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Abstract: The newly-developing Generalized Autoregressive Score(GAS) model can conduct modeling for the mean and volatility of three internet financial concept stocks—Eastmoney, Toocle and Hundsun. By combining with the descriptive statistical analysis, it can be observed that the return series has the typical abnormality of sharp peak and heavy tail. Moreover, the return series is smooth and steady. The time-varying characteristic of volatility is significant. There is the strong correlation and linkage features in the return series. In the future, predictive analysis of earnings and volatility is further conducted, so as to provide the reference information for improving Jiangsu Internet Finance Market, especially for China, greatly control market risks and stabilize the market.

1. Introduction

Driven by the rapid development of electronic technology, internet finance emerged at the right moment and got the rapid development [1]. The rapid development of internet finance destroys the operational mode of traditional finance, reduces trading costs, improves resource configuration rate, reinforces capital mobility, improves financial service efficiency, and achieves a goal of serving for entity economy. Based on the current development status, operational mode of the internet finance has lots of risks. With the increasingly strong national supervision strength, problems of internet finance are gradually exposed, thus it is necessary to do risk control and early-warning. Numerous scholars have greatly studied on it. Most of them have analyzed from the perspectives of constructing and improving the internet bank supervision framework, supervision policy network and supervision system [2].

Volatility shows the stock price's uncertainty of changes in some periods. It has the important applications in numerous financial fields, including risk management and asset configuration. To estimate and predict the volatility of assets' return series is an important topic of financial econometrics. Volatility can reveal the risk degree of financial market to some extent. The average earnings reveal the profitability of financial products [3]. In view of it, this author discusses the efficiency and risks of internet financial market from the dynamic changes of average yield and volatility, and provides some references for Jiangsu internet financial market supervisory policy adjustment, especially for China.

At present, there are fewer literatures about earnings, volatility and correlation of the internet finance market. As a result, by taking concept stock market of internet finance as an example, the author studies financial yield, volatility and correlation features in internet finance market and provides the beneficial enlightenment on improving internet finance market functions.

2. GAS model

2.1. Basic theory

The GAS model is the time series model driven by observation. Time-varying parameters of lagging score are obtained through the density function. The advantages lie in purely depending on the mean and higher moment model and taking full advantages to the complete density structure to drive time-varying parameters in real time [4].

y_t is the N-dimensional random vector at t moment. Assuming that y_t is generated by the

observational density:

$$y_t|y_{1:t-1} \sim p(y_t; f_t), \quad (1)$$

Among which, $y_{1:t-1}=(y_1', \dots, y_{t-1}')$ includes the past value of y_t until $t-1$. f_t is the time-varying parameter vector of the function $p(\cdot)$. The upgrading equation of f_t is driven by the conditional density function score S_t and autoregression f_{t+1} , as shown in Formula (2):

$$f_{t+1} = \omega + \sum_{i=1}^p A_i s_{t-i+1} + \sum_{j=1}^q B_j f_{t-j+1}, \quad (2)$$

Among which, ω is the constant vector; A and B belong to the coefficient matrixes. The score S_t is the driving mechanism. Generally speaking, it is defined as:

$$s_t = S_t \nabla_t, \quad \nabla_t = \frac{\partial \ln p(y_t; f_t)}{\partial f_t}, \quad S_t = I_{t|t-1}^{-1}, \quad I_{t|t-1} = E_{t-1}(\nabla_t \nabla_t'). \quad (3)$$

Creal(2012)[5] provided other forms of S_t , let $S_t = \frac{I_{t|t-1} J_{t|t-1} J_{t|t-1}^{-1}}{I_{t|t-1}^{-1}}$ or let $S_t = I$.

To sum up, Formulas (1)-(3) are defined as GAS model of p and q orders, written as GAS(p, q).

2.2. Maximum likelihood estimation

An excellent property of the GAS model is to give the past information and random parameter vector $\zeta=(\omega, A, B)$, so as to estimate the time-varying parameter vector f_t accurately. $Y_{1:T}$ should be marked as the sample T in y_t . The parameter vector ζ can conduct likelihood estimation from the following formula[6]:

$$\hat{\xi} \equiv \arg \max_{\xi} \mathcal{L}(\xi; y_{1:T}), \quad (4)$$

Among which, $\mathcal{L}(\xi; y_{1:T}) = \log p(y_1; f_1) + \sum_{t=2}^T \log p(y_t; f_t)$; as $t=1$, there is $f_1=(I-B)^{-1}\omega$; as $t>1$, there is

$$f_1 = f_{(y_{1:t}, \xi)}.$$

In maximum likelihood estimation, it is worth noting that when the estimated value has congruence and progressive normality, the maximum of the logarithmic function in Formula(4) is changing. This is caused by nonlinearity of $\Lambda(\cdot)$ and different modes in f_t entering into score S_t . As a result, the optimal solution of the model is based on the gradient and initial value. In R language, the coefficient matrixes A and B are conducted the grid search to confirm the initial value.

2.3. The research method

In this thesis, GAS model is used to analyze the dynamic changes of yield and volatility of concept stock in the internet finance.

Assuming that density function of return on assets R_t is $p(R_t|f_t, F_t; \theta)$, f_t shows the model parameters changed with time, including mean and volatility parameters. F_t stand for the information set at t moment, while θ refers to the static parameter that is not changed with time. The f_t time-varying evolution model is the autoregression form driven by the proportional score vector. To be specific:

$$f_{t+1} = \kappa + \sum_{i=1}^p A_i s_{t-i+1} + \sum_{j=1}^q B_j f_{t-j+1} \quad (5)$$

$$s_t = S_t \cdot \nabla_t \quad (6)$$

$$\nabla_t = \frac{\partial \ln p(\epsilon_t | f_t, F_t; \theta)}{\partial f_t} \quad (7)$$

$$S_t = S(t, f_t, F_t; \theta) \quad (8)$$

Among which, $S(\cdot)$ is the matrix function. S is constructed by the Fisher information matrix. Formulas(1)-(4) give the GAS model with the orders of p and q , simplified as GAS(p, q). In this thesis, S_t is the unit matrix. There is $p=q=1$.

In the distribution modeling of financial asset yield, normal distribution and t distribution are two common distributions. The normal distribution can't depict the heavy tail feature of financial asset yield, thus it is easy to underestimate risks. T distribution can flexibly capture the heavy tail features, thus the fluctuation model selected in this thesis is the GAS model based on t distribution. It is simplified as GAS-t. The maximum likelihood method is used to estimate the model parameter.

3. Sample selection

The concept stock closing price series of Eastmoney, Toocle and Hundsun is selected. $r_t = \log P_t - \log P_{t-1}$ (continuous composite yield from t-1 to t) is used as the main research analysis object. The sample interval ranged from December 25, 2009 to September 10, 2018. After relevant data with the inconsistent trading time during the sample period, 2035 kinds of data matched with the trading time of three markets are obtained. The data come from Wind Information Financial terminal. All analytical results are obtained through R statistical software.

4. Empirical analysis

4.1. The stationary test

Firstly, ADF unit root test is used to do stationary test for price series and yield series, obtaining the P-value of yield series less than 0.01. Therefore, yield series refuses the null hypothesis with unit root under 1% of significant level, indicating that the yield series is the stationary series. The price series can't refuse the null hypothesis with the unit root under 1% of significant level. Therefore, the price series is unstable series.

4.2. Time-varying characteristic test of volatility

By taking Hundsun as an example, yield, sequence chart of square series, autocorrelation and partial autocorrelation are used for analysis.

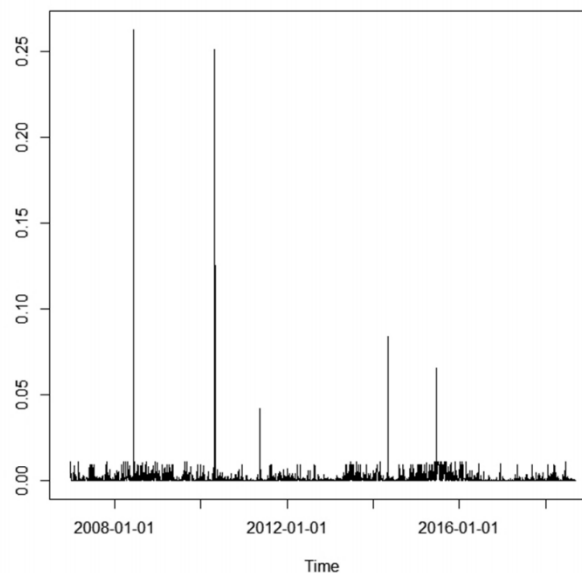


Figure 1 Square series figure of yield

It can be observed from Figure 2 that autocorrelation of r_t^2 is stronger autocorrelation coefficient and partial autocorrelation of r_t, r_t^2 when the lagging period is $k=26$. The significance differs from 0. The Box-Pierce test of r_t^2 indicates that when degree of freedom is 4, 6, 8, 10, 12, 14 and 16, P is very small. In the statistical significance, correlation before and after square sequence of yield is significant. It also can be observed from Figure 2 that volatility has time-varying characteristic. To sum up, time-varying model can be used to fit with the volatility of return series.

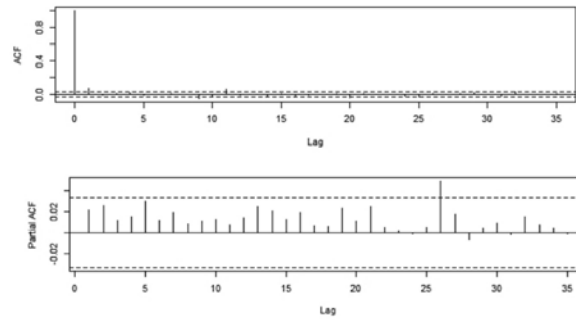


Figure 2 Square Series of Hundsun Yield Series and Hundsun Yield

4.3. GAS model estimation

GAS (1, 1)-t model is used to do the united polybasic estimation and analysis for mean yield and volatility of Eastmoney, Toocle and Hundsun.

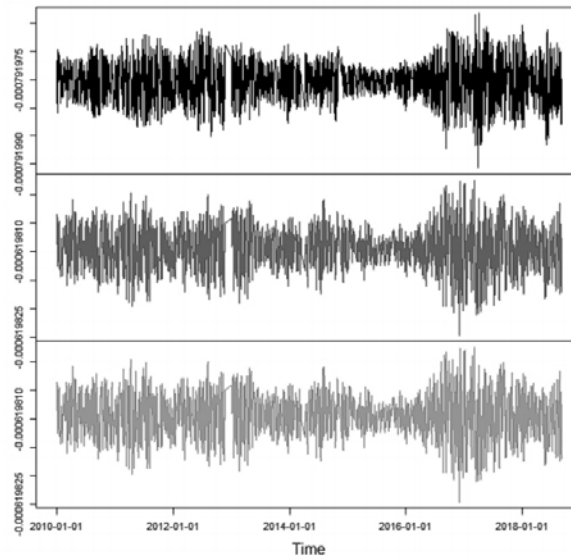


Figure 3 Dynamic Mean Yield of Eastmoney, Toocle and Hundsun

It can be observed from Figure 3 and Figure 4 that concept stock of internet finance in 2015 had the dramatic fluctuation. Correspondingly, mean yield during the period was hovering around 0, conforming to the physical truth of the market. Moreover, it can be observed that no matter for the mean or volatility, Eastmoney, Toocle and Hundsun have the similar moving trajectory and linkage features. This is identical with the high-strength correlation in return series.

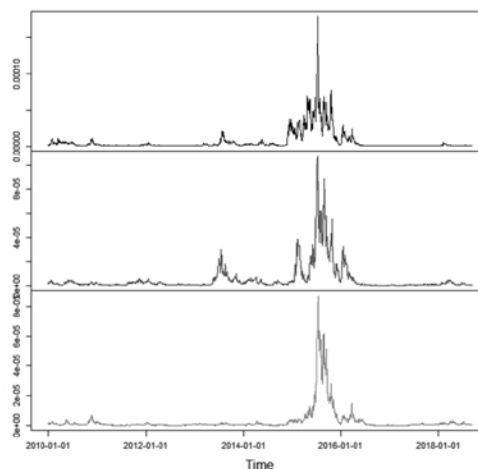


Figure 4 Dynamic Volatility of Eastmoney, Toocle and Hundsun

5. Conclusions

By taking three concept stocks in internet finance—Eastmoney, Toocle and Hundsun as

examples, the closing price at daytime was used to obtain the typical non-normality of sharp peak and heavy tail in the return series through the descriptive statistical analysis. There was the high-strength correlation and linkage features in return series. According to autocorrelogram and sequence chart, return series was stable, while the square series of yield had the stronger long-term autocorrelation. In addition, the newly developed GASGAS model was used to model the mean and volatility of return series. The parameter estimation results, dynamic mean value and volatility figures could be used to obtain the relatively stable return series. Volatility series had the significant dynamic time-varying characteristic, proving relevant conclusions obtained by descriptive statistical analysis. As a result, it is necessary to reinforce supervision on the internet finance, while promoting internet finance development, so as to maintain stability of the financial market.

In the future, the predictive analysis of yield and volatility series can be conducted, so as to provide reference information for functions of Jiangsu internet finance market, especially for China, greatly control the market risks and stabilize the market.

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