Application of the Markov Chain Monte Carlo Method Based on Bayesian Inference

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Background

- Agricultural prices are subject to frequent fluctuations, influenced by various factors such as monetary policy, financial markets, public events (e.g., pandemics), and global economic conditions.
- Agricultural price fluctuations have significant implications for farming, policy-making, and market predictions.
- There has been limited comprehensive analysis of how multiple factors simultaneously affect agricultural prices over different time frames and market conditions.

Abstract

The paper explores the application of the Markov Chain Monte Carlo (MCMC) method combined with Bayesian inference for analyzing agricultural price fluctuations. It examines various factors influencing price dynamics in China and the U.S. and provides insights into market trends, offering support for policy decisions and market forecasting.

Experiment model

The experiment model in this paper integrates Markov Chain Monte Carlo (MCMC) method with Bayesian inference to analyze the price fluctuations of agricultural products. The goal is to estimate the parameters of complex probability distributions influenced by various factors such as inflation, energy prices, policy uncertainty, and consumer confidence.

Equidistant Impulse Response Results (U.S. and China)

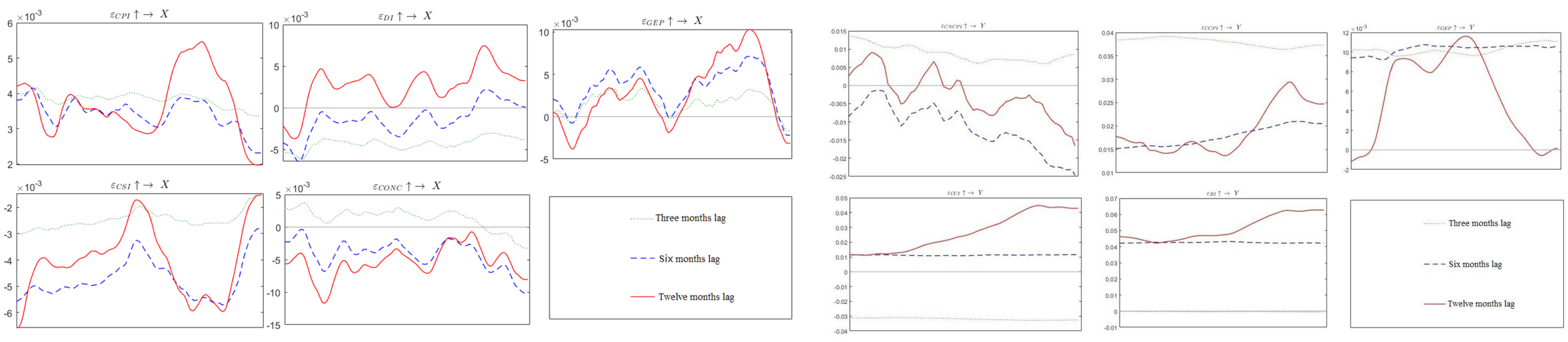

Figure 1 In the U.S., inflation and energy raise prices short-term but weaken over time, the dollar and consumer confidence affect prices differently short and long-term, and policy uncertainty always lowers prices. In China, prices are more volatile, with inflation and energy affecting short-term prices, policy uncertainty hitting prices early, and consumer confidence and the Renminbi having long-term positive effects.

Point-wise Impulse Response Results (U.S. and China)

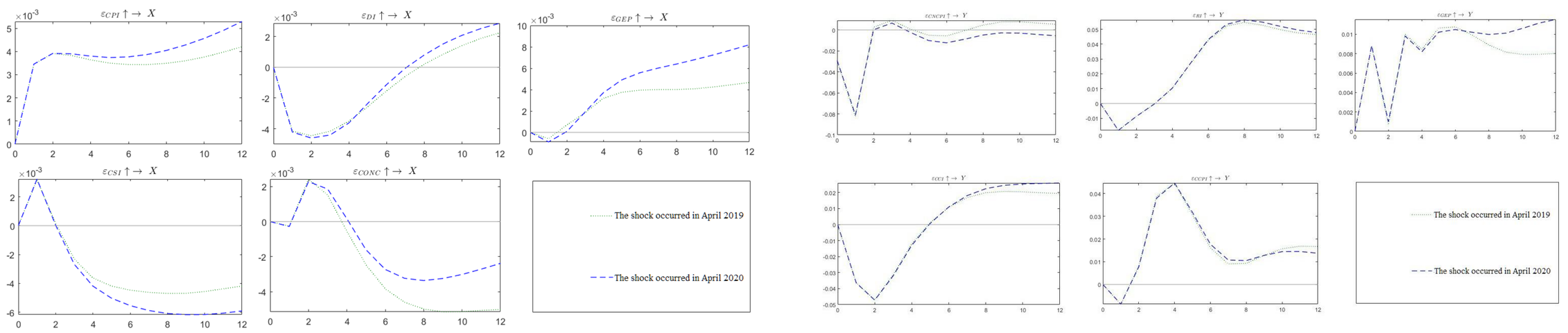

Figure 2 Before COVID, most factors had a smaller impact on U.S. agricultural prices, but after the pandemic, their influence grew, except for crude oil. In China, COVID had little effect, and price factors stayed steady. Inflation raises prices in both countries, but China's efforts to control it can lower prices, especially with lower incomes and reduced demand.

Conclusions

- Agricultural price fluctuations are influenced by complex, multidimensional factors.
- MCMC provides a robust framework for analyzing these fluctuations and aids in predicting market trends and informing policy.
- Differences in the factors influencing U.S. and Chinese markets were observed, with China's market being more volatile.

References

- Nakajima J. Time-varying parameter VAR model with stochastic volatility: An overview of methodology and empirical applications[J]. 2011.
- Hrozencik R A, Manning D T, Suter J F, et al. Impacts of Block-Rate Energy Pricing on Groundwater Demand in Irrigated Agriculture[J]. American Journal of Agricultural Economics, 2022, 104(1): 404-427.