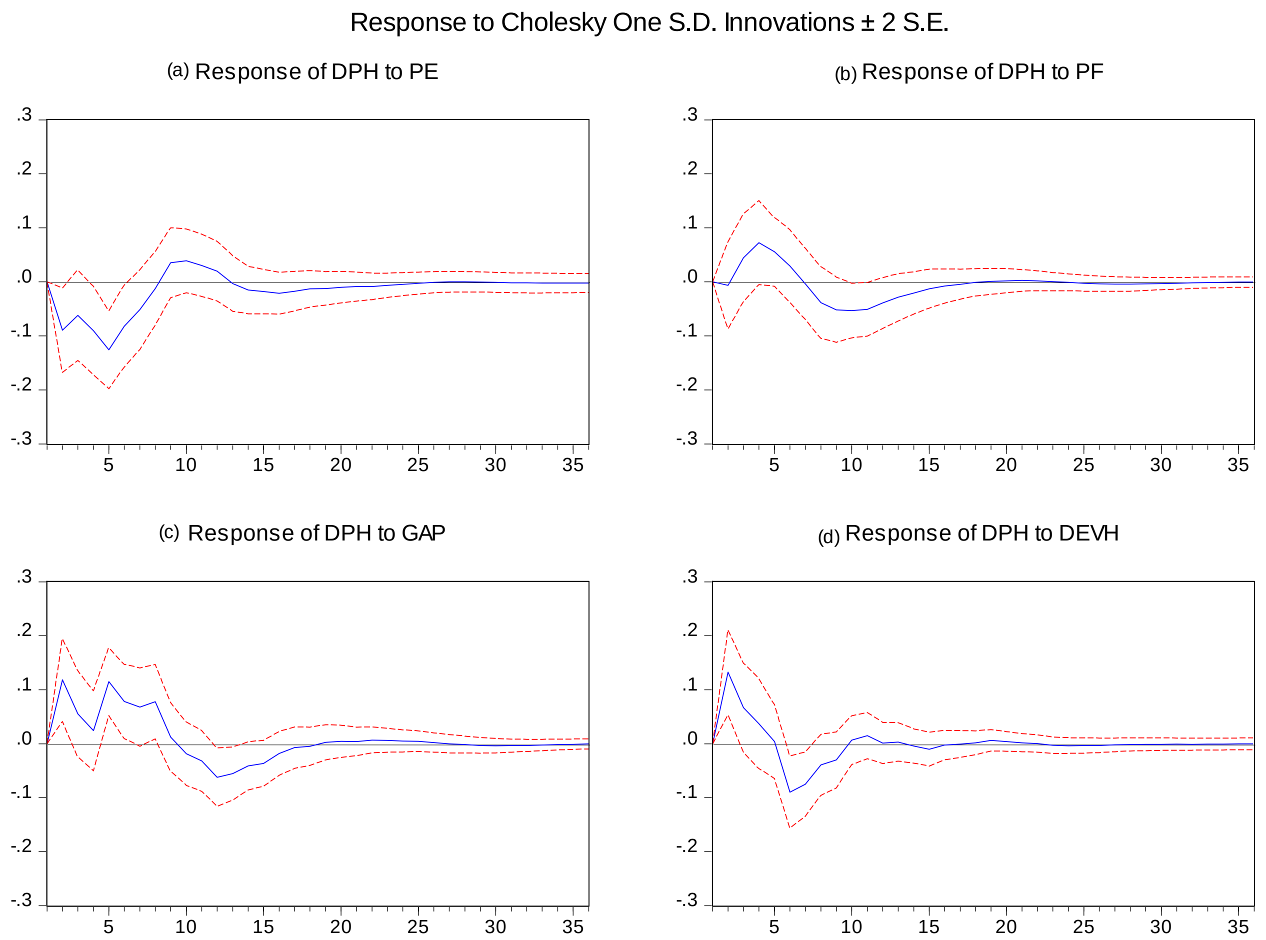
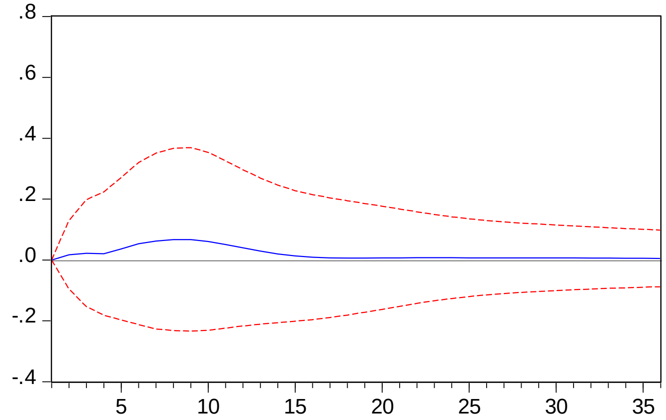


Figure 8. Impulse Responses of the Fed Funds Rate

Response to Cholesky One S.D. Innovations ± 2 S.E.

(a) Response of FUND to PE



(b) Response of FUND to PF