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Article

A study on the influence mechanism of commodity facilitation returns and monetary policy based on public confidence perspective

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Abstract: As a key factor in the macroeconomic process, the interaction between public confidence and the commodity market, especially its impact on commodity facilitation returns and macroeconomic linkages, is worth exploring in depth. This study adopts the TVP-SV-VAR model to analyze the causal linkages, dynamic characteristics, and mechanisms of the interaction, and reveals the following core findings: (1) The economic background and information shocks contribute to the variations in the effects and orientations of the economic variables, which highlight the time-varying nature of the economic interactions. (2) Consumer and investor confidence exert heterogeneous influence on the macroeconomy, and their different responses to the negative effect of interest rates and convenience gains are particularly significant in the post-crisis recovery period. (3) In the short-term perspective, the influence of public confidence on monetary policy and inflation exceeds that in the medium and long term, highlighting the immediate sensitivity of individual economic behavior. (4) Since 2015, accommodative monetary policy has accelerated market capital flows, delaying the interaction between confidence indices and inflation, revealing policy time lag effects. (5) Convenience gains exhibit complex time-varying interactions with key economic parameters (interest rates, commodity prices, and inflation), with 2011 and 2014 displaying particular patterns, mapping differences between short- and long-term mechanisms, respectively. The study highlights the central role of consumer and investor confidence in the precise tailoring of macroeconomic policies, providing a scientific basis for policy forecasting and economic regulation, and contributing to economic stability. Meanwhile, the dynamic evolution of consumer confidence deepens market trend foresight, enhances the precision of market participants' decision-making, and reinforces the resilience and predictability of economic operations.

Keywords: consumer confidence; investor sentiment; convenience gains; monetary policy; inflation

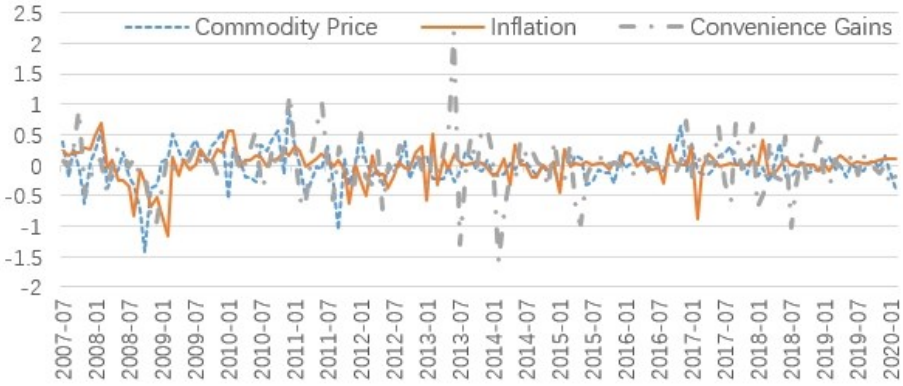
1. Introductory

In recent years, with the development of economic globalization and integration, the increase in international economic activities and trade, and the accelerated development of China's urbanization and industrialization, China's demand for bulk commodities such as metals and agricultural products has been rising (BOC Research, 2021). At present, China has become a major producer and importer in the world, while the pricing power of commodities represents, to some extent, a country's voice and international status (Zhang, 2019). However, under the global economic crisis and economic cycles, as well as changes in the pattern of supply and demand, the market has frequently experienced abnormal volatility. The most notable in China is the increased price volatility of agricultural products, metal commodities, and other commodities, with representative images such as "garlic you hard", "ginger you army",

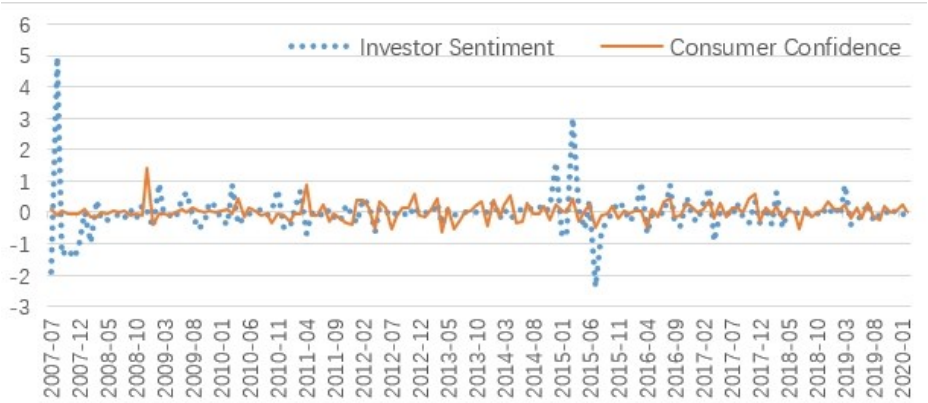
"beans you play" and other words reflecting the abnormal volatility of commodity prices (Huang and Chen, 1999). This reflects the extraordinary volatility of commodity prices, which has had an impact on China's economic performance on more than one occasion (Commodity Industry Research Report, 2024; Peking University HSBC Think Tank, 2021).

Commodities are an important primary market and an indispensable basic resource in the development of human society, and their prices and supply and demand have a significant impact on the economic system. With the deepening of people's knowledge of the commodity market and the constant changes in the economic environment, the attributes of commodities have changed, from the original production materials into investment commodities with financial attributes (Ke and Wei, 2012), and can be used to hedge against the risk of inflation, which is the fundamental reason why investors are more active in the flow of the commodities market (Baur and Lucey, 2010). Currently, the commodities market is similar to the financial market and can be considered the second-largest market in the financial investment category (Chen and Rogoff, 2003; Center for Financial Studies, Fudan Institute of Development Studies, 2021; Huajing Intelligence Network, 2022).

At present, the important impact of commodities on the macroeconomy is mainly reflected in economic growth and volatility, interest rates, inflation, etc., but it has certain limitations, most of the research is mainly focused on the impact between commodity prices and the macroeconomy(Hamilton, 2009; Killian, 2009), and commodity price changes in addition to supply and demand factors affecting the market will follow the consumption of this and the investor's market flow changes, and consumers and investors' Psychological activities will drive their behavioral decisions, affecting their own needs for asset allocation(Long et al., 1990; Shleifer and Summers, 1990), while the behavioral decisions of economic individuals will be affected from the microeconomic level to the macroeconomic level, thus changing the original economic development expectations(Akerlof and Shiller, 2010). Therefore, consumer confidence and investor sentiment on economic development can not be ignored as an influential factor, but also early studies have shown that the impact of economic subject confidence on macroeconomic development has a high research value (Bernanke et al., 1997; Huarong Rongda Futures, 2022; Mankiw et al., 1992; Peking University HSBC Think Tank, 2021).



(a) The state of volatility of commodity prices, inflation and convenience gains.



(b) Fluctuating states of investor sentiment and consumer confidence.

Figure 1. Fluctuation chart of changes in impact factors.

At the same time, different economies will be based on their own needs for the corresponding asset allocation, and commodities in addition to production and supply demand, commodity inventories are equally important, most of the previous research is usually aimed at the relationship between speculative stocks of commodities and the impact of economic policy, focusing on the impact of the commodity inventory factors, while ignoring the convenience of the inventory itself the impact of the gains of the economic policy, and the economy chooses to use commodities for speculation at the expense of its convenience gains. Economies that choose to use commodities for speculative purposes do so at the expense of the convenience gains they offer, which in turn reflect the consumer confidence and investment sentiment of the economy. For commodities, the convenience gain is an important factor and, as can be seen in **Figure 1**, the movements in commodity prices, convenience gains, and inflation are generally consistent, while the movements in investor sentiment and consumer confidence are consistent overall, but intensify in individual periods.

As for the impact mechanism of monetary policy, the main focus is on the monetary policy transmission mechanism, which is the top priority of macroeconomic policy regulation, but with the diversification of the economic environment, resulting in the traditional monetary policy transmission channels are blocked, the transmission is not smooth enough, which in turn weakens the effect of monetary policy. This may be due to the growing similarity between commodity markets and financial markets, as well as the subjective behavior of micro-individual decisions. After several global financial crises, economists and policymakers have more in-depth knowledge and development of macro and micro-economics, especially after the 2008 financial crisis, and gradually realized that the macro-economic operation needs to be built on the microeconomic foundation to play a more potent effect, and therefore a better combination of micro-economics and macro-economics is based on a greater concern. In particular, the microeconomic base is an important component of the transmission mechanism of monetary policy, which is embodied in the household and corporate sectors. The household sector is mainly based on consumer intertemporal resource allocation, and the corporate sector is based on corporate investment efficiency and cost minimization. Therefore, when studying the mechanism of monetary policy influence, it is logical to include influences that are representative of microeconomic behavior, which is usually based on subjective judgments of microeconomic

individuals, which highlights the importance of the analysis of psycho-behavioral factors for macroeconomic operations.

In summary, in the current economic environment, especially under the conditions of increased market volatility and liquidity, the impact of public expectations on the macro economy seems to be particularly important, and the commodity market is highly favored by investors after 2000, resulting in a large amount of currency inflow into the commodity market, which also implies that the investor sentiment and public expectations of the existence of an important impact on the direction of the flow of money and the flow rate, which shows that the micro-economic bodies This also implies that investor sentiment and public expectations have an important impact on the flow of money and the flow of money, which shows that the subjective psychological activities of micro-economics have important theoretical and practical significance in analyzing the influence mechanism of monetary policy in China. Based on the above background analysis of commodity markets and macroeconomics, the main research objective of this paper is to conduct an in-depth analysis of the influential relationship between commodity facilitation returns, consumer confidence, investor sentiment monetary policy, and inflation, and to clarify the channels of influence between them. Therefore, the contributions of this paper are: first, based on an extensive review and analysis of the existing literature, this paper identifies the gaps in the existing research and focuses on the link between commodity convenience gains, consumer confidence investor sentiment, and macroeconomic policies. Through theoretical innovation, this paper proposes a more comprehensive analytical framework that enriches the research on the interaction between residents' preferences and macroeconomic policies and fills the gaps in the literature; Second, based on the historical literature, this paper further explores the role of convenience gains in commodity inventories in the macroeconomy, especially their significance during periods of sharp price volatility. By analyzing the relationship between convenience gains and monetary policy and macroeconomic objectives, this paper makes up for the shortcomings of previous studies and provides a new perspective for understanding the dynamics of the commodity market; third, based on an in-depth analysis of historical literature, this paper proposes a new mechanism by which consumer confidence indirectly affects the macroeconomy through commodity convenience gains. This finding provides new theoretical support to explain the insignificant impact of the Chinese consumer confidence index on inflation in previous studies, and enhances the understanding of the relationship between consumer behavior and the macroeconomy; fourth, based on the existing literature, this paper introduces a time-varying analytical framework, and through the dynamic time-varying impulse response methodology, it provides an in-depth analysis of the dynamic impact mechanism of commodity facilitation gains, consumer confidence and investor sentiment on the relationship between monetary policy and inflation. Inflation through a dynamic time-varying impulse response methodology, provides an in-depth analysis of the dynamic impact mechanisms of commodity convenience gains, consumer confidence, and investor sentiment on monetary policy and inflation. The application of this methodology not only improves the understanding of the effects of monetary policy and the volatility of commodity markets but also provides new explanations for the effectiveness of monetary policy and market dynamics in recent

years.

The remainder of the paper is organized as follows: Section 2 is a review of the relevant literature; Section 3 provides a theoretical analysis of the impact of micro-psychological activities and macroeconomics and presents the research hypotheses; Section 4 describes the empirical model; Section 5 presents an empirical analysis of the impact mechanism of commodities and macroeconomics from the perspective of public expectations and the results; Section 6 provides a robustness test; and finally, it concludes and gives the corresponding policy recommendations.

2. Literature review

This paper explores and reviews the historical literature by focusing on the influential relationship between public confidence, commodity facilitation gains and macroeconomics as the main line of literature:

2.1. Public confidence and the macroeconomy

Public confidence plays a crucial role in macroeconomic stability and the robustness of the financial system. Farmer (2010) first emphasized the strong link between confidence and economic fundamentals, stating that confidence is not only a driver of economic activity but also a key factor in economic stability. Subsequently, Wu et al. (2004) further explored the predictive role of the consumer confidence index, arguing that this index can predict changes in consumer behavior and provide important signals to the market. Akerlof and Shiller (2010) viewed consumer and business confidence as an important source of economic volatility, and they argued that this confidence reflects the mood of market participants, the “animal spirits”. Travis-Hill (2023) states that public confidence in the macro economy is a key component of financial stability and economic growth. Macroeconomic resilience to shocks is closely linked to public confidence in the justice system, the maintenance of which, as stated by the OECD Council (2014), is essential for the continuation of the economy. There is a positive mutual driving effect between confidence and the economic cycle, and inflation can hurt confidence, leading to a divergence between the price cycle and the confidence cycle (Song and Li, 2024).

There is a significant relationship between consumer confidence index and economic growth. Dees and Brinca (2013) showed that the consumer confidence index can effectively reflect economic fluctuations. Chatterjee and Dinda (2015) further concluded that there is a positive relationship between the consumer confidence index and economic growth rate. Annie Ho (2016) similarly verified that there is a significant impact relationship between the two.

The maintenance of public confidence is particularly critical in times of financial crisis. During the Argentine banking crises of 1995 and 2001, restoring public confidence in the banking system was considered central to economic recovery (Argentine Banking Crisis, 2016). During the global financial crisis of 2008, feedback loops between the financial markets and the macroeconomy had a significant impact on public confidence, and studies by Guo (2010) and Ren and Wei (2012) have recognized the importance of consumer confidence index in macroeconomics.

The formulation of policies and institutions is equally crucial in maintaining

public confidence. Jiang et al. (2011) show that consumer sentiment has a significant impact on price and consumption volatility, so it is important to take into account the consumption habits of the population when formulating interest rate policy. Bachmann and Sims (2012) also suggest that confidence is an important communication mechanism for coping with policy shocks. Lien et al.'s (2021) study finds that in states of high uncertainty, monetary policy is significantly less effective, especially when it fails to inspire entrepreneurial confidence. This finding emphasizes the key role of confidence in the transmission mechanism of monetary policy. Gobbi et al. (2022), on the other hand, examined the relationship between monetary policy, rational confidence, and "neo-Fisherian" depressions, and found that the neo-Fisherian proposition is theoretically possible, but less likely in practice. The Basel Committee specifically considered the importance of public confidence when assessing the impact of policy on the banking system and the macroeconomy (Hill, 2023). The purpose of the Reserve Bank Act was to maintain public confidence by preserving macroeconomic price stability (Governor's Message to Management, 2024).

2.2. Convenience gains and macroeconomics

Convenience yield is a key concept in understanding commodity price volatility, first introduced by Kaldor (1939), who argued that there is an inverse relationship between convenience yield and inventories. Working (1949) pointed out that a low level of inventories leads to higher prices and an increase in the marginal convenience yield. The role of convenience yield in commodity pricing. Pindyck (1993) found that the convenience yield contains all the information about commodity fundamentals, which suggests that the convenience yield may be more effective in predicting commodity prices than the commodity price itself. Knetsch (2007) also argued that in some cases, the convenience yield may be a better predictor than the commodity price.

The predictive role of convenience gains on macroeconomics. Stepanek et al. (2013) showed that convenience gains can predict not only future spot prices but also static inventory levels. Gospodinov and Ng (2013) further confirmed that commodity convenience gains and real commodity prices extracted through principal components have a good inflation prediction, which provides a new perspective on the effective combination of microeconomic level and macroeconomic level.

Convenience gains is a concept that plays an important role in macroeconomics as evidenced in various studies. Some studies have discussed how convenience gains affect the macroeconomy through the liability side of bank balance sheets, which suggests that convenience gains have an impact on the real economy (Rogers, 2022). The relationship between convenience gains and the macroeconomy is complex and multifaceted (Prokopczuk, 2023; Zheng et al., 2020), and convenience gains are thought to be negatively correlated with macroeconomic deviations (Risk and the Macro-economy, 2008). Convenience gains are not only explained by passive exposure to variables related to macroeconomics, financial risk and liquidity (Prokopczuk et al., 2023). Moreover, convenience gains can be extracted from measures such as credit markets, which further emphasizes their importance in understanding the macroeconomy (Vadim, 2022). Moreover, what about facilitation gains, in the sense that it belongs to an important component of financial markets and

changes in financial inclusion can affect monetary policy effectiveness (Garbobiya et al., 2024). Overall, convenience gains are a key factor in understanding the macroeconomy and its impact on various sectors. Further research is needed to fully grasp the complexity of facilitation gains and their macroeconomic implications.

2.3. Research progress

Exploring the mechanisms by which variables such as public confidence, inventory decisions of microeconomic entities, and convenience gains affect macroeconomic dynamics is a complex and multidimensional issue, which is not only limited by macroeconomic fundamentals but is also closely related to the expectations of market participants and government policy guidance. It is particularly important to deepen the understanding of the interactions between these variables and turn them into theoretical support and practical guidance for macroeconomic policymaking. Although academics and practitioners have gradually realized the potential value of convenience gains in macroeconomic forecasting, there is still a lack of in-depth research on how it affects the efficiency of monetary policy implementation and inflation targeting. Especially in China, academic research tends to explore the relationship between convenience gains and futures prices in the area of options and futures, ignoring the potential role of the rich information contained in convenience gains in guiding the formulation of macroeconomic policies, an area where research needs to be expanded.

As a key indicator of the characteristics of commodity markets, convenience gain is of great significance in analyzing the mechanism of commodity price volatility and improving the accuracy of macroeconomic forecasts. However, how to effectively utilize convenience gains to deepen the understanding of the mechanisms affecting monetary policy design and inflation targeting, as well as to integrate this element more accurately in macroeconomic analysis frameworks, remains a weak link in research and requires more systematic and in-depth exploration.

Taken together, convenience gains not only contain important information about the fundamentals of the commodity market but also show forward-looking signals that are more sensitive than direct commodity prices, especially in the context of the massive influx of capital into the commodity market, which strengthens the optimistic expectations of market participants about the commodity market, indirectly reflecting the significant impact of psycho-behavioral factors on the trend of the commodity market. Although psychological behavioral factors are often discussed in macroeconomic growth analysis, the specific role in the commodity market is also worth digging deeper into. At the same time, it is important to explore in depth the specific relationship between public confidence and the monetary policy transmission mechanism, including the ways and mechanisms of how confidence affects policy effects. Therefore, this paper aims to build a bridge between the psychological behavioral characteristics of micro-economies and the performance of commodity markets and macroeconomic activities using empirical analysis, to provide novel insights into understanding how market psychology affects the macroeconomy through mechanisms such as facilitating returns.

3. Theoretical analysis and research hypotheses

Considering that the importance of micro-economies is increasingly strengthened, and each micro-economy is based on its expectations of future economic development using individual utility optimization for inter-period asset allocation behavior decision-making, and according to the market supply and demand and effective information to constantly adjust the allocation decision-making, and there are differences in the different micro-economies on the expected economic development of the micro-economies, which makes micro-economies produce different behavioral decisions, which leads to the link between the micro-economy and the macro-economy has time-varying characteristics. Moreover, the subjective judgment of behavioral decisions has a certain lag and randomness, which may lead to a large difference in the degree of influence on macroeconomic decisions. By combing and analyzing the historical literature, this paper conducts a comparative time-varying analysis of the influence mechanism between the consumer confidence index the investor sentiment index, and the macroeconomy, and investigates the uncertainty of the two concerning convenience earnings, commodity prices and monetary policy, and inflation. The paper then focuses on the following aspects of research: first, whether consumer confidence and investor sentiment have an impact on the macro economy; second, whether consumer confidence and investor sentiment affect convenience gains in commodities; and third, how consumer confidence and investor sentiment and convenience gains play a role in the mechanism of monetary policy and inflation.

Constructing a theoretical modeling research framework. In macroeconomic analysis, the construction of comprehensive public confidence by integrating confidence indicators such as consumer confidence, investor sentiment and public confidence, it aims to provide a tool that comprehensively reflects market expectations. Consumer confidence reflects the public's views on the current state of the economy and future trends, and influences consumption behavior; investor sentiment affects capital market volatility and investment decisions. Through such indices, policymakers can better understand the public's perception of future economic conditions, thus providing an important reference for monetary policy decisions.

In formulating and implementing monetary policy, the Central Bank refers to public confidence and its combination with macroeconomic indicators. This reference is based on a comprehensive assessment of the current economic situation and expectations of the future direction of the economy. In this way, central bank can to identify more accurately the stage of the economic cycle and adjust their monetary policy tools accordingly to achieve the established macroeconomic objectives, such as price stability, economic growth, full employment and balance of payments. It has been found that increased entrepreneurial and consumer confidence can expand domestic demand and drive macroeconomic development by influencing the mediating variables of monetary policy. In addition, the adjustment of monetary policy can affect entrepreneurial confidence and consumer confidence, which in turn has an impact on domestic demand (Liu et al., 2019). Moreover, monetary policy shocks can significantly affect the confidence of economic agents, economic agents' confidence is positively correlated with real output (Chen, 2015), and market confidence enhances the transmission efficiency of monetary policy with social financing as the

intermediary target, and the impact on direct financing is stronger than that on indirect financing (Qin and Xu, 2018).

In addition, convenience gains, as a reflection of market expectations, interact with public confidence to influence the effectiveness of monetary policy. The convenience yield usually refers to the difference between the expected rate of return on an asset or commodity and the risk-free interest rate under given economic conditions. This indicator reflects market expectations of future economic conditions, while public confidence provides a broad estimate of the public's perception of future economic prospects. The interaction between the two reveals the link between public and market expectations, which in turn influences the policy decisions of central banks and their actual impact on the economy.

Based on the above analysis, this paper briefly summarizes the process of the overall impact mechanism using a general model:

The purely forward-looking New Keynesian Phillips curve proposed by Taylor, Rotemberg and Calvo et al. can be expressed as follows:

$$\pi_t = \beta E_t \pi_{t+1} + \lambda(y_t + y_{t-1})$$

where, $E_t\pi_{t+1}$ is the expected inflation rate, y is the output gap, β and λ are the coefficients. Zheng et al. (2020) extend the traditional New Keynesian Phillips curve by introducing convenience gains from commodities:

$$\pi_t = \beta E_t \pi_{t+1} + \lambda(y_t + y_{t-1}) + \gamma_\delta \bar{\delta}_t$$

where, $\bar{\delta}_t$ is a facilitation gain, γ_δ is the coefficient of the convenience gain of the commodity.

Monetary policy rules. Extended Taylor (1993) interest rate rule, as follows.

$$i_t = \phi_1 i_{t-1} + (1-\phi_1)[\phi_2(E_r\pi_{t+1} - \pi_t) + \phi_3\pi_t + \phi_4 y_t] + v_t$$

where, π_t is inflation rate, reaction coefficients chosen by the monetary authority ϕ_1, ϕ_2, ϕ_3 and ϕ_4 is a positive number. Under this monetary policy rule, the monetary authority adjusts short-term nominal interest rates to affect the main variables in the economy.

$$cf_t = \eta_1 cf_{t-1} + \eta_2 i_t + \eta_3 \pi_t$$

where, cf is public confidence.

Through the above theoretical analysis, the commodity market and macroeconomy under the public psychological behavior can be described as a link between the micro level and the macro level, which can be summarized as follows: confidence and sentiment of microeconomic individuals → commodity market → monetary policy → macroeconomic target (inflation) and vice versa. Based on the above analysis, this paper proposes the following research hypothesis:

3.1. Hypothesis 1: Time-varying effects of consumer confidence and investor sentiment on monetary policy

There may be significant differences in the impact of consumer confidence and investor sentiment on monetary policy during recessions and booms. During recessions, consumer and investor sentiment may have a stronger demand for an accommodative bias in monetary policy to stimulate economic activity. In contrast, during booms, these sentiments may have an impact on the tightening bias of monetary policy to prevent overheating and inflation.

3.2. Hypothesis 2: Time-varying effects of consumer confidence and investor sentiment on commodity convenience returns

Changes in consumer confidence and investor sentiment may have different impacts on commodity convenience returns across economic cycles. During economic downturns, these sentiments may hurt commodity convenience returns, while during economic booms, they may promote commodity convenience returns.

3.3. Hypothesis 3: The role of convenience earnings and commodity prices in indicating monetary policy

Changes in convenience earnings and commodity prices may reflect macroeconomic conditions and thus provide central banks with indications on monetary policy adjustments. When convenience gains and commodity prices rise, tight monetary policy may be needed to curb inflation; conversely, loose monetary policy may be needed to stimulate economic growth.

3.4. Hypothesis 4: The relationship between facilitation gains and the impact of price-based monetary policy instruments

Price-based monetary policy instruments may be positively related to facilitation gains. When the central bank reduces interest rates, this is often seen as a stimulus aimed at encouraging borrowing and investment, which may increase liquidity in the commodity market, and hence convenience gains. Such increased facilitation gains may affect pricing in commodity futures markets, causing them to rise.

Quantitative monetary policy tools, may have an inverse relationship with facilitation gains. When the central bank raises the reserve requirement ratio, commercial banks have less available funds, which may lead to less liquidity in the commodity market, which in turn reduces the convenience yield. This reduced facilitation gain may affect pricing in the commodity futures market, bringing it down.

3.5. Hypothesis 5: Stage differences in the relationship between convenience gains and the impact of commodity prices

The relationship between convenience gains and commodity prices may differ at different stages of the economy. In a recession, the relationship may be more complex, while in a boom, the link between convenience gains and commodity prices may be more direct.

3.6. Hypothesis 6: The relative degree of macroeconomic impact of consumer confidence and investor sentiment

While investor sentiment may have a significant impact on the macroeconomy in some cases, consumer confidence may have a more lasting and far-reaching impact on the macroeconomy at different stages. Consumer confidence may be more reflective of actual consumption behavior and long-term economic trends, while investor sentiment may be more reflective of short-term market volatility and speculative behavior.

4. Empirical model

4.1. Model introduction

The TVP-SV-VAR model is a model used to analyze multiple macroeconomic time series data. It is able to capture not only the dynamic relationships between variables but also to deal with parameter changes over time, which allows the model to adapt to changes in the economic environment and provide more flexible and accurate forecasts. The TVP-SV-VAR model is chosen in this paper because it is highly respected in macroeconomic analysis, mainly due to its core advantage-capturing the time-varying characteristics of macroeconomic variable parameters. The ability to accurately identify and predict structural changes and policy effects amidst the fluctuations of the economic cycle is of inestimable value to economic research and policy formulation. Particularly important is that many macroeconomic time series are often characterized by non-stationarity, and the TVP-SV-VAR model effectively addresses these challenges through the time-varying nature of its parameters, demonstrating excellent adaptability and flexibility. This enables the model to be responsive to changing economic environments and conditions, making it more appropriate and suitable for application in complex economic contexts compared to other models.

4.2. Model interpretation

Although the traditional vector autoregressive (VAR) model is more widely used, the estimated parameters are constant and cannot capture the time-varying characteristics of China's macroeconomy and analyze its influence mechanism, therefore, this paper adopts the TVP-SV-VAR model, which is based on Nakajima's (2011) study, and resets the intercept term on top of the study of the traditional VAR model, variance, and the estimated parameters. The method can be simply described as a time-varying SVAR model.

The TVP-SV-VAR model is set up as:

$$y_t = B_{1t}y_{t-1} + \cdots + B_{st}y_{t-s} + \varepsilon_t, t = s+1, \ldots, n, \varepsilon_t \sim N(0, \Omega_t)$$

Among other things, the y_t is the number of $(k \times 1)$ the observed variables of the column vector. $B_{1t} \ldots B_{st}$ is $(k \times k)$ the matrix of time-varying correlation coefficients of Ω_t is the time-varying covariance matrix of $(k \times k)$ the time-varying covariance matrix of $\Omega_t = A_t^{-1}\Sigma_t\Sigma_t A_t'^{-1}$ and A_t is the lower triangular matrix of $\Sigma_t = \text{diag}\,(\sigma_{1t}, \ldots \sigma_{kt})$ and β_t is the time-varying covariance matrix of $B_{1t} \ldots B_{st}$ the$(k^2 \times k)$ stacked matrices.$a_t = \left(a_{1t} \ldots a_{qt}\right)'$ is a vector consisting of A_t stacked vectors of $h_t = (h_{1t} \ldots h_{kt})$. The $h_{it} = log(\sigma_{it})^2$, the $i = 1 \cdots k$, and the time-varying parameters obeying a random wandering process:

$$\beta_{t+1} = \beta_t + \mu_{\beta t}$$

$$a_{t+1} = a_t + \mu_{at}$$

$$h_{t+1} = h_t + \mu_{ht}$$

$$\begin{pmatrix} \varepsilon_t \\ \mu_{\beta t} \\ \mu_{at} \\ \mu_{ht} \end{pmatrix} \sim N\left(0, \begin{pmatrix} I & 0 & 0 & 0 \\ 0 & \Sigma_\beta & 0 & 0 \\ 0 & 0 & \Sigma_a & 0 \\ 0 & 0 & 0 & \Sigma_h \end{pmatrix}\right)$$

where, $e_t = A_t^{-1}\Sigma_t\varepsilon_t$, the Σ_a and Σ_β is a diagonal array, i.e., the equations are independent of each other $\beta_{t+1}\sim N(\mu_{\beta 0}, \Sigma_{\beta 0}), a_{t+1}\sim N(\mu_{a0}, \Sigma_{a0}), h_{t+1}\sim N(\mu_{h0}, \Sigma_{h0})$.

As can be seen in the model construction, this econometric model requires many parameters to be estimated, and since the likelihood function under random fluctuations is difficult to handle, the parameters are generally estimated using Bayesian Inference (Bayes Inference) and Markov Monte Carlo Simulation (MCMC) methods. To facilitate the accessibility of the parameter estimation, the estimation process is Σ_h、Σ_a and Σ_β assumed to be a diagonal matrix, and a priori probability densities of the parameters are obtained from the given historical information.

4.3. Model illustrations

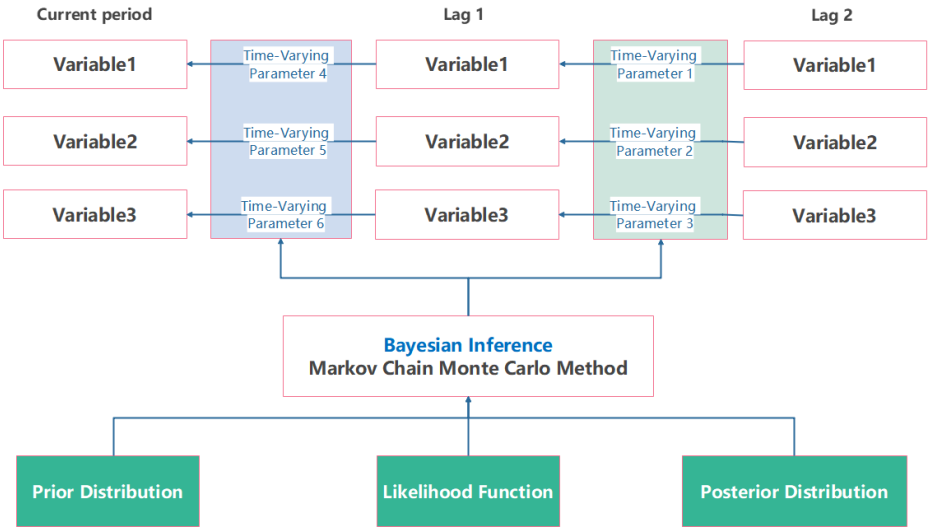


Figure 2. Illustrate the model's components and interactions.

Figure 2 simply summarizes the estimation process of the empirical model; the real estimation is far more complex than the figure.

5. Empirical analysis

5.1. Empirical framework and data selection

The theoretical analysis and research hypotheses of this paper mainly reflect that: first, the development of the macroeconomy will increasingly rely on the psychological behavioral decisions of microeconomic individuals, and the public psychological factors will pass through the micro level to the meso-economy, and finally affect the macroeconomic operation; second, the changes in the economic environment will lead to significant changes in the behaviors of microeconomic individuals, which are not static; and third, the importance of the commodity market on the macroeconomics is becoming increasingly important. Therefore, it is necessary to analyze the dynamic process of this influence mechanism from a time-varying perspective. In this paper, we set up model I:$y_t = [\text{CCI CON CPI P R M}]'$. This paper sets up Model I., Model II:$y_t = [\text{ISI CON CPI P R M}]'$. The purpose of this setup is to make it easier to distinguish the impact of consumer confidence and investor sentiment

on the macroeconomy, to formulate more targeted macroeconomic policies. The dataset used for the empirical analysis of this study is derived from CSMAR and Wind Financial Database. To minimize the possible impact of the novel coronavirus epidemic on the results of the study, the period from July 2007 to February 2020 was selected as the time frame of the study.

The empirical part of this paper mainly involves commodity convenience returns, confidence proxy variables, monetary policy, and macroeconomic target indicators. Whereas convenience return is a forward-looking variable in this paper and there is no actual data, the convenience return treatment of Gospodinov and Ng (2013) is borrowed and commodity price futures data are used as the basis. Specifically, j is the commodity's percentage net convenience yield is calculated as:

$$CON_{t,n}^{j} = \frac{(1 + i_{t,n})S_t^j - F_{t,n}^j}{S_t^j}$$

$CON_{t,n}^{j}$ is the convenience yield, the $i_{t,n}$ is the yield to maturity on Chinese government bonds (3 months), the S_t^j is the commodity j is the spot price of $F_{t,n}^j$ is the futures contract price of the commodity j is the futures contract price of the commodity. Since the data are from futures trading in the Chinese market, the commodities selected are mainly representative agricultural products, metal commodities, and energy commodities, and the spot prices and futures contract prices of the commodities Copper (Cu), Soybean, Rubber, Cotton, Sugar, Aluminum, Zinc, Soybean meal from July 2007 to February 2020, and the futures contract prices are the spot prices and futures contract prices of the commodities from July 2007 to February 2020, and the futures contract prices of the commodities are the spot prices and futures contract prices of the commodities. Meal from July 2007 to February 2020 with monthly data of spot price and futures price, sourced from the WIND Financial Client. And, the principal components of maximum rotation were extracted by principal component analysis as a proxy variable for commodity convenience returns and commodity prices. Daily data of the yield to maturity (3 months) of the Chinese government bond, sourced from the WIND Financial Client.

About analyzing the role of confidence and sentiment in the mechanism for influencing monetary policy, there is a need to seek representative and inclusive indicators of confidence and sentiment in economies. The consumer confidence index is an indicator of the strength of consumer confidence, which comprehensively reflects and quantifies consumers' evaluation of the current economic situation and their subjective feelings about the economic outlook, income levels, income expectations and the psychological state of consumption; it is a leading indicator for predicting the trend of the economy and the tendency of consumption, and it is an indispensable basis for monitoring changes in the economic cycle. The available data on China's confidence include the Entrepreneur Confidence Index and Banker Confidence Index released by the People's Bank of China, the Entrepreneur Confidence Index and the Consumer Confidence Index series released by the National Bureau of Statistics, while the Consumer Confidence Index (CCI) is chosen in this paper. This is because to better observe the micro-individual's psychological behavioral decisions, the more universal public expectations, rather than the pointing psychological expectations of

entrepreneurs and bankers with professional functions, perhaps they are more suitable for analyzing the operation of the macro-economy, but not the focus of this paper. On the other hand, the China Investor Sentiment Index (ISI) is based on the collection of hundreds of millions of financial text big data that can respond to investor sentiment on the Internet and uses deep learning methods to measure the Chinese investor sentiment reflected by text information. On the one hand, it portrays the changes in investor sentiment in the financial market since 2008, and on the other hand, it can track the current changes in investor sentiment in real-time. Similarly, investor sentiment (ISI) is not an indicator of highly specialized functions, and thus is more representative of the psychological factors of micro-individuals. The Consumer Confidence and Investor Sentiment indices are from the WIND Financial Client.

Analysis of monetary policy indicators. In the historical literature, regarding the selection of monetary policy proxies, researchers generally tend to adopt the growth rate of the M2 money supply to represent the stance of quantitative monetary policy. The M2 growth rate, as a dynamic indicator of money supply, can reflect the central bank's intention and effect of regulating liquidity in the economic system. Meanwhile, the 7-day interbank lending rate, as a representative of short-term market interest rates, is often used to measure the degree of price-based monetary policy loosening and tightening. For example, the work of Yang et al. (2014), Dai and Liu (2016), Du et al. (2017), Wang and Li (2017), Fu and Yang (2019) have adopted the above indicators to explore the impact of monetary policy on economic variables. These studies reveal the mechanism of the role of quantitative and price-based monetary policy tools in macroeconomic regulation and their potential impact on different economic indicators through empirical analysis, and this number is from WIND Financial Client.

Inflation indicator analysis. Inflation, as one of the four macroeconomic control objectives, plays a central role in maintaining economic stability. In this study, we focus on analyzing the importance of price stability and inflation control. To quantify the dynamics of inflation, the monthly growth rate of the consumer price index (CPI) is selected as a key proxy for inflation. CPI, as an important economic indicator reflecting changes in the cost of consumption, can sensitively reveal the fluctuation of the price level, and provide an intuitive and easy-to-interpret quantitative tool for macroeconomic analysis, which is derived from the CSMAR All figures are from CSMAR Cathay Pacific database.

Since the yield to maturity of Chinese government bonds and the interbank lending weighted rate are daily data, the monthly indicator series are constructed based on the daily data by averaging the daily prices of the corresponding months. The data of the above variables are used to remove the influence of seasonal factors using the X12 method, and the Hodrick-Prescott (HP) trend estimation of commodity spot prices is performed to obtain the actual commodity prices. The smoothing parameter of the HP filter is set to the default value of 14,400 for monthly data. After the ADF test, except for interest rates and convenience gains, they are smoothed by first-order difference and the significance results are shown in **Table 1**. In theory, TVP-SV-VAR does not need smooth data, but this paper needs the Granger test to analyze the overall transmission mechanism, so the original data are used in the robustness test. The descriptive statistics are shown in **Table 2** below.

Table 1. Table of results of smoothness test of variables.

ADF test		
	t-Statistic	Prob.*
CCI	−15.0633	0.0000
ISI	−12.5696	0.0000
CON	−2.65354	0.0847
CPI	−4.15749	0.0011
M	−11.7993	0.0000
P	−9.66182	0.0000
R	−3.0744	0.0306

Table 2. Descriptive statistics.

	Mean	**Median**	**Maximum**	**Minimum**	**Std. Dev.**	**Observations**
CCI	0.02182	0.011167	1.429394	−0.62536	0.270118	152
CON	0.002554	−0.07003	3.270289	−2.10187	1.002805	152
CPI	0.000422	0.020555	0.697685	−1.16997	0.259671	152
P	−0.01231	−0.02927	0.931371	−1.41605	0.290894	152
ISI	−0.01982	−0.05075	4.934417	−2.38667	0.678752	152
R	1.009894	1.037719	1.916605	−0.06653	0.356511	152
M2	0.021945	0.020886	0.080576	−0.00744	0.011309	152

5.2. Granger causation

This paper needs to analyze the problem of the influence mechanism of monetary policy through Granger causality, so it is necessary to determine the optimal lag. Chen and Tang (2009) select the optimal lag order by constructing a VAR model with two influencing factors and referring to the lag order criterion. The lag order test for the consumer confidence model is 2nd order, and the lag order test for the investor sentiment model is 2nd order.

There is a significant Granger causality between the variables of Consumer Confidence, Investor Sentiment, Convenience Gains, Price Based Monetary Policy, and Quantity Based Monetary Policy Inflation. **Table 3** shows the Granger causality test that partially rejects the original hypothesis, from which it can be seen that the Consumer Confidence Index (CCI) is not a Granger cause of inflation (CPI), which is contrary to intuitive expectations, especially in some studies in the West, which have long been shown that consumer confidence influences the country's macroeconomic development and predicts inflation, so the probable reason for this situation in China is that China is a socialist country with Chinese characteristics, which has its distinctive features in whatever aspects, and thus will produce different results from other countries. Putting aside the coverage and bias in the collection of consumer confidence data itself, the people of China have traditional saving habits, and this preventive saving directly affects consumers' intertemporal resource allocation (Long and Zhou, 2000), which in turn affects the consumer confidence consumption index. At the same time, consumer spending accounts for a relatively small proportion of the macroeconomy, which may also contribute to the insignificant impact of the consumer

confidence index on inflation. However, the consumer confidence index is the Granger cause of money supply, thus affecting monetary policy regulation. More importantly, commodity convenience gains affect the consumer confidence index, which suggests that the inventory factor of commodities holds an important influence in the minds of consumers, who constantly adjust their intertemporal resource allocation according to changes in inventory levels, and by doing so, convenience gains also closely link the consumer confidence index to monetary policy and inflation, constituting a flow link in the influence mechanism.

Table 3. Table of results of Granger causality test.

Null Hypothesis.	**F-Statistic**	**Prob.**
CON does not Granger Cause CCI	5.90987	0.0163
CCI does not Granger Cause M	2.71561	0.0695
ISI does not Granger Cause R	5.63809	0.0189
ISI does not Granger Cause M2	2.96123	0.0549
P does not Granger Cause ISI	7.06233	0.0087
CPI does not Granger Cause ISI	4.0565	0.0193
R does not Granger Cause CON	2.98529	0.0536
CON does not Granger Cause P	3.51166	0.0324
CON does not Granger Cause M2	3.40636	0.0358
R does not Granger Cause P	6.17493	0.0027
P does not Granger Cause M2	3.33191	0.0385
R does not Granger Cause M2	2.46297	0.0887
P does not Granger Cause CPI	7.73140	0.0006
R does not Granger Cause CPI	3.11654	0.0473

Whereas the investor sentiment index (ISI) is not a Granger cause of inflation (CPI), inflation is a Granger cause of the ISI, and the ISI is also a Granger cause of interest rates and money supply. The fact that convenience gains affect commodity prices and that commodity prices act on both the investor sentiment index and inflation as well as money supply suggests that the macroeconomic impact of commodity markets is extremely important and should be given more attention. It is also found that interest rates are extremely closely related to the impact of commodity prices and convenience earnings, consistent with historical research. The overall influence mechanism is briefly summarized in **Figure 3**, from which it can be seen that the convenience gain of commodities connects the consumer confidence index to the macroeconomy, making the consumer confidence index in China have a conduction influence, so that the convenience gain of commodities, consumer confidence, and investor sentiment have an important influence on monetary policy and inflation, which proves that Hypothesis 1 (3.1) is reasonable.

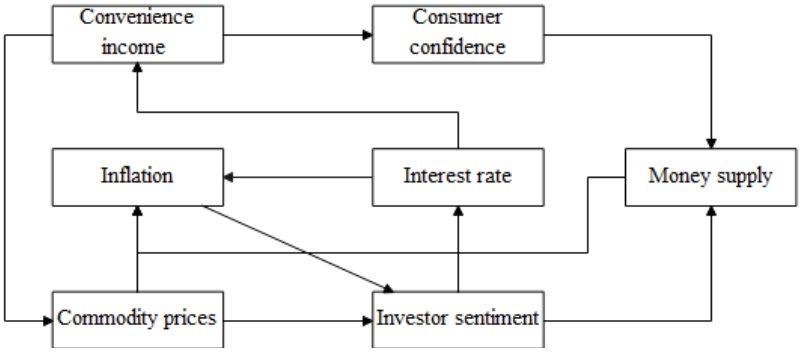


Figure 3. Summary impact mechanism diagram.

Note: This figure only briefly summarizes the system's impact mechanisms; the true overall economic impact mechanisms are far more complex.

5.3. Estimated results for MCMC

The results of parameter estimation can be seen in **Table 4**. The simulation algorithm using MCMC performs 10,000 samples through the a priori information, the first 1,000 are used as the desired burn-in values, and the remaining number of samples are used to estimate the parameters of the posterior distribution, including the mean, standard deviation, 95% confidence interval, and convergence statistics of the parameters to be estimated. As can be seen from **Table 4**, the Geweke diagnostic probabilities are all greater than 10% and the null factors are relatively small, the null factors indicate the uncorrelated samples derived in the process of estimating the parameters, which indicates that this estimation result is convergent and valid. Moreover, the standard deviation of the estimated results is small and the means are within the corresponding confidence intervals, so the overall sampling results are relatively satisfactory.

Table 4. Parameter estimation results.

ESTIMATION RESULT I						
Parameter	Mean	Stdev	95%L	95%U	Geweke	Inef.
sb1	0.0228	0.0026	0.0183	0.0287	0.337	7.3
sb2	0.0227	0.0026	0.0183	0.0283	0.484	9.6
sa1	0.0645	0.0178	0.0396	0.1107	0.256	46.07
sa2	0.0627	0.0176	0.0367	0.1045	0.865	38.22
sh1	0.6435	0.1386	0.4078	0.9522	0.985	39.04
sh2	0.504	0.1281	0.2797	0.7734	0.761	63.57
ESTIMATION RESULT II						
Parameter	Mean	Stdev	95%L	95%U	Geweke	Inef.
sb1	0.0229	0.0026	0.0185	0.0288	0.665	8.51
sb2	0.0228	0.0027	0.0183	0.0286	0.004	8.32
sa1	0.0676	0.02	0.0397	0.1171	0.00	39.96
sa2	0.0637	0.0198	0.0382	0.1137	0.352	58.71
sh1	0.5959	0.1344	0.3789	0.8972	0.277	58.59
sh2	0.4482	0.1129	0.2521	0.6888	0.537	61.44

Figure 4 shows a visual formal representation of the parameter estimation results and process. As shown in the figure, the sample autocorrelation coefficient converges to 0 as the number of iterations increases, which ensures the applicability of the sampling iteration process. Moreover, the sample convergence trajectory of the model shows the fluctuation state of the "white noise" trajectory, and the posterior distribution is more uniform, which again indicates the validity of this estimation.

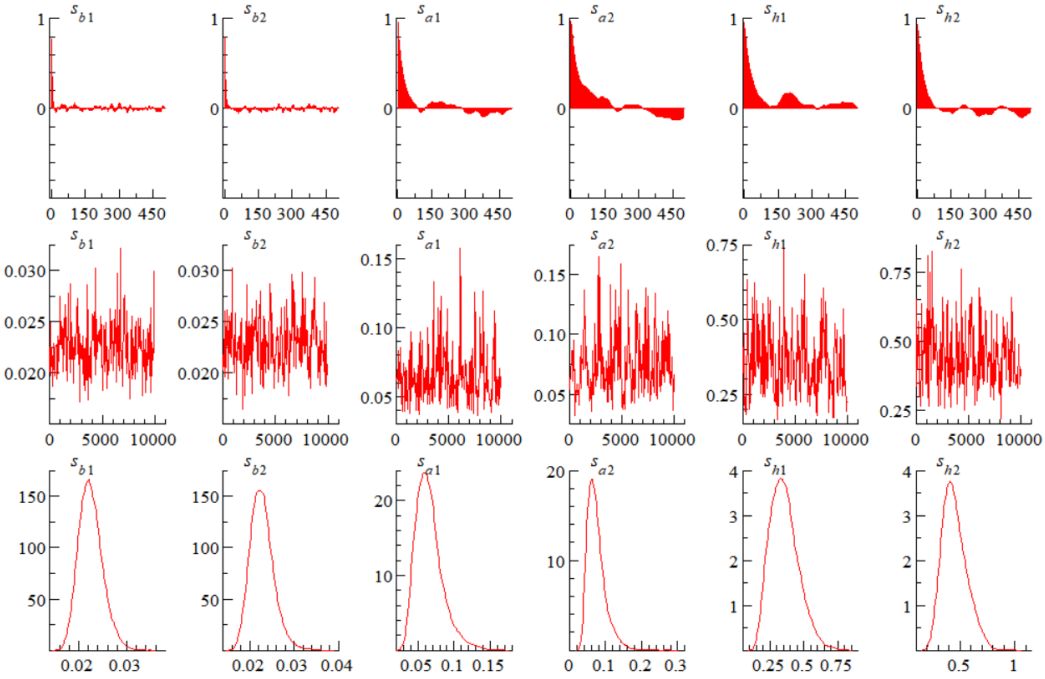


Figure 4. Sample autocorrelation plot, sample path and posterior density plot.

5.4. Time-varying pulse impact analysis

As can be seen from **Figure 5**, there are very significant time-varying characteristics of each variable, which proves the rationality of time-varying and time-varying characteristics mentioned in the hypothesis, and the characteristic point time of each time-varying characteristic shows consistency, which indicates that this paper is more suitable for the time-varying approach to analyze the influence mechanism among variables, and that each variable has a strong dependence on the overall economic environment. As can be seen in **Figure 6**, the degree and direction of the influence between the variables change with the economic environment and the impact of information shocks at all times. Upon comparative analysis, it is observed that there is some variability in the macroeconomic impact of the consumer confidence index and investor confidence index. Between 2007 and 2015, both had a negative impact on interest rates (first column of the graph), but the investor sentiment index reacted to a greater extent, while the consumer confidence index to a lesser extent, during the period of recovery from the global financial crisis, which caused the economy to be hit hard, and consumers devoted more resources to saving in case of emergencies and to plan for the next stage of asset allocation. The mechanisms by which the two affect convenience returns differ significantly (second column of the chart). The investor sentiment index had a positive impact from 2014 to 2016 and a negative impact for

the rest of the period, while the consumer confidence index had a negative impact up to 2014 and a positive impact almost all the time in the later period, which suggests that consumers have a higher degree of confidence in the boom period, while investors put more goods into circulation during the boom period, thus similarly goods lose their convenience gains. There is a significant difference in the impact of the two on inflation (fourth column of the graph), consumer confidence index is a positive influence until 2012, while investor sentiment is an inverse influence until 2015, the degree of influence slowly decreasing, but then began to decrease significantly after 2015, the possible reason for this situation is that after the financial crisis, the country has adopted a loose money supply as a way to promote economic development, which pushed investors to accelerate the flow in the market (this paper does not show all the results due to the need of analysis).

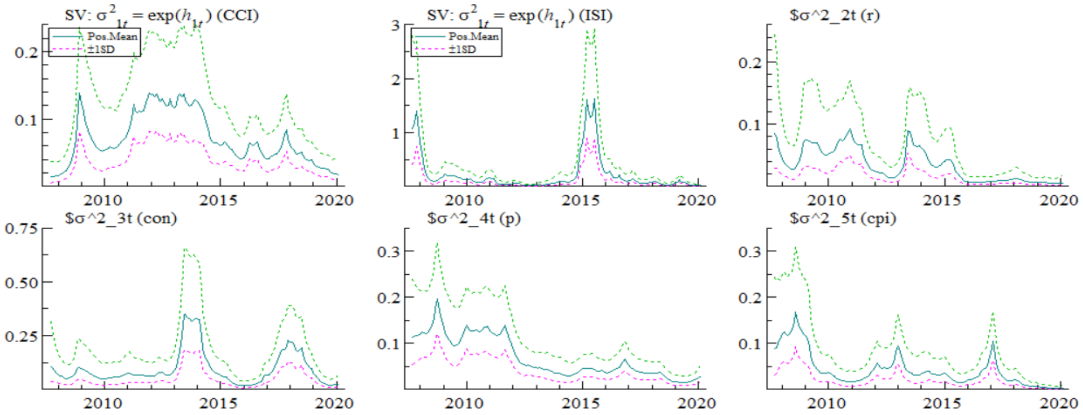


Figure 5. Characterization of temporal variability.

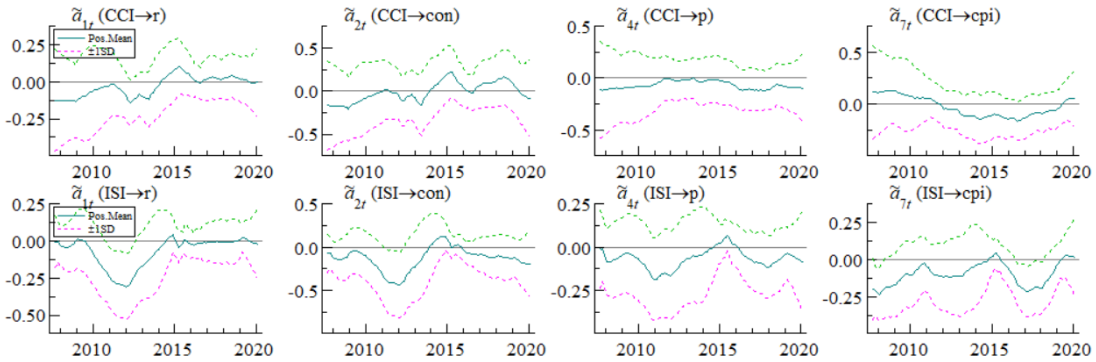


Figure 6. Map of time-varying impact mechanisms.

Figures 7–9 show the time-varying dynamic impulse response plots for 3, 8 and 12 periods ahead. By comparing the influence relationship between the two of consumer confidence and investor sentiment and monetary policy and inflation, as a whole, the short-term impact is greater than the medium-term and long-term impact, and the influence mechanism of consumer confidence and investor sentiment on other variables in the short-, medium-, and long-term tends to be almost the same, while the influence of other variables on the two of them are almost always reflected in the short-term impact only. This suggests that microeconomic individuals usually maintain consistency in their bodies in their consumer and investment behavior preferences, and

will appropriately adjust the way they make asset allocation decisions, but the overall variability is not particularly significant.

Figure 7 It is worth noting that there is what appears to be an inverse degree of volatility in the effects of consumer confidence and investor sentiment on convenience returns in **Figure 7** (second column of the graph), with consumer confidence rising and investor sentiment declining during economic crises and recoveries, because investors perceive periods of lower convenience returns as times when they should invest their available resources in the market to promote market liquidity, whereas Consumers, on the other hand, perceive lower convenience gains and lower levels of commodity prices, which allows them to maximize their disposable resources and thus increase consumer confidence. In the mechanism of influence on commodity prices (the third column of the figure), consumer confidence has a greater degree of influence than investor sentiment during the financial crisis and the recovery period, but both become negative after 2015, while short-term fluctuations in consumer confidence begin to become inverse in mid-2014, to a greater degree relative to investor sentiment, while longer-term fluctuations are smoother. As can be seen in **Figure 7**, consumer confidence has a greater impact in times of financial crisis and economic recovery, while investor sentiment has a more consistent impact on consumer confidence, albeit to a lesser extent, thus demonstrating the plausibility of Hypothesis 6 (3.6.).

Figure 8 shows the mechanism of the impact of the economic variables on public confidence. As can be seen from the figure, the impact of interest rates, commodity prices, inflation and money supply on consumer confidence and investor sentiment is relatively smooth in the medium to long term, while the short-term impact is dramatic and the degree of short-term impact on investor sentiment remains relatively pronounced. What is clear is that the short-term impact of inflation on consumer confidence is largely differentiated between positive and negative relationships through the recession and boom phases, and that money supply plays a key role in influencing investor sentiment.

Figure 9 shows the impact relationship between convenience gains and each economic variable, and since the impact relationship is roughly consistent under the influence of the consumer confidence index and the investor sentiment index, and is more consistent in the short-medium and long-run, with some differences in the degree of individuality, only the impact relationship in the case of consumer confidence is shown. As can be seen from the figure, the interest rate has the most significant impact on the convenience gain, and the degree of consumer confidence under the impact is more obvious, at the same time, the convenience gain a negative impact on the commodity price before 2015, and after that, it becomes a positive impact, this is because in this stage China has been using loose monetary policy to promote economic development and maintain economic stability, loose monetary policy makes the commodity market active, and the convenience gain is relatively low, when the economic development of the economy, to maintain economic stability, loose monetary policy makes the commodity market active. Convenience gain is relatively low, when the economic development for a more stable level, the amount of money market investment is relatively stable, and convenience gain and commodity prices maintain relative stability, which proves the rationality of Hypotheses 3 (3.3.) and Hypotheses 4 (3.4.). It is worth noting that there is a mirrored phenomenon in the

mechanism of the impact between facilitation gains and commodity prices, with prices positively impacting facilitation gains before 2014 and negatively impacting them thereafter, and with commodity prices once again fluctuating sharply after 2014, with investors in a wait-and-see mode, leading to a negative impact, thus proving the plausibility of Hypothesis 5 (3.5.).

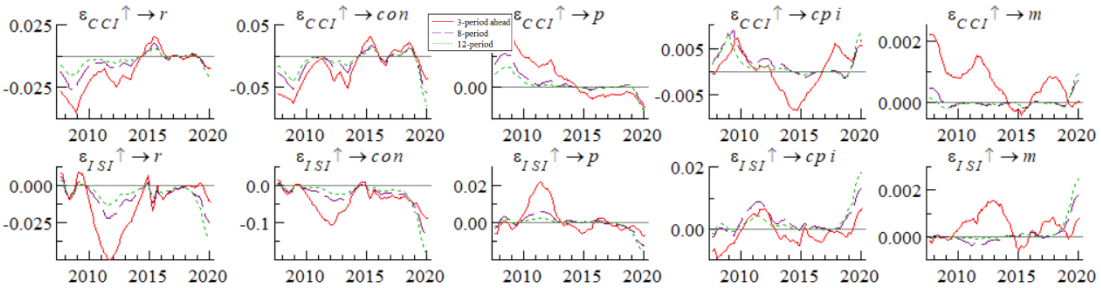


Figure 7. Time-varying impulse response plot.

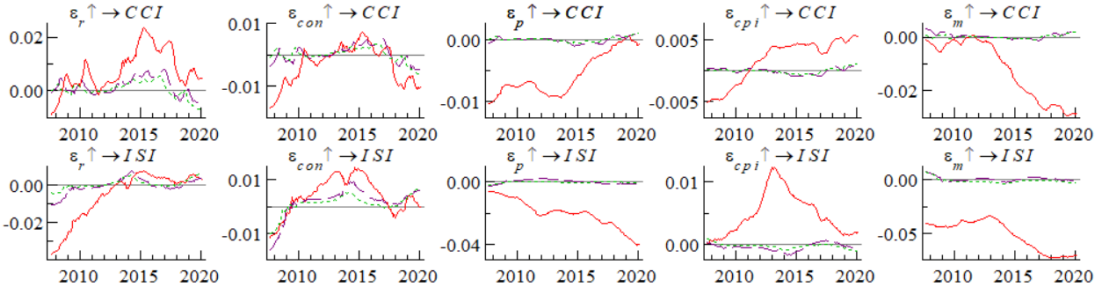


Figure 8. Time-varying impulse response diagram.

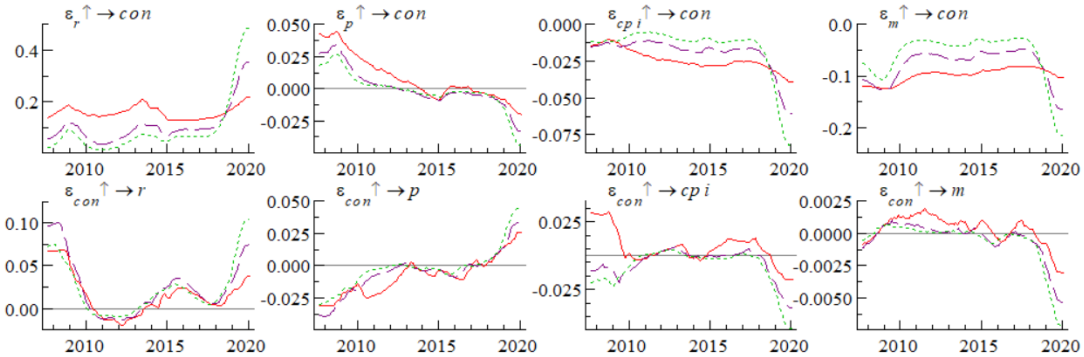


Figure 9. Time-varying impulse response plot.

5.5. Time-point impulse response analysis

Figures 10–12 are used to analyze the point-in-time impulse responses at different economic stages and points in time, mainly to observe whether there are structural mutations at certain points in time. This paper chooses the time points of 2011, 2014 and 2016, and does not choose before and after the global economic crisis, because in the time-point dynamic impulse response process, the financial crisis has been analyzed more during the financial crisis, and in the financial crisis and the recovery period there are certainly structural mutations, so this paper chooses to analyze whether there are structural mutations in the process of relatively stable economic development after 2011, avoiding the late impact of the financial crisis.

Whether there is a structural mutation.

As can be seen in **Figure 10**, in the overall consumer confidence index and investor sentiment index point-in-time impulse response is more consistent, but there are differences. In the process of the two on the interest rate (the first column of graphs), the negative impact in 2011 and 2014, while in 2016 the consumer confidence index was positive, which indicates that the consumer's confidence in the expected economy is based on the stable development of the macroeconomy is predicted, but the investor is relatively more cautious, but only to return the investor sentiment as much as possible to a smoother state. In the pulse response of the two to convenience returns (second column chart), it was found that consumer confidence first rose and rapidly declined in 2014, and then gradually returned to a stable state. This is because in the positive and negative relationship of the time stages of various variables mentioned earlier, starting from 2014, the consumer confidence index had a positive impact on convenience returns, while investor sentiment had a certain lag, resulting in this structural mutation. In the time point impact of the two on inflation (as shown in the fourth column chart), it can be seen that the consumer confidence index in 2011 returned to a stable state in the fifth period, while the investor sentiment index only reached a stable state in the thirteenth period, indicating that consumers seem more sensitive and conservative towards inflation.

Figure 11 shows the impact of each variable on the public confidence index. As can be seen from the figure, the shock response of the interest rate on consumer confidence and investor sentiment that shock on consumer confidence instantly declined and then instantly became a positive response, and reverted to the equilibrium state in the period of 3 periods, while the investor sentiment experienced several shocks in the thirteenth period before reverting to the equilibrium state, which indicates that the investors' response to the interest rate is more sensitive to interest rates, and that the interest rate has an important impact on the investment process, and the convenience return are almost consistent with interest rates. The structural mutations in consumer confidence and investor sentiment are also more pronounced in the mechanism of influence on inflation, but consumer confidence had a larger response in 2016. From the effect of convenience gains on inflation, it is clear that inflation is shocked by convenience gains shocks and returns to equilibrium in the 10th period, showing a similar state at each point in time, suggesting that convenience gains are good predictors for inflation.

Since the shocks between convenience gains and the other variables become highly similar states under the consumer confidence and investor sentiment perspectives, only the point-in-time impulse response results under the influence of consumer confidence are shown. From **Figure 12**, it can be seen that the interest rate has been positively affecting the convenience yield, but the time to reach a steady state was more rapid in 2011, while the impact of convenience yield on the interest rate was negatively shocked in 2011, while it is positively shocked at other points in time, which may be because of the influence of the accommodative monetary policy. In **Figure 12** as a whole, the 2011 point in time is significantly different from the other times, which may be due to the time lag in the effect of the policy under the effect of the accommodative monetary policy.

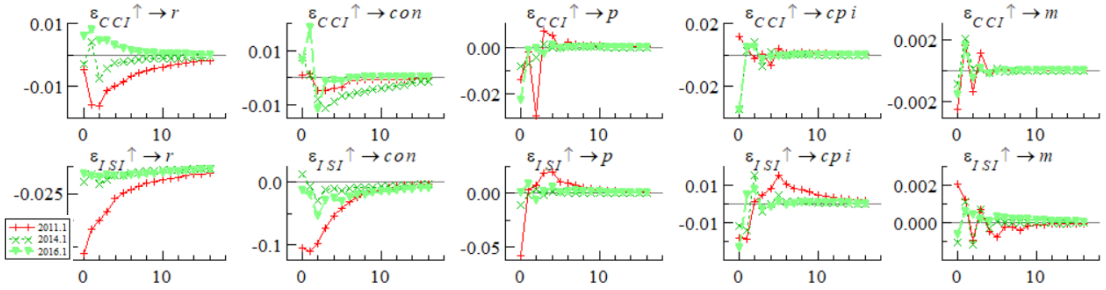


Figure 10. Time-point impulse response plot.

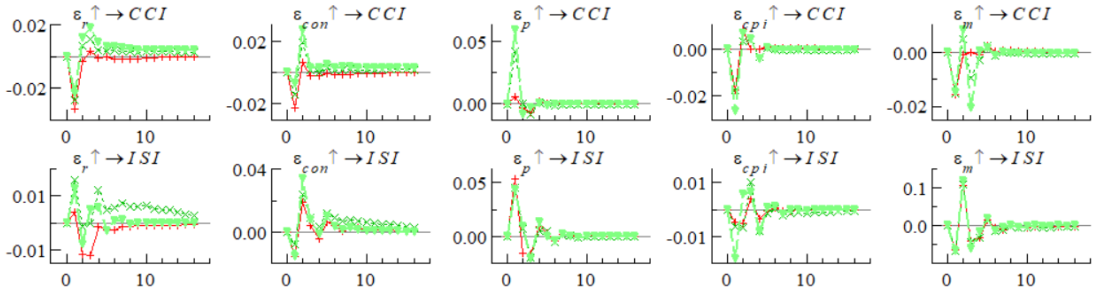


Figure 11. Time-point impulse response graph.

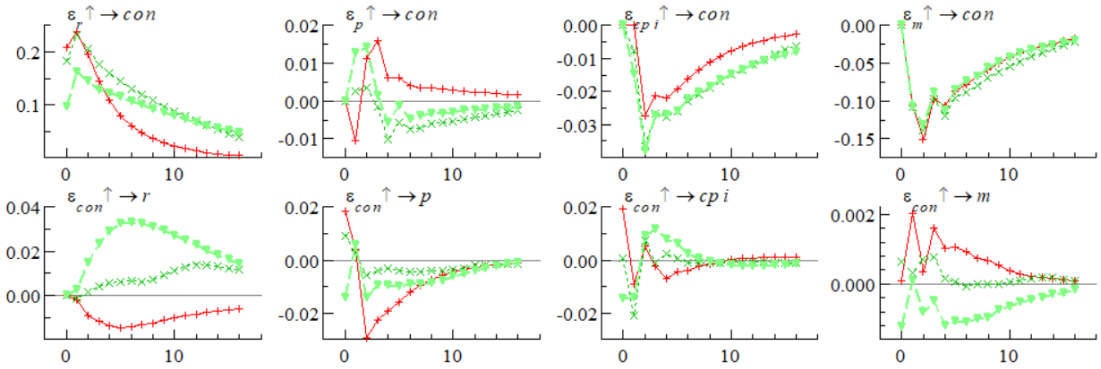


Figure 12. Time-point impulse response plot.

6. Robustness check

The robustness test in this paper focuses on the stability of the above research questions by switching windows, replacing alternative variables, and changing the frequency of the data.

Switching windows: this paper employs an analysis with different time windows to ensure that the results do not depend on a specific period. By changing the start and end points of the time series analysis, the paper assesses the applicability of the model over different historical periods. In addition, through rolling window analysis, this paper further examines the stability of the model parameters over different time subsets, thus ensuring the timeliness and generalizability of the findings.

Replacement of replacement variables: To test the sensitivity of the model to different economic indicators, this paper replaces the original inflation indicators with quarterly GDP and monthly PPI indicators. Quarterly GDP serves as a broad measure of macroeconomic activity, while monthly PPI provides more high-frequency

information on changes in the price level. With this substitution, the paper verifies the robustness of the model to changes in different economic indicators and ensures the reliability of the conclusions.

Changing data frequency: This paper also explores the sensitivity of the model to changes in data frequency. By converting raw monthly data to quarterly data, the paper examines the performance of the model at different levels of temporal aggregation. This frequency conversion helps to assess the robustness of the model over different time scales and reveals the different responses of the model to short-term fluctuations and long-term trends.

After conducting the above robustness tests, the paper re-applied the TVP-SV-VAR model for empirical analysis. The results show that the conclusions drawn maintain a high degree of consistency under different testing conditions. The small degree of difference in the distributional levels of the parameter estimates indicates that the different tests have limited effects on the model parameters. In addition, the structural mutation time points and the underlying conclusions are more consistent under different testing conditions, further validating the robustness of the findings. These tests not only enhance the credibility of the research findings but also provide important references for subsequent studies. By demonstrating the consistency of the research results under different conditions, this paper provides macroeconomic policymakers, market analysts and investors with a more reliable basis for decision-making. At the same time, it also provides more solid data support for the study of consumer behavior, which helps to gain a deeper understanding of consumers' responses to economic conditions and their behavioral patterns.

While the results of the robustness tests support the validity of the study, we also recognize that all tests are based on existing data and model settings. Any economic model is constructed based on a set of assumptions that may not fully reflect the complexity of the real world. The TVP-SV-VAR model in this paper may assume a time-varying linear relationship between the variables, whereas the real-world economic relationships may be more complex, or perhaps some variables are linearly related to each other and some are nonlinearly related to each other. And, the study is conducted based on a specific economic theoretical framework, but economic theories may not be able to fully explain all the observed phenomena, especially in a rapidly changing market or policy environment. These limitations suggest that despite the robustness of the study results, caution is needed in interpreting and applying them.

7. Conclusions and policy recommendations

In this paper, the TVP-SV-VAR model is used to identify and analyze the influence mechanism of the commodity market and monetary policy in the process of public psychological behavior change as well as its time-varying characteristics, and the following research conclusions can be obtained:

First, through the Granger causality test between consumer confidence, investor sentiment, commodity factors and monetary policy and inflation, it can be seen that consumer confidence does not have a significant impact on inflation, while investor sentiment is an important influence, which may be because China's consumers have traditional saving habits and future risk aversion and other influencing factors, and

consumer confidence is a money supply Granger reasons, this may be because in the process of economic operation, the central bank's money injection will be regulated according to the consumption level of residents. At the same time, the impact of consumer confidence on the macro economy is an indirect effect, while investor sentiment has a direct effect; second, distinguish between the economic boom period the economic recession period and the economic recovery period, the performance of consumer confidence and investor sentiment is different in different periods, and it presents a reverse effect in the economic recession period and the recovery period, and presents a positive effect in the economic boom period; Thirdly, commodity convenience gain connects the behavior of microeconomic individuals and macroeconomic operation, at the same time, convenience gain is an expected indicator, its fluctuation characteristics also reflect the expectations of consumers and investors on the future operation of the commodity market, which can also be understood as another aspect of the psychological behavior of microeconomic individuals, compared with the index of consumer confidence and investor sentiment, in the commodities market, the convenience gain is more targeted and directional, and is more suitable for a more detailed analysis of the influence mechanism between commodity markets and monetary policy and inflation, and price-based monetary policy has a greater impact on convenience gains; fourth, monetary policy can influence public expectations through publicly accessible means such as information disclosure, and public expectations further influence their intertemporal behavioral decisions, thus further influencing monetary policy and inflation, forming a closed loop; fifth, public confidence has a more consistent impact on the macroeconomy in the short to medium term, while the impact of the macroeconomy on public confidence is more significant in the short term.

Based on the above conclusions, it is believed that public confidence has important theoretical and practical significance on China's commodity market and macroeconomic operations: First, monetary policy adjustment: since consumer confidence does not have a significant impact on inflation, while investor sentiment is an important influencing factor, the central bank should pay more attention to investor sentiment when formulating monetary policy to effectively regulate inflation. At the same time, the central bank should adjust the amount of monetary investment according to the consumption level of residents to stabilize consumer confidence. Second, economic cycle management: policymakers should distinguish between the boom, recession and recovery periods and adjust policies according to the characteristics of the different phases to achieve a smooth transition of the economy. In the recession and recovery periods, policies should focus more on boosting consumer confidence and investor sentiment, while in the boom period, they should focus on preventing over-inflation. Third, commodity market management: attention should be paid to the indicator of commodity facilitation gains, as it connects individual microeconomic behaviors with macroeconomic performance and reflects consumer and investor expectations of future commodity market performance. At the same time, the use of price-based monetary policy should be increased to effectively influence facilitation gains and thus commodity markets. Fourth, monetary policy and public expectations: central banks should influence public expectations through information disclosure and other means, thereby influencing their intertemporal

behavioral decisions and forming a closed loop between monetary policy and inflation. Fifth, long-term policy planning: policymakers should recognize that the impact of public confidence on the macroeconomy is more consistent in the short- to medium- and long-term, so they should pay attention not only to the short-term effects, but also to the long-term effects when formulating policies to achieve stable macroeconomic growth.

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