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The Impact of Financial Risk Factors on China's Real Economy

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Abstract: As the world's second largest economy, China has accounted for around one-third of global GDP growth over the last decade while, at the same time**,** China's economy faces a dramatic increase of economic uncertainty and financial risks in the recent years, preventing financial risk has been made a top economic priority for the next years of China's government work.This study employs dynamic factor model with time-varying coefficients to build three factors associated with financial risk derived from extensive financial and macroeconomic data in China. Subsequently, this paper investigate the non-linear impacts of these financial risk factors on China's real economy. Our findings reveal that financial risk shocks have the potential to transmit to the real economy, inducing a contractionary effect on both output and inflation rates. Notably, these spillover effects are significantly magnified during periods of economic recession. The most important policy implication of this paper is that: other than monitoring and preventing the financial risks in financial system, China's government should also reduce its policy uncertainties to better promote financial stability.

Keywords: Financial risk, Real economy, Time-varying DFM, TVAR model

1. Introduction

In the aftermath of years marked by rapid credit expansion, PBoC has elevated the priority of mitigating financial risk. The deceleration of China's GDP growth and substantial capital outflows have accelerated the exposure of various risks within the country's financial system. These risks encompass the significant fluctuation of the stock market, the burgeoning system of shadow banking, and the considerable debt amount of local government. In 2017, Moody's downgraded China's sovereign credit rating for the first time since 1989, raising concerns about the looming risk of financial instability in China.

The global financial crisis of 2007–08 serves as a poignant caveat that financial market not only transmits and propagates negative shocks to the real sector but also can drive the business cycles [1]. Consequently, a substantial body of literature underscores the importance of the financial sector in general equilibrium models following the crisis. Christiano et al. find that risk shocks originating from financial institutions play a significant role in business cycle fluctuations [2]. Gertler and Karadi, along with Gertler et al., incorporate the financial market into the standard DSGE model with endogenous bank run, quantitatively assessing the effects between financial market and the real sector [3,4]. Another empirical literature strand focuses on the measurement of systemic financial risks. Based on Stock and Watson, Hatzius et al. and Lucchetta and Nicolò construct a financial stress index

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from an extensive set of US financial data using PCA, and they quantify and predict real and systemic financial risks in several economies using the DFM [5-7].

Building on these insights, this paper contributes to the existing literature in two keyways. Firstly, this paper extracts three financial risk factors from an extensive dataset encompassing financial and macroeconomic indicators in China, utilizing the time-varying Dynamic Factor Model based on Koop and Korobilis [8]. Secondly, this paper constructs a threshold Vector Autoregressive (VAR) model to capture the non-linear relationship between the three financial risk factors and China's real economy.

2. Data and Model

2.1. Model

This paper constructs the p-lag time-varying Dynamic Factor Model (DFM) to derive the financial risk factors, where factor loadings are time-varying. This paper assumes that error terms are zero-mean Gaussian disturbances with time-varying covariances. The evolution of time-varying regression coefficients $a_t = (c_t', vec(B_{1t})', \dots, vec(B_{pt})')'$and $b_t = ((\Lambda_t^f)', (\Lambda_t^y)')'$ are defined as:

$$a_t = a_{t-1} + \mu_t^a \tag{1}$$

$$b_t = b_{t-1} + \mu_t^b \tag{2}$$

Where $\mu_t^a \sim N(0, \sum_t^a)$,$\mu_t^b \sim N(0, \sum_t^b)$, and$\sum_t^a$,$\sum_t^b$ are time-varying covariances matrices.

2.2. Data

This paper gathers data primarily from the Chinese interbank market, bond market, and stock market, utilizing the VIX (CBOT Volatility Index) to gauge global financial conditions. All series undergo normalization via the z-score method, covering the period from January 2007 to September 2017. All data, excluding VIX, are sourced from CEIC, while VIX data is obtained from the FRED database.

3. Empirical Results

3.1. Financial Risk Factors

In line with Koop and Korobilis [8], this paper employs a Bayesian method with the Markov Chain Monte Carlo (MCMC) algorithm to estimate the time-varying Dynamic Factor Model (DFM). This paper pragmatically opts for three factors, akin to the approach by Bernanke et al. [9]. Based on the estimated model, this paper identifies three Chinese financial risk factors presented in Fig. 1.

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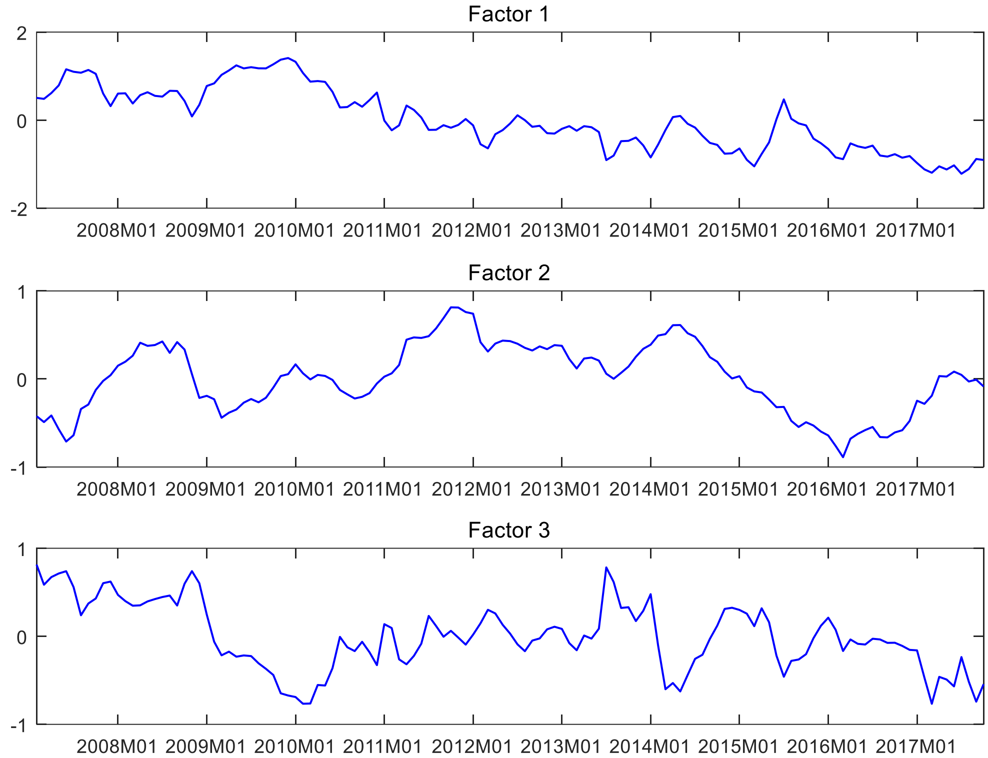

Figure 1: Three Estimated Chinese Financial Risk Factors

Fig. 1 illustrates three estimated factors denoted as F1, F2, and F3, respectively. The loadings before and after rotation are detailed in Table 1. F1 predominantly exhibits positive loadings on the yield spread of government bond and long-term corporate bond. Characterized by frequent fluctuations, F1 peaked after the 2008 financial crisis, followed by a subsequent downturn. Consequently, F1 primarily reflects the risk status of the bond market and the liquidity risk premium, demonstrating a strong correlation with the real sector.

FRF2 is characterized by positive loadings on the consumer loan rate and corporate bond yield spread, indicating its interpretation as the default risk factor. Notably, during the 2008 financial crisis, credit spreads rose significantly due to enterprise bankruptcies and financial difficulties. Post the 4-Trillion-Yuan Stimulus Package, China's debt-related challenges became more pronounced, maintaining FRF2 at elevated levels.

Meanwhile, FRF3 exhibits positive loadings on stock market volatility and turnover rate, symbolizing the volatility risk of the stock market. The tumultuous events of the Chinese stock market in 2007 and the subsequent periods of heightened volatility in 2013 and 2015 correlate with elevated levels of FRF3.

Table 1: Factors loadings before and after rotation.

Variable	Unrotated factor loadings			Varimax rotated factor loadings		
	Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3
3mTED	-0.52	0.48	0.14	-0.47	0.25	-0.48
6mTED	-1.04	0.32	-0.07	-0.71	-0.16	-0.82
3mTED	-0.77	0.50	-0.07	-0.51	0.09	-0.77
1-5yHRate	1.11	1.98	2.07	-0.64	2.90	0.80

Table 1: (continued).

O5yHRate	1.08	1.97	2.04	-0.64	2.86	0.77
CLoan_s	-0.57	-0.13	-0.62	0.02	-0.57	-0.63
CLoan_l	-0.69	-0.40	-0.81	0.07	-0.92	-0.67
Loan_s	0.68	0.50	1.02	-0.22	1.08	0.73
Loan_l	-0.65	-0.36	-0.79	0.08	-0.86	-0.65
B_beta	1.06	-0.88	0.87	0.16	0.01	1.62
1y3mTS	1.10	-0.13	-1.07	1.54	-0.10	0.06
3y3mTS	1.47	-0.23	-1.21	1.90	-0.11	0.25
5y3mTS	1.39	-0.31	-1.08	1.74	-0.15	0.32
7y3mTS	1.35	-0.39	-1.05	1.70	-0.23	0.36
10y3mTS	1.20	-0.50	-1.00	1.56	-0.35	0.37
1y3mCS	1.25	2.58	0.76	0.37	2.93	-0.24
3y3mCS	1.60	1.86	-0.37	1.40	2.02	-0.32
5y3mCS	1.34	1.09	-0.77	1.50	1.12	-0.29
7y3mCS	1.32	0.89	-0.83	1.53	0.92	-0.22
10y3mCS	1.19	0.69	-0.87	1.46	0.69	-0.21
SVOL_SH	1.57	-0.41	1.24	0.27	0.75	1.88
SVOL_SZ	1.68	-0.87	1.63	0.09	0.57	2.43
TO_SH	1.65	-0.58	1.93	-0.15	0.92	2.44
TO_SZ	1.43	-1.11	1.28	0.15	0.13	2.21
VIX	0.10	-0.08	-0.13	0.16	-0.08	0.02

3.2. Threshold Tests and Estimates

To capture the non-linear effects of three financial risk factors on China's real economy, this paper estimate the 5 variables TVAR system for the China's economy, $Y_t = \{f_{1t}, f_{1t}, f_{3t}, y_t, \pi_t\}$,which include the three financial risk factors f_{1t}, f_{1t}, f_{3t}, the growth rate of industrial production(IP growth rate) y_t and the CPI inflation rate π_t. This paper assumes that Y_t follows a threshold vector autoregressive process given by:

$$Y_t = \begin{cases} c_1 + A_1(L)Y_t + \varepsilon_{1t} if S_{t-d} \leq Y^* \\ c_2 + A_2(L)Y_t + \varepsilon_{2t} if S_{t-d} > Y^* \end{cases} \tag{3}$$

Where S_{t-d} is the threshold variable with delay d and $Y^*$is the threshold value. $c_1$and $c_2$are constants in different regimes, while $A_1(L)$ and $A_2(L)$ are regime-dependent lag polynomial matrices. The regime-specific shock ε_{1t} and ε_{2t} are normally distributed with zero mean and covariance matrices $\Sigma_1 = E(\varepsilon_{1t}\varepsilon_{1t}')$and $\Sigma_2 = E(\varepsilon_{2t}\varepsilon_{2t}')$.

Before estimating the TVAR model, this paper selects the optimal lag order (2 in this case) according to the Akaike Information Criterion (AIC) by estimating the linear VAR model. Subsequently, this paper conducts a nonlinearity test for the TVAR model against the linear VAR model using the likelihood ratio (LR) test statistic proposed by Hansen [10]. The threshold test results are presented in Table 3 in the appendix. This paper chooses the first-order lag of the inflation rate as the threshold variable and accept the 2-regime TVAR model. The model is estimated using the Gibbs sampling and Metropolis-Hastings algorithm, as detailed in Appendix A.

The probabilities of the inflation rate being in different regimes are depicted in Fig. 2. This illustration vividly demonstrates that China's real economy can be bifurcated into two regimes based on the inflation rate, with the estimated threshold value at approximately 0.04, aligning with the 4% inflation target in China's monetary policy history. Regime 1 corresponds to a period of economic recession characterized by an inflation rate below the threshold, lasting between 2008M8 and 2010M6 due to the 2008 financial crisis and the new normal period since 2012 marked by a deceleration in economic growth rate. Meanwhile, Regime 2 predominantly covers the period of robust credit expansion around 2007 and 2011.

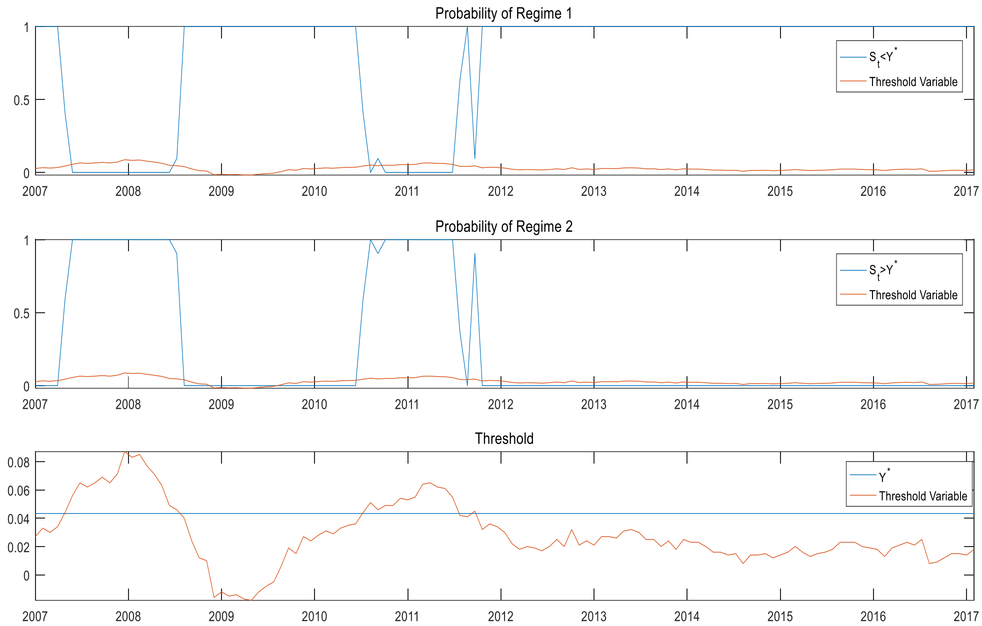

Figure 2: Probability of different regimes and the threshold variable

3.3. Regime-Dependent Impulse Response Analysis

To delve deeper into the impact of financial risk shocks on China's real economy, this paper introduces the regime-dependent impulse response function of the Time-Varying Autoregressive (TVAR) model. In Fig. 3(a), the results reveal that the Industrial Production (IP) growth rate and inflation rate exhibit a decline when subjected to a one-standard deviation maturity risk shock. Notably, the negative response of output in regime 1 during the first period is approximately 1.3%, significantly surpassing the 0.2% response observed in regime 2.

Fig.3. (b) shows the response of real economy to the default risk shock. The decline in the inflation rate in regime 1 is notably more pronounced than in regime 2, while the IP growth rate experiences a drop of about 0.6%. This suggests that substantial government and debt default riskdefault risks may exert intense downward pressure and impose a considerable burden on China's growth, especially during the recessionary regime. Fig. 3(c) illustrates the impulse response to stock volatility risk shocks. Similar to the default risk shock, the IP growth rate experiences a drop of approximately 0.7% in regime 1. Additionally, there is evidence indicating that the negative impact of volatility risk shocks is more pronounced in regime 1.

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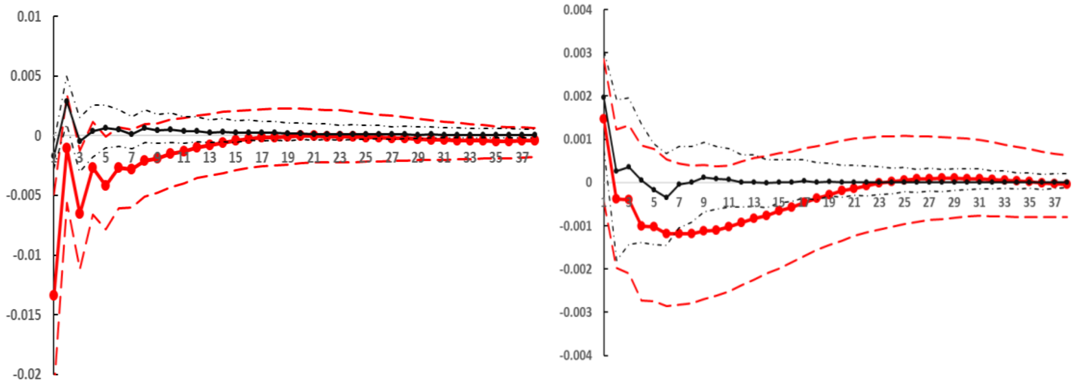
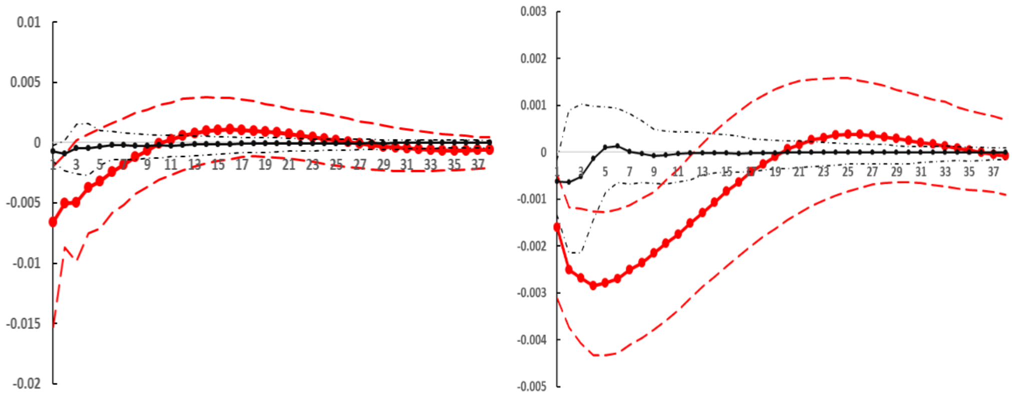


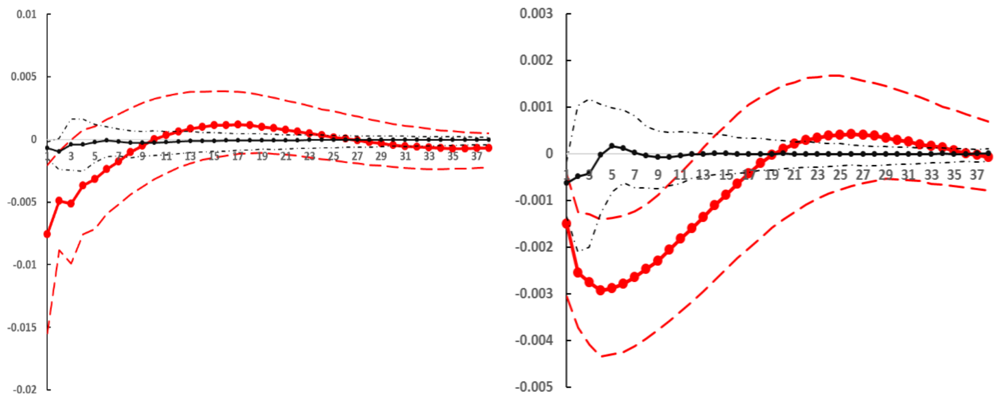
IP growth rate CPI inflation rate

(a)Impulse response to the shock of FRF1



IP growth rate CPI inflation rate

(b) Impulse response to the shock of FRF2



IP growth rate CPI inflation rate

(c) Impulse response to the shock of FRF3

Figure 3: Impulse Response of Financial Risk Shocks

Note: The red dotted line represents regime 1 (recession regime), and the black dotted line represents regime 2 (expansion regime). The dashed lines represent the 15% and 85% error band.

4. Conclusion

This study employs a time-varying Dynamic Factor Model (DFM) to derive three financial risk factors from extensive financial and macroeconomic data in China spanning from 2007 to 2017. Subsequently, this paper delves into the non-linear impact of these financial risk factors on China's real economy. The findings unequivocally establish that financial risk shocks have the capacity to transmit to the real economy, inducing a contractionary effect on output. Moreover, these spillover effects are significantly magnified during periods of economic recession. In light of these results, it is imperative for China's policymakers to accord top priority to the mitigation of financial risks.

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