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Application Research on Monitoring Systemic Risk in Real Economic of China

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ABSTRACT*: This paper analyzes the empirical relationship between debt leverage and systemic risk based on SCCA model. The result shows the climbing of debt leverage would push up the level of risks across all national economic departments, and further accumulate the risks within financial sector and finally generate and transmit systemic risk through debt channel and equity channel. This suggest that, transfer debt leverage especially form non-financial company sector to other national economy departments can improve the level of systemic risk within financial system.*

KEYWORDS - *SCCA Model, Risk Contagion, Systemic Risk*

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1. Introduction

At early 70s, Bank of International Settlement (BIS) started to realize the importance of Systemic Risk. After that, BIS put Systemic Risk identification and evaluation in consideration of financial stablelization. (Borio,2003) However, there are some argument between academic community and policy maker upon content and category of Systemic Risk. From the degree of the damage, Billio et al. (2012) claimed Systemic Risk is a certain type of a risk can threat the whole financial system and Macroeconomics. It generates fragile system and exceeding unstable of the market, to further damage economic development and social welfare. From the view of risk contamination, Schwarcz (2008) emphasized with the increasing disintermediation, to define Systemic Risk should more rely on the chain-reaction between financial institution and market after risk event compromised. As international financial regulator Financial Stability Board (FSB) define systemic Risk more specifically as such events like economic cycle, macroeconomic policy reform, a shock form internal market and so on, which can cause intense turbulence of financial system within a country. Furthermore, generating enormous negative externalities on global financial system and international substantial economy. From the existing analysis results, although from different perspectives, academics and regulator reaches a common understanding: Firstly, Systemic risk focus on the whole or important components of financial system but a certain institution of market. Then, Systemic risk is contagions; individual loss can bring in systematic chain-reaction to all units within financial system. Finally yet importantly, Systemic Risk can generate the strong outflow effects on substantial economy. This work will review a series existing empirical research on risk measurement model combine with the special nature of Chinese financial market to

conduct a better method to access Systemic Risk within financial system of China. Which can help regulator monitor and stable financial market.

2. Literature Review

Since the Asian Financial Crisis, the scholars progressively focus on measurement on Systematic Risk. There are even more empirical works on systemic risk measure models since the recent internal financial Crisis. Although, academic cycle have done lot of useful explores on systemic risk, but until now, they still did not reach a common a definitive theory framework of how to measure and monitor systemic risk.

Jobst and Gary (2013) claimed existing method could be divide to two categories from their fundamental ideas and core ideology. The first called contribution approach. This approach is mainly studies the scope, scale, concentration and correlation of financial service between individual financial institution and other financial institution, as well as the systemic importance of the resulting individual financial institutions. The other called participation approach, this approach aimed on analyzing how a financial institution participates in the formation of systemic risk through its common exposure to external shocks.

In specific, most work attempt to address the issue of joint default risk or deal with loss dependency, from the perspective of financial institutions, can classified as contribution approach. Such as CoVaR (Adrian& Bunnermeier, 2008), CoRisk (Chan-Lau, 2010),SES (Acharya. et al 2009) and its spending method DIP (Huang et al.,2010), Granger causality test(Billio et al.,2010),SRISK (Broynlees and Engle,2011), Dynamic Conditional Correlation DCC-GARCH (Engle,2012) and Consistent Information Multivariate Density Optimizing CIMDO-Coupila (Segoviano and Goodhart,2009) and so on.

Some paper focus on network-analysis and build model base on proxy, analyzing how the asset position that generate systemic risk linked. (Allen et al,2010; Espinosa-Vega&sole, 2011) can be classify to participation approach. However, none of these works involves a corresponding structure of risk. For this reason, Gray and Jobst (2009) developed a perspective research framework on qualitative systemic risk. They further developed Gray et al. (2002,2006,2008) Contingent Claims Analysis (CCA) measure the joint default risk of multiple financial institutions as Systemic Contingent Claims Analysis (SCCA).

3. Conceptual Framework

The approach to access China's systemic risk can divided into two steps. The first step is to identify and summarize the existing indicators of systemic risk measurement, using Partial Components Quantile Regression (PQR) measures the effectiveness of various indictors, which can predict macroeconomic shocks. The second step, using Principal Components Quantile Regression (PCQR) (Gilglio et al., 2016) extract unobservable indicator, which that can effectively predict the macroeconomic shocks from individual measurement indicators. After that, summing and extracting the effective indicator to construct systemic risk index.

Partial Quantile Regression:

$$y_{t+1} = \alpha f_t + \eta_{t+1}$$

Where η_{t+1} is the quantile forecase error, f_t is latent.

The cross section of predictor is defined as the vector x_t, where

$$x_t = \Lambda F_t + \varepsilon_t \equiv \varphi f_t + \psi g_t + \varepsilon_t$$

Idiosyncratic measurement error are denote by ε_t. Thus, common variation among the elements of x_t has portion that depends on f_t, and is therefore relevant for forcasting the conditional distribution of y_{t+1}, as well as a forecast-irrelevant portion drive by g_t.

In stage of extracting principle components as F_t :

$$\hat{F}_t = (\Lambda'\Lambda)^{-1}\Lambda' x_t$$

Where Λ as$\sum_{t+1}^{T} x_t$, represent the first K feature vector.
In estimation stage, out-of-sample predictive quantile regression with y_{t+1} to f_t

$$Q_\tau(y_{t+1}|I_t) = \hat{\alpha}'\hat{F}_t$$

$$\forall t, 当N, T \to \infty, \hat{\alpha}'\hat{F}_t - \alpha' f_t \xrightarrow{p} 0$$

The theorem states that PCQR constructs consistent forecasts for the conditional quantile of y_{t+1}.

1. on(PQR):

Denote the target variable as y_{t+1}, scalar real macroeconomic shock whose conditional quantiles we wish to capture with systemic risk measures. The τ_{th} quantile of y_{t+1} is its inverse probability distribution function, denoted

$$Q_\tau(y_{t+1}) = inf\{y: F(y) \geq \tau\}$$

Then, denoted τ_{th} quantile loss function as:

$$\rho_\tau(x) = x(\tau - I_{x<0})$$

In which, $I_{x<0}$ is indicator function.

$$I_{x<0} = \begin{cases} 1, x < 0 \\ 0, x \geq 0 \end{cases}$$

The quantile function may also be represented as the solution to an optimization problem.

$$Q_\tau(y_{t+1}) = arg\ \inf_q\ E[\rho_\tau(y_{t+1} - q)]$$

Previous literature shows that this expectation based on quantile representation is convenient for handing conditioning information set and deriving a plug-in M-estimator. In the conditional quantile of y_{t+1} are affine functions of observables x_t.

$$Q_\tau(y_{t+1}|It) = \beta_{\tau,0} + \beta_\tau' x_t$$

An advantage of quantile regression is that the coefficients $\beta_{\tau,0}$, β_τ are allowed to differ across quantile. Thus, quantile models can provide a richer picture of target distribution when conditioning information shifts more than just the distribution's location. In this paper, the focus attention separately on $\tau = 0.2$, $\tau = 0.5$, $\tau = 0.8$ to study systemic risk impacts on extreme and central tendency of macroeconomic shocks.

The crucial standard to evaluate significant of systemic risk indicator based on whether conditional quantile regression is more accurate to forecast macroeconomic shocks distribution than a conditional quantile regression. Forecast accuracy can be evaluated via a quantile R^2 based on loss function ρ_τ:

$$R^2 = \frac{1 - \frac{1}{T}\sum_t[\rho_\tau(y_{t+1} - \hat{\alpha} - \hat{\beta}X_t)]}{\frac{1}{T}\sum_t[\rho_\tau(y_{t+1} - \hat{q}_\tau)]}$$

The out-of-sample R^2 can be negative if the historical unconditional quantile offers a better forecast than the conditional variable, vise versa.

At last, use adjusted MSPE of Clark & West (2007) to test the significant of conditional quantile estimation.

2.Principal Components Quantile (PCQR):

Based on individual predictor only focus on a certain level of systemic risk which product the insignificant and incomprehensive to estimate economic fluctuation, refer to Giglio er al.(2016) PCQR extract and sum significant information from individual indicator to construct systemic risk index.

Assume that the τ^{th} quantile of y_{t+1}, conditional on an information set I_t, is a linear function of an unobservable univariate factor f_t

$$Q_\tau(y_{t+1}|I_t) = \alpha f_t$$

Realizations of y_{t+1} can be written as:

$$y_{t+1} = \alpha f_t + \eta_{t+1}$$

Where η_{t+1} is the quantile forecase error, f_t is latent.

The cross section of predictor is defined as the vector x_t, where

$$x_t = \Lambda F_t + \varepsilon_t \equiv \varphi f_t + \psi g_t + \varepsilon_t$$

Idiosyncratic measurement error are denote by ε_t. Thus, common variation among the elements of x_t has portion that depends on f_t, and is therefore relevant for forcasting the conditional distribution of y_{t+1}, as well as a forecast-irrelevant portion drive by g_t.

In stage of extracting principle components as F_t :

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The theorem states that PCQR constructs consistent forecasts for the conditional quantile of y_{t+1}.

Conclusion

This paper base on SCCA model, use data from Chinese financial market to make an empirical analysis of the inter-link contagious between leverage of debt and systemic risk. The results include four perspectives: 1. The climb of debt leverage significantly push up then level of systemic risk which keep changing the contagious path and spread of risks within the network of financial markets and institution. 2. The volatility of financial market make a significant effect to macro-financial risk indicators. The volatility first mitigates before financial crash, and when exacerbate during crisis. 3. The debt leverage dramatically arise within each department of Chinese nation economy during recent years, which indicate rapid accumulation of systemic risk. 4. Transfection of debt leverage from non-financial company to government department and residence department will reduce the level of systemic risk within financial network.

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