# The Influence of Fed’s Monetary Policy on Commodity Market Dynamics

**Shiqi Geng, Sijie He, Zhouhan Jin, Xuexi Zheng**

**Abstract**

We explore how Federal Reserve policy influences commodity markets via price transmission. Using the MIU framework with instrumental variable estimation, we discover that monetary policy significantly influences on commodity prices, while quantity purchased of commodities response weakly to monetary policy. This challenges conventional monetary transmission theories, indicating that structural market factors may overshadow policy impacts on commodity quantity. This research has implications for the design of market stabilization policy.

**Keywords:** Monetary transmission, Commodity price dynamics, Policy elasticity

# I. Introduction

Monetary policy and commodity markets are an integral yet quite incomprehensible part of economic policy. This paper discusses how monetary policy set by the Federal Reserve influences commodity markets, mainly the mechanics of transmission, which allow changes in policy to affect commodity prices, the volume of transactions, and market behavior in general. Although there has been earlier research that identified general relations existing between monetary interventions and financial markets, there is a need to further demarcate the specific channels whereby this kind of policy affects commodity markets.

Our paper is based on the Money-in-the-Utility framework and extends the theoretical underpinning introduced by Sidrauski in 1967 to study the short-term response of the markets due to monetary policy changes. We control for endogeneity via two-stage instrumental variables approach and report isolated causal effects of monetary policy variables on the commodity markets. Our findings indicate that monetary policy has a significant impact on commodity prices, whereas the quantity of commodities purchased shows only a weak response to changes in monetary policy. This aligns with the theory of supply and demand and reflects the characteristic of inelastic demand for commodities.

We contribute to this literature by providing empirical evidence of the efficiency of monetary policy in shaping commodity market outcomes, drawing some valuable implications for the efforts of policymakers at dampening market volatility and relieving supply-demand imbalances. On the other hand, our findings run against conventional assumptions of monetary policy transmission to commodity markets and therefore hint at some significant implications for policy design and implementation.

# II. Literature Review

The relationship between commodity prices and transaction volumes is closely tied to monetary policy. This review explores the neutrality of monetary policy through the Money-in-the-Utility (MIU) model and its implications for commodity markets. Sidrauski (1967) introduced the MIU model, which incorporates money balances into utility functions to analyze the impact of monetary policy on consumption and savings. The model suggests that, in the long run, monetary policy does not affect real variables like output or consumption, a concept known as monetary super-neutrality. This idea has become a fundamental part of monetary theory.

Feenstra (1986) extended the MIU model, showcasing money’s role in facilitating transactions and influencing consumption and trading behaviors. Similarly, Lucas and Stokey (1987) illustrated how monetary policy affects price levels, purchasing power, and trade volumes, shedding light on the broader effects of monetary changes. Mogliani and Urga (2018) examined the instability of money demand and its impact on trading volumes, highlighting the importance of liquidity changes in understanding market dynamics. Eggertsson and Woodford (2003) discussed the role of unconventional monetary policies, such as quantitative easing, in stabilizing markets during economic disruptions.

Taken together, these studies provide a solid foundation for understanding how monetary policy shapes commodity markets and highlight the importance of both theoretical models and empirical research in addressing these complex interactions.

# III. Theory

The theoretical foundation of this study is based on the money-in-utility (MIU) model, which integrates real money balances into the utility function to analyze the effects of monetary policy on economic decisions. This model, initially formalized by Sidrauski (1967), provides a framework for understanding how monetary policy influences consumption and savings decisions through changes in price levels and real balances. Subsequent extensions, such as those by Feenstra (1986), have refined the model to incorporate the role of money in facilitating transactions, emphasizing its utility-enhancing properties.

## Derivation of the Consumption Function

In the MIU framework, an individual's utility is a function of consumption () and real money balances (). The Cobb-Douglas specification commonly used in empirical applications assumes:

where represents the weight assigned to consumption in utility. This functional form captures the trade-off between consumption and holding money balances, aligning with theoretical insights on liquidity preferences (Lucas & Stokey, 1987).

The budget constraint is:

where is the price level, is nominal money holdings, and is nominal income. This constraint reflects the allocation of income between consumption and money holdings.

To maximize utility, the Lagrangian function is formulated as:

where is the Lagrange multiplier representing the marginal utility of income.

The first-order conditions (FOCs) for optimization are:

1. **With respect to C:**
2. **With respect to M:**
3. **With respect to λ:**

Equating the expressions for from the FOCs for and gives:

Substituting into the budget constraint yields:

Simplifying:

Thus, the consumption function is:

The first-order condition (FOC)

## Implications for Commodity Markets

The consumption function demonstrates an inverse relationship between consumption and the price level (). This aligns with theoretical predictions that higher price levels reduce real purchasing power, thereby lowering consumption. In the context of commodity markets, price levels () influence commodity prices (​) and, consequently, the quantity of commodities purchased (​). This establishes a theoretical link between monetary policy, which affects , and commodity market dynamics.

# IV. Data

## Data and Variables

The analysis employs the following variables:

|  |  |
| --- | --- |
| **Dependent Variable** | Quantity purchased of key commodities (Qc), measured in physical units (e.g., barrels of oil, tons of grain). |
| **Independent Variable** | Commodity prices (Pc), measured in U.S. dollars per unit. |
| **Instrumental Variable** | Federal Reserve monetary policy indicators, including changes in the federal funds rate and quantitative easing measures. |
| **Control Variables** | Global economic conditions (e.g., GDP growth rates, exchange rates), geopolitical factors, and supply-side shocks. |

This fact can be supplemented by the evidence of the stationarity test results, where sales of commodities generally do not have a unit root, meaning they are potential candidates for stationary variables with a constant mean. Commodity prices, on the contrary, might have a unit root which prevents them from a constant mean.

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Stationarity | Lags | |
| Treasury bond yield | √ | AR(1) | |
| Oil price | × | - | |
| Log oil price | × |  | |
| S&P index | × | - | |
| Oil sale | × | - | |
| Log oil sale | × |  | |
| Western Texas oil sale | × | - | |
| Log WTOS | × |  | |
| Gold sale | √ | AR(3)\* | |
| Log gold sale | √ | AR(3)\* | |
| Copper sale | √ | AR(3)\* | |
| Log copper sale | √ | AR(3)\* | |
|  |  |  |  |
| \*controlled for monthly seasonality |  |  |  |

**Table 1 Augmented Dickey-Fuller (ADF) Test**

The test results also justify the choice of three lags in the estimation equation. (AR(3))

# V. Methodology

This study employs a two-stage instrumental variable (IV) approach to investigate the causal relationship between commodity prices and the quantity purchased of commodities, using Federal Reserve monetary policy as the instrument. The rationale for this approach is that monetary policy affects price levels (), which influence commodity prices and indirectly affect demand.

In the **first stage**, the relationship between monetary policy and commodity prices is estimated. Monetary policy is proxied by changes in the federal funds rate and balance sheet expansions. The first-stage regression equation is:

Where ​ represents commodity prices, and captures the policy instruments.

In the **second stage**, the predicted values of commodity prices (​) from the first stage are used to estimate their impact on the quantity purchased of commodities (​). The second-stage regression equation is:

where ​ represents the causal effect of changes in commodity prices on the quantity purchased.

This IV approach addresses potential endogeneity arising from reverse causality or omitted variable bias. By isolating the variation in commodity prices attributable to monetary policy, the methodology ensures robust causal inference.

## Estimation and Robustness

The estimation uses generalized method of moments (GMM) to account for heteroskedasticity and autocorrelation in the error terms. Robustness checks include alternative specifications of monetary policy instruments. For instance, Google search index of FOMC interest rate adjustment is used as the alternative instrument variable for robustness check.

This methodology provides a robust framework to study the impact of monetary policy on international commodity markets, shedding light on the transmission mechanisms of policy interventions.

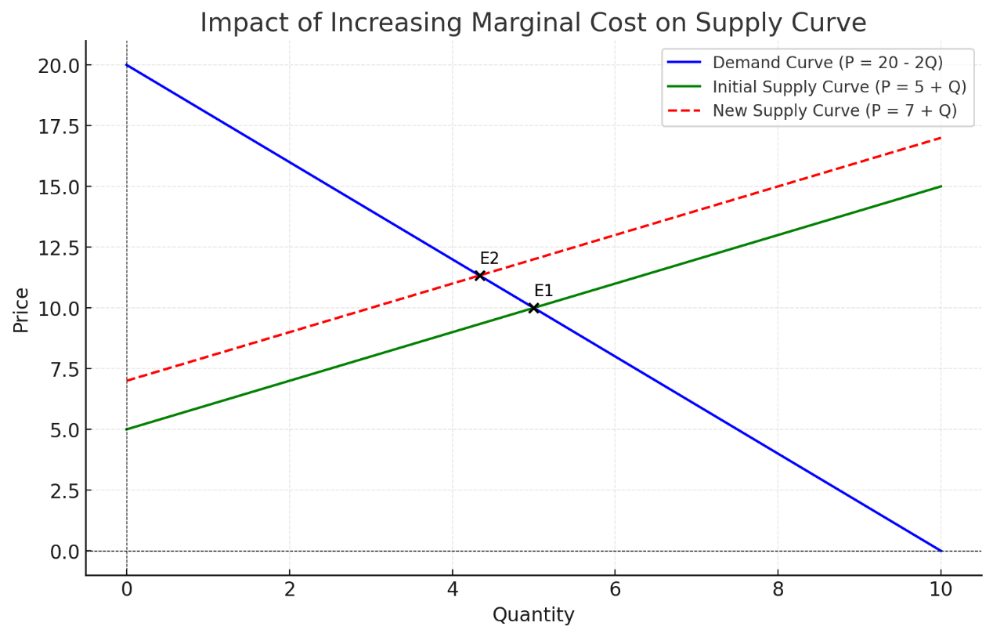
# VI. Preliminary Results

## (1) First Stage Analysis

In order to empirically test the relevance condition and the exclusion restriction, Granger causality tests are conducted to test the causality between monetary policy variable (Treasury bond yield) and prices and quantity of oil. The estimation equations are as follows:

The result (shown in column (1) and (2) the data appendix) shows there is a significant first stage for the relevance condition and insignificant result for exclusion restriction. The result means the IV (Monetary Policy) is strongly correlated with Independent Variable commodity prices (​), and don’t have a direct relationship with the dependent variable. Dependent Variable quantity purchased of commodities (​).

We could use theory to analyze supply and demand of commodity market. Since there is a stable need for commodity like energy and metal elements, it is reasonable to assume there is a low demand elasticity of demand regarding monetary policy. Meanwhile, it is also reasonable to argue that in a monopsonic market structure like energy, suppliers can easily make strategic decision in their production plan, making them more responsive to changes in the price level. Thus, the relevance condition and the exclusion restriction theoretically hold true for monetary policy being the IV.



**Figure 1 Impact of Increasing Marginal Cost on Supply Curve**

The conclusions from the data analysis align with our theoretical analysis. According to the MIU theory, monetary policy impacts the supply and demand dynamics in the commodity market by altering the price level (P). Commodity demand is price inelastic, while supply is elastic. This implies that price changes have little effect on demand quantity, but prices respond strongly to demand fluctuations. At the same time, producers can quickly adjust supply to accommodate changes in demand, thereby mitigating large fluctuations in sales volume. Therefore, expansionary monetary policy significantly drives up prices with a slight increase in sales, while contractionary monetary policy significantly lowers prices with a slight decrease in sales.

## (2) Second Stage Analysis

The IV estimation results (in column (3) as for 2SLS specification and column (4) for GMM specification) show an **insignificant** slight negative response of oil sale (0.3%) for 1% of oil price increase.

# VII. Falsification Tests

The Granger causality test examines whether past values of one variable (e.g., Google search index) help predict the current values of another variable (e.g., sales changes), beyond the predictive power of the variable's own past values. In the context of the falsification test, the goal is to determine if the Google search index (used as an instrument for monetary policy changes) has any causal predictive power over sales changes.

Columns (5) and (6) in the data appendix present the results of this test, where lagged values of the Google search index are included as explanatory variables for sales changes. If the Google search index does not Granger-cause sales changes, it suggests that the instrument is unrelated to the dependent variable (sales changes), thereby validating its exogeneity.

The falsification test is motivated by the insignificant results in the instrumental variable (IV) regression using bond yield as the monetary policy variable. These insignificant results indicate a potential issue with the instrument's validity or its strength in capturing the variation in monetary policy that affects sales.

The Granger causality test in the falsification test framework provides additional evidence about the validity of the Google search index as an instrument. The insignificant results in the IV regression suggest that the Google search index may not be a suitable instrument for capturing the causal effect of monetary policy on sales, either due to weak instrument issues or concerns about its exogeneity.

# VIII. Discussion

Our findings carry some useful insights on the differential impacts of monetary policy on the commodity markets - **Monetary policy strongly influences commodity prices while its influences on sales volume are weak.** This asymmetrical response pattern is in a confluence with both our theoretical framework and empirical results.

Two basic characteristics of commodity market structure are supported by our findings:

**1. Price Response:** The influence of monetary policy on commodity prices is substantial, as evidenced by our robust first-stage findings. This validates the efficacy of monetary transmission in impacting price levels within commodity markets.

**2. Quantity Response:** Sales volumes are extremely insensitive to changes in price, which in turn means that monetary policy has little impact on the real quantities transacted. Such insensitivity is indeed expected from commodity markets - inelastic demand because commodities happen to be essential inputs, and elastic supply due to producers who can strategically alter their output.

These findings have important policy implications:

**1. Transmission of Monetary Policy:** Although monetary policy demonstrates efficacy in impacting commodity prices, its capacity to influence actual transaction volumes is constrained by inherent structural factors within the market.

**2. Policy Design:** The government needs to acknowledge that monetary interference can be more efficient in stabilizing prices rather than in treating market disequilibrium.

Future research should explore several promising directions. A deeper investigation of potential asymmetric responses to monetary tightening versus easing. Additionally, extending the analysis to a broader range of commodities would help test the generalizability of our findings. Finally, we could employ local projection methods combined with instrumental variables to better analyze the dynamic effects and address potential endogeneity concerns in the estimation of causal relationships.

# Reference

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# Appendix

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) | (5) | (6) |
|  | First stage | Exclusion | First stage | Exclusion | 2SLS | GMM |
|  | D.logoilprice | D.logoilsale | D.logoilprice | D.logoilsale | D.logoilsale | D.logoilsale |
| LD.logoilprice | -0.535\*\*\* |  | -0.519\*\*\* |  | 0.226 | 0.226 |
|  | (0.062) |  | (0.063) |  | (0.51) | (0.51) |
|  |  |  |  |  |  |  |
| L2D.logoilprice | -0.374\*\*\* |  | -0.353\*\*\* |  | -0.334 | -0.334 |
|  | (0.067) |  | (0.068) |  | (-0.78) | (-0.78) |
|  |  |  |  |  |  |  |
| L3D.logoilprice | -0.222\*\*\* |  | -0.248\*\*\* |  | 0.0844 | 0.0844 |
|  | (0.061) |  | (0.063) |  | (0.25) | (0.25) |
|  |  |  |  |  |  |  |
| LD.logoilsale |  | -1.139\*\*\* |  | -1.156\*\*\* | -0.560\*\*\* | -0.560\*\*\* |
|  |  | (0.061) |  | (0.060) | (-6.00) | (-6.00) |
|  |  |  |  |  |  |  |
| L2D.logoilsale |  | -0.902\*\*\* |  | -0.925\*\*\* | -0.421\*\*\* | -0.421\*\*\* |
|  |  | (0.076) |  | (0.076) | (-4.46) | (-4.46) |
|  |  |  |  |  |  |  |
| L3D.logoilsale |  | -0.359\*\*\* |  | -0.378\*\*\* | -0.0860 | -0.0860 |
|  |  | (0.061) |  | (0.061) | (-1.26) | (-1.26) |
|  |  |  |  |  |  |  |
| LD.yield | -0.041 | 0.034 |  |  |  |  |
|  | (0.029) | (0.045) |  |  |  |  |
|  |  |  |  |  |  |  |
| L2D.yield | -0.030 | -0.022 |  |  |  |  |
|  | (0.029) | (0.045) |  |  |  |  |
|  |  |  |  |  |  |  |
| L3D.yield | -0.109\*\*\* | 0.014 |  |  |  |  |
|  | (0.029) | (0.044) |  |  |  |  |
|  |  |  |  |  |  |  |
| L.google |  |  | 0 | 0 |  |  |
|  |  |  | (0) | (0.001) |  |  |
|  |  |  |  |  |  |  |
| L2.google |  |  | 0 | -0.001 |  |  |
|  |  |  | (0.001) | (0.001) |  |  |
|  |  |  |  |  |  |  |
| L3.google |  |  | 0  (0) | -0.001  (0.001) |  |  |
|  |  |  |  |  |  |  |
| r2 | 0.289 | 0.619 | 0.237 | 0.625 | 0.206 | 0.206 |
| N | 245 | 245 | 245 | 245 | 246 | 246 |
| F | 5.91\*\*\* | 0.27 | 0.02 | 1.51 |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

*t* statistics in parentheses

\* *p* < 0.05, \*\* *p* < 0.01, \*\*\* *p* < 0.001

