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How did the macroeconomic sectors respond under the pandemic in China? Evidence from FAVAR model

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Abstract

This study examines the impact of the pandemic on macroeconomic sectors, with a focus on the intensity and duration of the impact. Findings from the FAVAR model show that the pandemic negatively affected business index, consumption, industrial output, and financial markets. Negative impacts on the macroeconomic business index lasted over 12 months. The study highlights the need for improved macroeconomic governance and risk prevention strategies to maintain economic development and social stability.

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1. Introduction

The COVID-19 global pandemic emerged not only as a public health crisis but also severely affected the global economy and financial markets [1]. The shock it created had a ripple effect across all sectors of the global economy, triggering consequences such as significant decline in global GDP [2], rise in global unemployment [3], disruption of supply chains [4], suspension of manufacturing and services industries [5] and the decimation of industries such as tourism and even transportation [6]. The World Bank reveals that the COVID-19 pandemic has a long-term and profound impact on the global economy. As predicted by it, between 2022 and 2030, average global potential GDP

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growth is expected to decline by roughly a third from the rate that prevailed in the first decade of this century—to 2.2% a year¹. For developing economies, the decline will be equally steep: from 6% a year between 2000 and 2010 to 4% a year over the remainder of this decade.

To scientifically assess the effects of major public health emergencies on economic system, regulate its negative effect and improve the resilience of the economic system is an important national strategic requirement [7]. This paper focuses on the impact of the COVID-19 pandemic shock on the economic system in China, so as to provide suggestions on economic system risk monitoring mechanism and risk governance under public emergencies.

However, compared to general public emergencies such as natural disasters, the COVID-19 pandemic has unique characteristics, such as widely spread, highly uncertain, and severe damage [8]. Based on the above three characteristics, the study of the impact of the COVID-19 pandemic on China's economic system needs to focus on the following two issues. On the one hand, with the continuous improvement of domestic pandemic prevention policies, the impact of each outbreak on the economic system is different [9]. So, it is necessary to analyze the impact of the pandemic on the economic system in China from the perspective of time evolution. On the other hand, the pandemic is having a very severe effect, which varies across sectors [10]. Therefore, it is essential to analyze the shocks of the pandemic on different economic sectors.

To give a comprehensive description of the scenario and to understand the patterns of pandemic shocks, the Factor-augmented vector autoregressive model (FAVAR) is constructed and the impulse response method is used to measure the intensity of the outbreak on China's macroeconomic impact. The main advantage of FAVAR relative to conventional VAR is that it utilizes the information in high-dimensional data sets to identify the space spanned by the structural shocks without the loss of parsimony. Due to such advantages, FAVAR has become increasingly popular in the empirical macroeconomic literature during recent years.

The remainder of this paper is as follows. Section 2 provides a general description of the methodology. Section 3 presents the data sources that we use and the results of the empirical analysis. Section 4 concludes.

2. Method

We apply the FAVAR model to investigate the impact of the pandemic on macroeconomic sectors. In this model, observable and unobservable factors jointly follow a vector autoregressive process, which further drives the co-movement of a large number of observable variables. We study the identification restrictions for FAVAR models, and propose a likelihood-based two-step method to estimate the model. The estimation explicitly accounts for factors being partially observed.

FAVAR has been introduced by Bernanke et al. [11] on the strand of the structural dynamic factor model [12], to solve the problem of information tightness contained in a simple VAR. The FAVAR model is defined as follows:

$$\begin{bmatrix} F_t, Y_t \end{bmatrix} = \phi(L) \begin{bmatrix} F_{t-1}, Y_{t-1} \end{bmatrix} + v_t \quad (1)$$

where Y_t is a vector ($n \times 1$) of endogenous variables, F_t is a vector ($k \times 1$) of unobserved factors, $\phi(L)$ is a matrix polynomial in the lag operator ($n \times m$) and v_t is an error term.

We apply two-step FAVAR model to extract factors from a large set of variables and, then, use these factors in a classical VAR model, with a reduced number of variables containing several information. According to Bernanke et al. [11], the economic system contains information about observable variables Y_t and unobservable factors F_t :

$$X_t = \Lambda^f F_t + \Lambda^y Y_t + \varepsilon_t \quad (2)$$

where Λ^f and Λ^y are the matrix ($n \times k$) and matrix ($n \times m$) of factorial loadings, respectively. ε_t follow a standard normal distribution. In essence, Y_t and F_t are common forces that drive the dynamics of X_t .

The estimation procedure consists of a two-step principal components approach, which, in turn, provides a non-parametric way of uncovering the space spanned by the common components [13]:

$$\hat{C}_t(F_t, Y_t) = \alpha F_t + \beta Y_t \quad (3)$$

Finally, the VAR in F_t and Y_t is estimated and identified recursively as discussed above.

¹ Data source: World Bank. (2021) "Falling long-term growth prospects".

3. Data

This study seeks to examine the impact of the pandemic on Chinese economy. Severity of the pandemic is measured by newly confirmed cases in China. And 155 macroeconomic variables are divided into 16 sectors, including business index of macro-economic, consumer confidence, consumption, consumer price index, producer price index, industrial output, investment in fixed assets, import, export, transportation, interest rate, money supply, general budget expenditure, general budget revenue, stock price and exchange rate. The data used in this study were collected from two primary sources: Wind database (<https://www.wind.com.cn/>) and CEIdata (<https://ceidata.cei.cn/>). All the indicator variables are available at a monthly frequency. The sample period covered is from January 2010 to October 2022.

4. Results

Based on the factor augmentation vector autoregressive model, this paper investigates the impulse response by 16 macroeconomic sectors to the pandemic and the results. The results are presented in Fig. 1. The 90% confidence interval is represented by the dotted line.

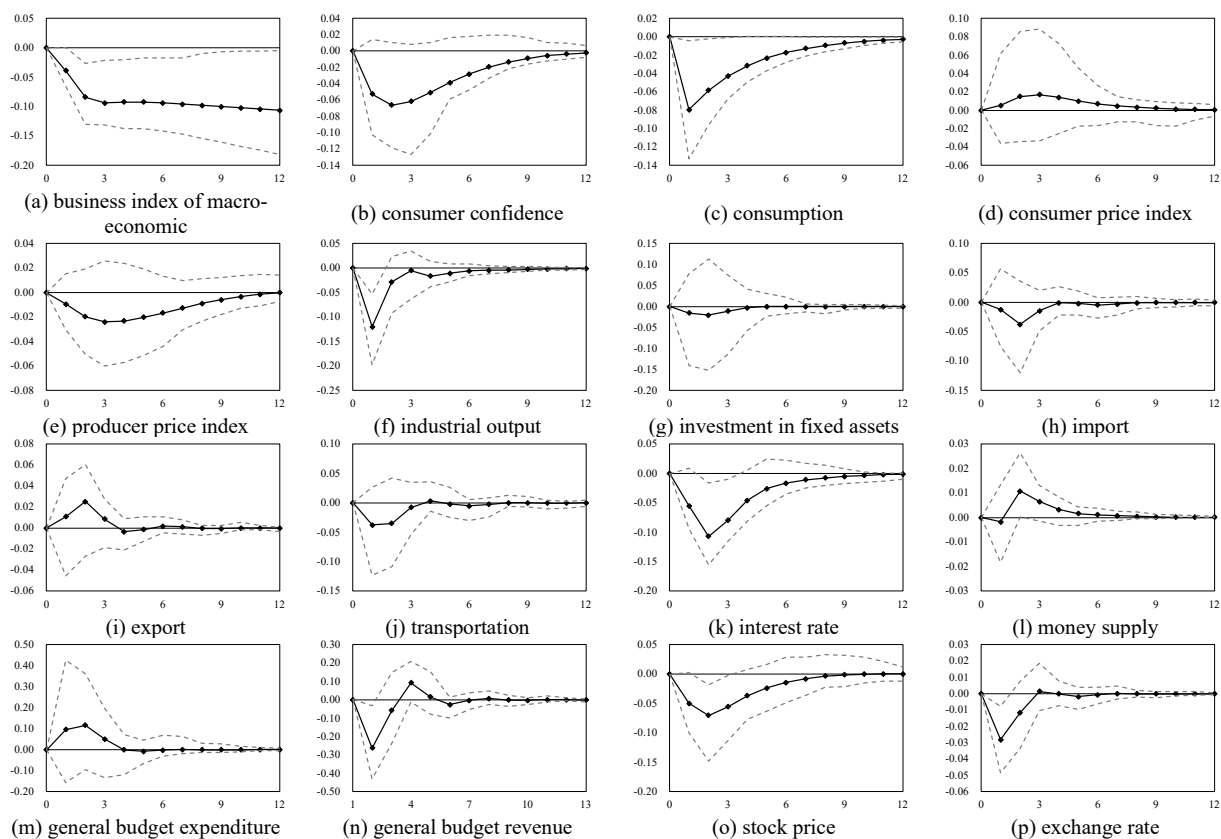


Fig. 1. Impulse responses to the pandemic shocks

Fig. 1 reveals that the pandemic has affected each of the 16 macroeconomic sectors differently. Fig.1 (a) indicates that the negative shocks to business index of macro-economic have persisted and are expected to continue for the next 12 months. The negative shocks to consumption and industrial output reached a trough in the first month, as shown in Fig. 1 (c) and (f). This could be attributed to the restrictions on consumption and economic activities due to the blockade policy, which quickly recovered after each lifting[1]. The shocks to interest rates and money supply reached

a trough in two months, as shown in Fig. 1 (k) and (l). The government's release of liquidity (lowering interest rates and increasing the money supply) is likely responsible for promoting economic recovery.

Besides, the stock market and the exchange rate market were both affected by the shock of the pandemic in the first and second months [14–16], as shown in Fig. 1(o) and (p). Fig.1 (b), (e), (g) and (h) show no significant negative responses of consumer confidence, producer price index, investment in fixed assets, import, transportation. Fig.1 (d), (i) and (m) show no significant positive responses of consumer price index, export and general budget expenditure.

5. Conclusion

Examining the intensity and duration of the impact of sudden public events on macroeconomic sectors is of great significance for us to improve macroeconomic governance response mechanisms and risk prevention strategies, as well as to maintain the overall economic development and social stability. This paper adopts FAVAR model to measure the impulse response by macroeconomic sectors in China to the pandemic. The empirical results of this paper show that the business index of macro-economic, consumption, industrial output, stock price and exchange rate were negatively impacted by the pandemic, among which the negative impact on the macroeconomic business index lasted for more than 12 months. On the other hand, the money supply and general budget revenue were positively impacted by the pandemic.

The implications are as follows: Public emergencies have a detrimental effect on both the supply and demand sides of the economy. Consequently, it is imperative to adopt a long-term basic policy of "promoting consumption and expanding domestic demand" and enhance the emergency management of the supply security chain to safeguard the production capacity of enterprises during times of crisis."

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