Effects of Commodity Price Movements on China's Macroeconomy

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Abstract: As indispensable basic resources in macroeconomic development, commodity price fluctuations continually affect national economic performance. Following the global COVID-19 outbreak in 2019, China's and international commodity prices plunged and then fluctuated sharply in the post-pandemic era. This paper employs monthly indices of bulk commodities (energy, non-ferrous metals, minerals, oil and fats, agricultural products) and key macro-indicators (CPI, PPI, M2, benchmark interest rate) from June 2006 to December 2021, constructs a five-variable Structural VAR model, and conducts impulse-response and variance-decomposition analyses. Results indicate that in the short term, commodity price shocks exert a significant positive effect on CPI, PPI and interest rates, while negatively impacting money supply; the magnitude and persistence differ markedly across commodity categories. Strategy recommendations are proposed to strengthen price-monitoring mechanisms, improve medium stabilization systems, and improving the discourse power of international commodity pricing.

Keywords: Commodities; Price Fluctuation; Macroeconomics; Inflation; SVAR Model

1. Introduction

1.1 Research Background and Objectives

Commodities are the lifeblood of the national economy—essential resources and major consumables that drive macroeconomic activity. When COVID-19 swept the globe in 2019, demand plummeted, liquidity dried up, and supply chains buckled, sending commodity prices into a nosedive. But by early 2020, central banks flooded markets with easy money, and governments scrambled to ease supply bottlenecks, sparking a price rebound.

Fast-forward to 2022: pandemic restrictions lifted, factories roared back to life, and the global economy began healing—until Russia invaded Ukraine in February. Combined with loose monetary policies and stimulus spending, this shock sent some commodity prices soaring for a second straight year. But by mid-2022, the tide turned: tighter liquidity, slowing growth, and China's supply-stabilizing policies pushed prices down again.

The 2022 Government Work Report sounded the alarm: even as the world emerged from the pandemic, recovery remained fragile. Energy, metals, and minerals stayed in short supply, fueling inflation. Taming wild commodity price swings without triggering systemic risks became a top policy priority.

This study tackles that challenge head-on. By decoding how international commodity gyrations affect China's economy—and identifying key interaction mechanisms—we aim to strengthen China's commodity markets. These insights are vital for building China's "dual circulation" growth model, safeguarding financial stability, and powering post-pandemic recovery. Plus, by mapping how price shocks transmit through the economy, we equip policymakers to fine-tune responses for sustainable growth.

1.2 Approach and Methodology

This paper zooms in on five commodity categories (energy, metals, minerals, oils, and farm goods) alongside classic macroeconomic indicators. Using a Structural VAR (SVAR) model (a statistical powerhouse for time-series data) to dissect real-time interactions between prices and economic variables.

The three-step strategy:

1). Build a five-variable SVAR model to trace how commodity shocks ripple through the

economy (impulse response analysis).
2). Measure each commodity's explanatory power over macroeconomic shifts (variance decomposition).
3). Translate findings into actionable policies for stable, high-quality growth.

1.3 Breakthroughs

The potential innovations of this study lie in two main aspects:
1). It attempts to "open the black box" of commodity price impacts by examining not only macroeconomic indicators but also sub-category price indices (e.g., energy, non-ferrous metals, minerals, oilseeds, and agricultural products), yielding differentiated conclusions through comparative empirical analysis.
2). For more rigorous findings, the study uses impulse response analysis to observe macroeconomic indicators' reactions to standardized commodity price shocks and variance decomposition to quantify the proportion of macroeconomic variability explained by commodity price changes.
The limitations of this research also focus on two points:
1). Variable selection could be broader. Due to data availability constraints, only core macroeconomic indicators were included, omitting other critical measures like employment and financial risks.
2). The theoretical model's fit to real-world conditions could be improved. The study assumes a lower-triangular matrix for short-term constraints, limiting the analysis to this framework. However, actual macroeconomic conditions are more complex, and the mechanisms through which commodity prices affect the economy may diverge from the model. Further refining the model to better capture and visualize complex macroeconomic fluctuations remains a key area for future improvement.

2. Literature Review and Theoretical Basis

Scholars at home and abroad have studied the impact of commodity prices on macroeconomic performance from a wide range of perspectives and using diverse methods.

2.1 Economic Growth

The Chongqing Branch of the People's Bank of China found that economic growth is weakened by declines in international commodity prices and that this effect is indirect [1]. Liu showed that falling commodity prices lead to substantial losses in GDP. Focusing on the positive relationship between commodity prices and economic growth [2], Yang used a general equilibrium model and Bayesian methods to analyze short-term and long-term changes [3]. Their results showed that, in the short run, economic growth exerts a positive shock on energy prices, but this effect weakens in the long run.

2.2 Price Levels

Chu treated international commodity prices as a leading indicator of inflation [4]. Wong demonstrated that changes in commodity prices affect both the producer price index (PPI) and the consumer price index (CPI) [5]. Baskaya further disaggregated the analysis and found that, in the short term, the prices of oil, grain and industrial raw materials significantly influence price levels, whereas in the long term international industrial raw materials exert a more pronounced effect [6]. Blomberg et al. examined commodities such as gold, oil and food and found that, over the long run, the interaction between commodity prices and consumer prices diminishes [7].

2.3 Financial Markets

Allcott and Keniston reported that as commodities become increasingly financialized, their impact on financial markets strengthens [8]. Hu showed that as liquidity decreases, the correlation between the commodity market and the stock market intensifies [9].
Most empirical studies on the effects of commodity price volatility employ vector autoregression (VAR) models and their extensions. Xiao et al. (2009) constructed a Bayesian VAR model including indices of oil, grain and industrial raw material prices, as well as the CPI, industrial output, money supply and exchange rate [10]. Aastveit (2014) used a factor-augmented VAR to examine the different effects of oil supply and demand shocks on a wide set of U.S. macroeconomic variables [11].

3. Empirical Analysis

3.1 Variable Definitions and Data

This paper establishes the following variables: the China Commodity Price Index (CCPI) to represent the price changes of bulk commodities in China, with subcategories including the

energy sector (CCPIe), non-ferrous metals sector (CCPIc), minerals sector (CCPIm), oil and fats sector (CCPIo), and agricultural products sector (CCPIa). The above data are sourced from the WIND database, covering monthly year-on-year data from June 2006 to December 2021. To eliminate the impact of heteroscedasticity, all data are logarithmically processed, and years with missing data are excluded.

For the selection of macroeconomic variables, this paper adopts the following: the Consumer Price Index (CPI) to represent inflation levels; the Producer Price Index (PPI) to represent price changes in the production sector; the benchmark interest rate (I) to represent liquidity levels; and the broad money supply (M2) to represent China's demand conditions. The data are sourced from the CSMAR database **(see Table 1)**.

Table 1. Descriptive Statistics of Variables

VARIABLES	N	mean	sd	min	max
month	187	19,784	1,648	16,953	22,615
CCPI	187	130.6	22.71	81.48	187.3
CCPIe	187	110.5	25.34	48.81	161.4
CCPIo	187	180.4	32.67	99.41	249.7
CCPIm	187	133.0	30.89	71.43	235.9
CCPIa	187	154.3	23.24	97.07	194.0
CCPIc	187	80.88	12.86	46.33	113.3
GDP	187	53,909	23,435	18,043	113,493
CPI	187	102.6	1.954	98.20	108.7
PPI	187	101.4	4.713	91.80	113.5
M2	187	1.201e+06	614,097	322,756	2.383e+06
I	187	2.351	0.841	1.500	4.140
LNGDP	187	10.79	0.474	9.801	11.64
LNCCPI	187	4.856	0.179	4.400	5.233
LNCCPIe	187	4.676	0.249	3.888	5.084
LNCCPIo	187	5.178	0.189	4.599	5.520
LNCCPIm	187	4.864	0.230	4.269	5.464
LNCCPIa	187	5.026	0.162	4.575	5.268
LNCCPIc	187	4.380	0.164	3.836	4.730
LNCPI	187	4.631	0.0189	4.587	4.689
LNPPI	187	4.618	0.0464	4.520	4.732
LNI	187	0.792	0.355	0.405	1.421
LNM2	187	13.84	0.590	12.68	14.68

*Note: Data compiled by the author.

3.2 Checking for Steady Trends (ADF Test)

Before diving into the analysis, we first checked whether the time series data were stable using the Augmented Dickey-Fuller (ADF) test (see Table 2). The raw logarithmic data showed instability, so we applied first-order differencing to transform them into stationary series like DLNM2, DLNCPI, DLNPPI, and others. The results were clear: all P-values fell below 0.01, meaning we could confidently reject the null hypothesis at the 1% significance level. This confirmed that the transformed data were stable, hinting at potential long-term relationships among the variables.

To determine how many past time points (lags) should influence the current values, we relied on the Akaike Information Criterion (AIC). Table 3 summarizes the optimal lag lengths for relationships between commodity price indices (like CCPI, CCPIe, CCPIc) and economic indicators (M2, CPI, PPI, and interest rates). Surprisingly, the magic number was 3 across the board—meaning the past three periods mattered most.

Table 2. ADF Test Snapshot

Variable	T-score	P-value	Trend
LNM2	-4.26	-3.48	Unstable
LNCCPI	-1.22	-3.48	Unstable

LNCCPIe	-1.66	-3.48	Unstable
LNCCPIo	-2.72	-3.48	Unstable
LNCCPIm	-1.87	-3.48	Unstable
LNCCPIa	-2.56	-3.48	Unstable
LNCCPIc	-1.56	-3.48	Unstable
LNCPI	-2.10	-3.48	Unstable
LNPPI	-0.95	-3.48	Unstable
LNI	-0.47	-3.48	Unstable
DLNM2	-13.57	-3.48(<0.01)	Stable
DLNCCPI	-7.20	-3.48(<0.01)	Stable
DLNCCPIe	-8.11	-3.48(<0.01)	Stable
DLNCCPIo	-9.214	-3.48(<0.01)	Stable
DLNCCPIm	-9.334	-3.48(<0.01)	Stable
DLNCCPIa	-9.08	-3.48(<0.01)	Stable
DLNCCPIc	-9.03	-3.48(<0.01)	Stable
DLNCPI	-12.41	-3.48(<0.01)	Stable
DLNPPI	-4.69	-3.48(<0.01)	Stable
DLNI	-9.45	-3.48(<0.01)	Stable

*Note: Data compiled by the author.

Table 3. Best Lag Times for Commodity Prices

Lag Length	CCPI	CCPIo	CCPIm	CCPIa	CCPIc	CCPIe
0	-28.12	-27.53	-26.84	-29.46	-27.54	-26.85
1	-29.20	-28.54	-27.76	-30.47	-28.62	-27.80
2	-29.18	-28.60	-27.89	-30.49	-28.63	-27.83
3	-29.31*	-28.70*	-27.99*	-30.55*	-28.78*	-27.89*
4	-29.17	-28.58	-27.87	-30.42	-28.67	-27.75

*Note: Asterisks mark the ideal lag under AIC.

3.3 Crafting the SVAR Model

Here's how the Structural Vector Autoregression (SVAR) model works:

Aet = Vt = But

The matrices A and B define the model's structure. Depending on how we set them, SVAR models come in three flavors:

A-type: B is an identity matrix (B = I), allowing K × (K - 1)/2 restrictions.

B-type: A is an identity matrix (A = I), with the same restriction count.

AB-type: Neither A nor B is identity, permitting more restrictions (K × K + K × (K - 1)/2).

This study adopts the AB model of SVAR with k=5, which necessitates 10 additional constraints. For simplicity, the following constraints are applied to matrices A and B:

Matrix

$$A=\begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ NA & 1 & 0 & 0 & 0 \\ NA & NA & 1 & 0 & 0 \\ NA & NA & NA & 1 & 0 \\ NA & NA & NA & NA & 1 \end{pmatrix} B=\begin{pmatrix} NA & 0 & 0 & 0 & 0 \\ 0 & NA & 0 & 0 & 0 \\ 0 & 0 & NA & 0 & 0 \\ 0 & 0 & 0 & NA & 0 \\ 0 & 0 & 0 & 0 & NA \end{pmatrix}$$

By incorporating these variables, data, and constraints, we construct a five-variable SVAR model. The model includes DLNCCPI (with subcomponents DLNCCPIe, DLNCCPIc, DLNCCPIm, DLNCCPIo, DLNCCPIa), DLNM2, DLNCPI, DLNPPI, and DLNI.

We chose the AB-type with 5 variables (k = 5), requiring 10 constraints. After simplifying these rules, we built a 5-variable SVAR model featuring differenced logs of commodity indices (energy, metals, minerals, etc.), money supply, price indices, and interest rates.

3.4 Impulse Response Analysis

Based on the SVAR model, impulse responses can analyze the interactions among multiple variables. The significance lies in examining how disturbances in endogenous variables propagate, which in this context refers to how changes in various commodity price indices specifically affect macroeconomic indicators.

The impulse responses of China's macroeconomic indicators to commodity price indices are shown in Figures 1-6.

First, the impacts of different types of commodity price indices on China's money supply vary significantly. The composite commodity price index has a negative impact on money supply, starting near zero in the first period, increasing to -0.001 by the sixth period, then weakening and stabilizing at zero by the eleventh period. The energy commodity price index shows a similar pattern, initially positive

near zero in the first period, turning negative and peaking at -0.0008 in the sixth period before weakening to zero. The oil and fat commodity price index has a positive impact in the first five periods, sharply turning negative in the sixth period (-0.001), then weakening to zero. The mineral commodity price index follows a pattern akin to the composite index, starting negative near zero, briefly positive in the second period, then peaking at -0.001 in the fourth period before weakening. The agricultural commodity price index starts at 0.0014 in the first period, drops to zero by the fifth period, turns negative (-0.0005 by the seventh period), and slowly weakens to zero. The non-ferrous metal commodity price index has a negative impact, starting at -0.0005 and peaking at -0.0015 in the third period before weakening. Notably, non-ferrous metals exert the strongest negative impact on money supply, while agricultural commodities have the strongest positive impact.

Second, the impacts of different commodity price indices on the consumer price index (CPI) are generally positive. The composite index's impact rises from 0.001 in the first period to 0.0013 in the third, then drops sharply to near zero by the tenth period. The energy index follows a similar trend, peaking at 0.0012 in the third period. The oil and fat index fluctuates, briefly turning negative in the third period before peaking at 0.0006 in the fifth. The mineral index also fluctuates, peaking at 0.0005 in the fifth period. The agricultural index peaks at 0.0005 in the fifth period after a brief dip. The non-ferrous metal index peaks early at 0.0007 before declining. Among these, non-ferrous metals have the strongest positive impact on CPI.

Third, the impacts on the producer price index (PPI) are also generally positive. The composite index starts at 0.0035, briefly rises, then weakens to zero by the eighth period. The energy index starts at 0.003, peaking briefly before weakening. The oil and fat index starts at 0.0018, weakening to zero by the tenth period. The mineral index starts at 0.0028, weakening to zero by the eighth period before a slight negative dip. The agricultural index rises steadily to 0.0025 by the fourth period before weakening. The non-ferrous metal index peaks at 0.0045 in the third period before weakening. Here, non-ferrous metals have the strongest positive impact on PPI, while agricultural commodities have the weakest.

Finally, the impacts on interest rates are mostly positive. The composite index starts at 0.11, dropping to zero by the sixth period, then turning negative before stabilizing. The energy index follows a similar trend. The oil and fat index peaks at 0.013 in the fifth period before turning negative. The mineral index peaks at 0.008 in the third period before weakening. The agricultural index fluctuates between 0.005 and 0.01 in the first five periods before stabilizing. The non-ferrous metal index starts near 0.01, weakening to zero by the fifth period before a slight negative dip.

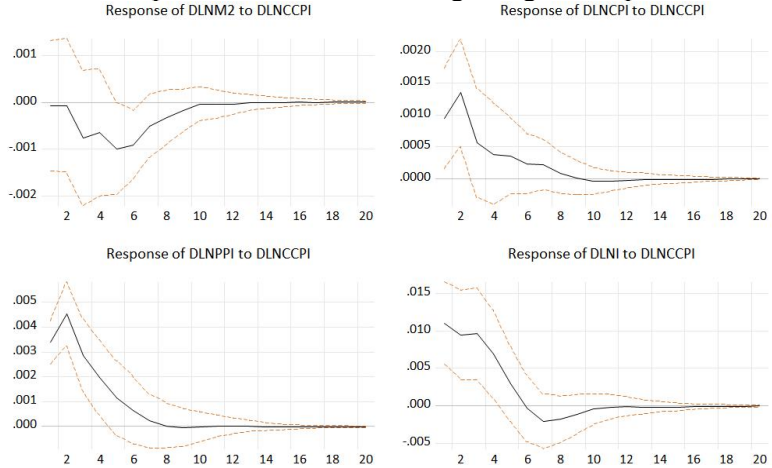

Figure 1. How Commodity Prices Affect the Macroeconomy: Impulse Response Analysis

*Note: Calculated by the author (95% confidence interval).

3.5 Variance Decomposition

Variance decomposition examines the contribution of each structural shock to the forecast error variance of the endogenous variables. **Tables 4–7** (in the original) present the variance decompositions of money supply, CPI, PPI and interest rates with respect to the commodity price indices. Non-ferrous metals explain the largest share of variation in the

money supply and production prices, while mineral commodity prices account for most of the variation in the CPI. Oil and fats prices contribute most to the variance of interest rates. Overall, the production price index exhibits the strongest explanatory power among the macro- economic variables.

3.5.1 Money supply

Non-ferrous metals (6.6%) have the biggest impact, followed by agricultural products (3.4%). Over time, commodity prices generally play a larger role in explaining money supply changes.

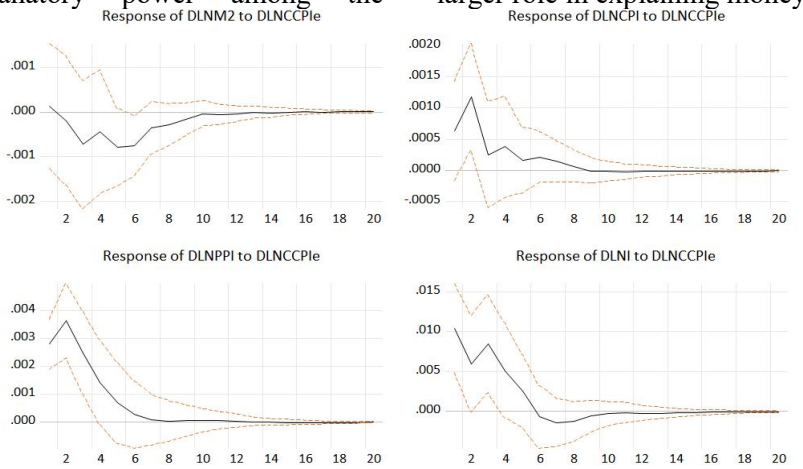

Figure 2. How Energy Commodity Prices Affect the Macroeconomy: Impulse Response Analysis

*Note: Calculated by the author (95% confidence interval).

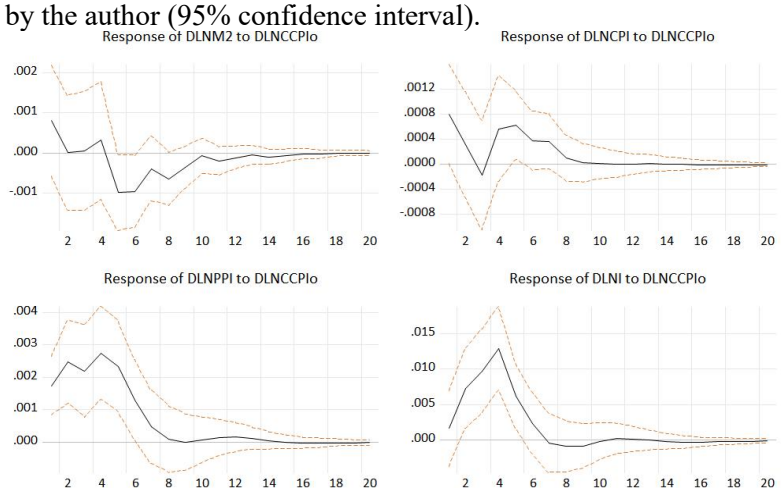

Figure 3. How Oil and Fat Commodity Prices Affect the Macroeconomy: Impulse Response Analysis

*Note: Calculated by the author (95% confidence interval)**.**

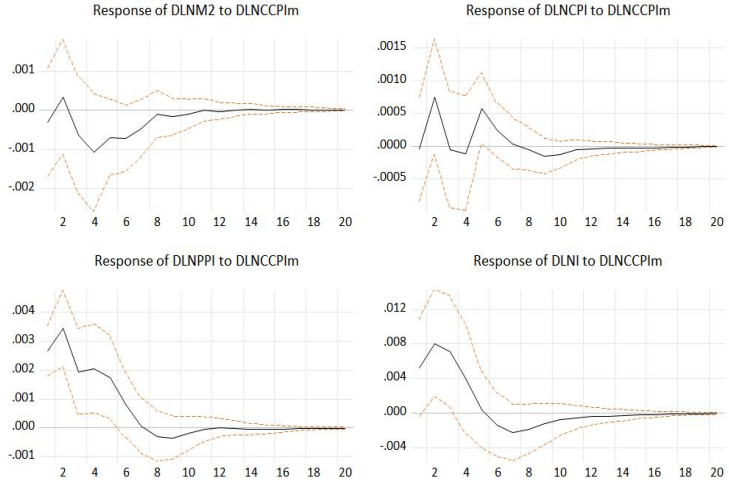

Figure 4. How Mineral Commodity Prices Affect China's Demand: Impulse Response Analysis

*Note: Calculated by the author.

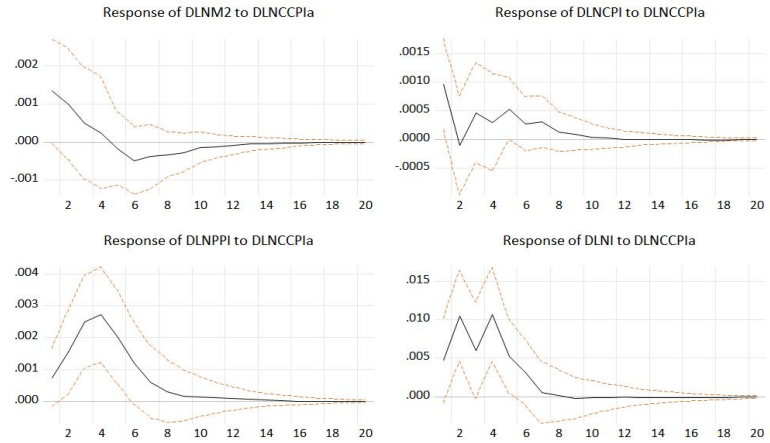

Figure 5. How Agricultural Commodity Prices Affect China's Demand: Impulse Response Analysis

*Note: Calculated by the author (95% confidence interval).

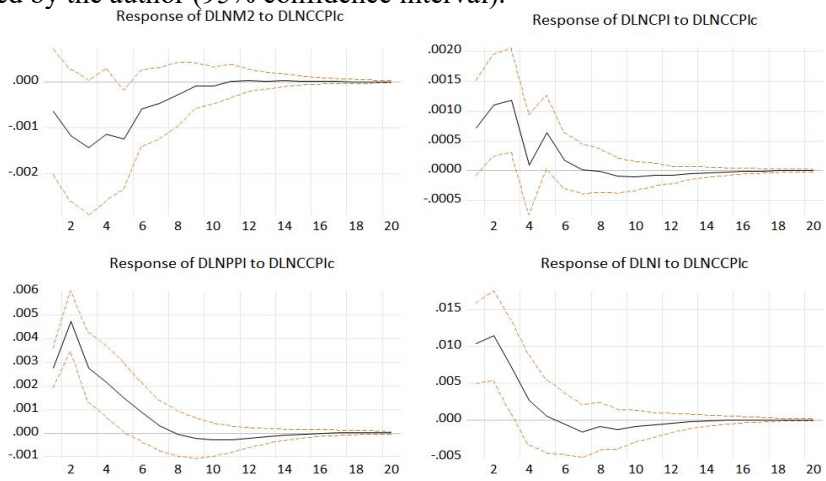

Figure 6. How Non-ferrous Metal Prices Affect Benchmark Interest Rates: Impulse Response Analysis

*Note: Calculated by the author (95% confidence interval).

Table 4. How Different Commodity Price Indices Explain Changes in Money Supply

Period	DLNCCPI	DLNCCPIe	DLNCCPIo	DLNCCPIm	DLNCCPIa	DLNCCPIc
1	0.000	0.000	0.007	0.000	0.021	0.005
2	0.000	0.001	0.007	0.018	0.031	0.020
3	0.006	0.006	0.007	0.017	0.032	0.041
4	0.009	0.007	0.007	0.016	0.029	0.049
5	0.018	0.013	0.016	0.026	0.029	0.062
6	0.026	0.018	0.024	0.027	0.031	0.064
7	0.028	0.019	0.025	0.027	0.032	0.066
8	0.028	0.019	0.029	0.027	0.033	0.066
9	0.028	0.020	0.030	0.027	0.033	0.066
10	0.028	0.020	0.030	0.028	0.034	0.066
11	0.028	0.020	0.030	0.028	0.034	0.066
12	0.028	0.020	0.030	0.028	0.034	0.066

*Note: Calculated by the author with a 95% confidence level.

3.5.2 Consumer prices

Mineral prices dominate (26.9%), with other commodities like energy (5.7%) and non-ferrous metals (9.7%) also significant. Commodity prices explain CPI movements better than money supply changes.

3.5.3 Producer prices

Non-ferrous metals (39.9%) and total commodity indices (39.9%) are top influencers. Commodities overall have a stronger grip on PPI than on CPI or money supply.

3.5.4 Interest rates

Oil and fat prices (19.0%) lead the pack, with total commodity indices (18.7%) close behind.

These tables reveal how different commodity categories "vote" in shaping China's economic indicators—with metals and oils often casting the heaviest ballots.

Table 5. How Different Commodity Price Indices Explain Changes in the Consumer Price Index

Period	DLNCCPI	DLNCCPIe	DLNCCPIo	DLNCCPIm	DLNCCPIa	DLNCCPIc
1	0.031	0.014	0.022	0.184	0.032	0.018
2	0.084	0.054	0.023	0.234	0.029	0.055
3	0.090	0.054	0.023	0.230	0.034	0.092
4	0.089	0.055	0.031	0.251	0.035	0.088
5	0.092	0.056	0.041	0.268	0.042	0.098
6	0.093	0.057	0.045	0.269	0.044	0.098
7	0.093	0.057	0.048	0.267	0.046	0.098
8	0.093	0.057	0.048	0.266	0.047	0.097
9	0.093	0.057	0.048	0.266	0.047	0.097
10	0.093	0.057	0.048	0.266	0.047	0.097
11	0.093	0.057	0.048	0.266	0.047	0.098
12	0.093	0.057	0.048	0.266	0.047	0.098

*Note: Calculated by the author with a 95% confidence level.

Table 6. How Different Commodity Price Indices Explain Changes in the Producer Price Index

Period	DLNCCPI	DLNCCPIe	DLNCCPIo	DLNCCPIm	DLNCCPIa	DLNCCPIc
1	0.288	0.191	0.079	0.019	0.014	0.211
2	0.376	0.246	0.119	0.057	0.038	0.362
3	0.386	0.258	0.151	0.080	0.097	0.373
4	0.397	0.261	0.210	0.084	0.157	0.389
5	0.399	0.260	0.247	0.083	0.187	0.397
6	0.399	0.259	0.256	0.082	0.196	0.399
7	0.398	0.258	0.254	0.084	0.198	0.398
8	0.397	0.257	0.252	0.085	0.198	0.397
9	0.396	0.257	0.251	0.086	0.198	0.396
10	0.395	0.256	0.250	0.086	0.197	0.396
11	0.395	0.256	0.250	0.086	0.197	0.397
12	0.395	0.256	0.250	0.086	0.197	0.397

*Note: Calculated by the author with a 95% confidence level.

Table 7. How Different Commodity Price Indices Explain Changes in Interest Rates

Period	DLNCCPI	DLNCCPIe	DLNCCPIo	DLNCCPIm	DLNCCPIa	DLNCCPIc
1	0.085	0.074	0.002	0.019	0.016	0.076
2	0.132	0.089	0.040	0.057	0.083	0.145
3	0.171	0.119	0.097	0.080	0.098	0.160
4	0.187	0.127	0.178	0.084	0.150	0.157
5	0.187	0.128	0.190	0.083	0.160	0.154
6	0.184	0.126	0.188	0.082	0.163	0.152
7	0.185	0.126	0.185	0.084	0.161	0.152
8	0.185	0.126	0.183	0.085	0.161	0.152
9	0.185	0.126	0.182	0.086	0.160	0.152
10	0.185	0.126	0.182	0.086	0.160	0.153
11	0.185	0.126	0.182	0.086	0.160	0.153
12	0.185	0.126	0.182	0.086	0.160	0.153

*Note: Calculated by the author with a 95% confidence level.

4. Conclusions and Policy Implications

4.1 Conclusions

First, in the short term, the commodity price index has a significant positive driving force on the consumer price index, producer price index, and interest rates, while exhibiting a negative impact on the money supply.

Second, different categories of commodity price indices show notable variations in their effects on the money supply, consumer price index, producer price index, and interest rates: among all commodity categories, nonferrous metals have the most negative impact on the money supply, while agricultural products have the most positive impact; nonferrous metal commodity prices exert the strongest positive

influence on both the consumer price index and producer price index; the positive effects of various commodity prices on interest rates show relatively minor differences.

Third, in variance decomposition, the nonferrous metal commodity price index demonstrates the strongest explanatory power for the money supply, and it is also observed that the explanatory ability of various international commodity price indices on the money supply generally strengthens over time; the mineral commodity price index has the highest explanatory power for the consumer price index; the nonferrous metal commodity price index shows the strongest explanatory power for the producer price index; the oil and fat commodity price index has the greatest explanatory power for interest rates. Meanwhile, compared to other indicators, the producer price index generally exhibits the strongest explanatory ability.

4.2 Policy Recommendations

Based on the research conclusions above, this paper provides the following policy-oriented suggestions for macroeconomic governance and commodity price prediction and regulation.

First, it is essential to strengthen the analysis and monitoring of commodity market trends and early warnings. In the post-pandemic era, as the international landscape continues to evolve, close attention must be paid to the impact of events such as global economic recession, Federal Reserve interest rate hikes, and geopolitical conflicts on the futures and spot price trends of commodities. International commodities should be categorized by type to address corresponding price volatility risks in a targeted manner, and a scientific early-warning information processing and reporting system should be established to minimize risks arising from abnormal commodity price fluctuations.

Second, the commodity reserve system should be comprehensively improved. Building on the existing foundation, the multi-level and diversified construction of the reserve system should be accelerated, aiming to establish a hierarchical system where government reserves, corporate reserves, central reserves, and local reserves complement each other. Efforts should be made to ensure stable supply and prices of key categories such as energy, nonferrous metals, and minerals, while enhancing production levels for these critical commodities. Strategic commodity reserves should be reasonably expanded to create a world-class, high-standard, end-to-end commodity trade chain.

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