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Based on the Perspective of Fuzzy Theory and GARCH-MIDAS Method to See How Economic Policy Uncertainty Drives the Volatility of Asian Emerging Stock Market

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Abstract: At present, there are two main phenomena in the classical measurement econometric research method: on the one hand, the same frequency data are used in the research process; on the other hand, many studies use low-frequency stock market data as the data index of the research object, which makes Asian stock market data has the same frequency as macro exogenous explanatory variables. The purpose of this paper is to solve the problem that the traditional co-frequency model cannot obtain the causal relationship between the macroeconomic explanatory variables and the fluctuations of emerging Asian stock markets due to the limitation of data frequency. This paper based on the fuzzy rationality hypothesis, using fuzzy mathematics and fuzzy statistical tools to improves the traditional GARCH-MIDAS model. Through the improved GARCH-MIDAS method, studied the fluctuation of emerging Asian stock markets. The results show that through the ability prediction for improved models, analyzed and found that both single-factor and multi-factor models have strong predictive power. By comparison, we can find that the multi-factor mixing model can better describe long-term component of price volatility in emerging Asian stock markets than the single factor mixing model.

1. Introduction

Since the beginning of this year, the continuous interest rate hike in the United States has not only brought greater depreciation pressure on the currencies of various countries, especially in emerging markets, but also exerted certain pressure on capital outflows from these countries.

According to foreign media reports, overseas funds are withdrawing from the stock markets of the six emerging markets in Asia at the fastest rate since the 2008 financial crisis. The amount of evacuation reached 19 billion US dollars. Among the six emerging markets are China, in addition to India, Indonesia, the Philippines, South Korea, Thailand and Taiwan. Study the effects of leverage and economic policy uncertainty (EPU) on future volatility in the regime's transition framework. HAR-RVs with leverage and economic policy uncertainty can achieve higher prediction accuracy than RV and GARCH models [1]. This means that these factors in the institutional transformation framework can significantly improve the predictive performance of HAR-RV. The generalized autoregressive conditional heteroscedasticity (GARCH) model is used to study the volatility of the Bangladesh stock market. Significant “low-risk associated with high-risk” phenomena were detected during the crisis and “leverage” occurred during each period. Investors are irrational, based on risk taking and asset return characteristics. Therefore, the market is not as mature as developed markets [2]. The uncertainty of monetary policy is isolated from the general macroeconomic uncertainty, often with unintended adverse consequences and may weaken the economic environment. The task of the central banker is very difficult. Their models are based on many shocks from various sources, with relatively large uncertainties in predicting output and inflation. What is important is how central bank governors respond to these expectations and how they communicate the potential risks associated with setting interest rates [3].

Combined with the extreme value theory and the AR-GARCH model, the risk value of the offshore RMB interbank lending rate in different periods was measured, and the US dollar London Interbank Offered Rate was compared and the future development trend was inferred. The offshore RMB interbank market in Hong Kong is still in the initial stage of international currency development in the offshore market. The overall risk will be reduced in the future, and the value of risk will increase with the extension [4]. The securities regulators of the United Arab Emirates have only received external shocks from the UK but have not obtained them from the United States; this is mainly due to the close ties between the two countries. As a result, UAE investors seek capital on outside their home country as their UK investment options increase. Improving the transparency of transactions through information technology will increase the efficiency of Dubai's financial markets [5]. Different methods are used in each margin trading policy stage to estimate the impact of policies on China's stock market volatility, including but not limited to VAR models, impulse response functions and ARCH regression models [6]. Taking into account the government's early intervention in the Chinese stock market as a natural experiment, the foreign experience of the Chinese stock market in a specific period was explained. This atypical market is generated by a consensus of behavior among heterogeneous traders, which is driven by minimal price constraints. Paradoxically, price limits aimed at stabilizing prices actually exacerbate price volatility in the long run [7]. The additional explanatory information of the US variables is mainly from the stock market indicators, and the link between the short-term Taiwan and the US stock market volatility is particularly obvious [8]. Twenty-five years of volatility research has played a secondary role in the macroeconomic environment [9]. It has been found that the traditional social learning model is very suitable for certain types of changes in policy, but it cannot adapt to the transition from Keynesianism to monetary decision-making mode. In the case of a paradigm shift, policies respond to broader social debates related to electoral competition, which requires the re-establishment of traditional national-social relations concepts [10].

In this paper, the improved GARCH-MIDAS mixing model is used to re-examine and study the impact of Asian macroeconomic factors on stock price volatility. The main innovations of the research are: (1) Model selection. In this paper, we use the improved GARCH-MIDAS mixing model. The traditional study of macroeconomics affects the stock market by using the same frequency (low frequency) vector autoregressive model, but only using the same frequency (low frequency) variable when studying macroeconomic and stock price fluctuations. It is easy to lose the effective information brought by the high frequency variable, and may even cause the model misplacement problem, and the GARCH-MIDAS mixing model solves the problem of the same frequency variable limitation. At the same time, unlike the classic GARCH-MIDAS mixing model, the classical GARCH-MIDAS mixing model only considers the effects of low frequency exogenous variables on high frequency endogenous variables. (2) In terms of indicator selection, this paper selects factors that affect Asian stock price volatility from a newer economic perspective, including monetary policy, price level and international exchange rate, and selects representative variables to study the impact on Asian stock price volatility. . Taking into account the background of exchange rate reform, the scope of research data adopted in this paper begins after the exchange rate reform. (3) In terms of research conclusions, the improved GARCH-MIDAS model supports the estimation of multi-factor models in addition to the estimation of single-factor models. Therefore, in the study of the single factor model and the multi-factor model, it is found that the multi-factor mixing model can better describe the long-term component of the Asian stock market price fluctuations than the single factor mixing model. At the same time, the predictive ability analysis of the research model found that the single factor model and the multi-factor model have strong predictive ability, and the prediction effect based on the multi-factor horizontal effect model is better than the single factor-based horizontal effect model. In addition, the study also found that the level of money supply and volatility have a significant positive impact on Asian stock market volatility; the horizontal effect of consumer price index has a significant negative correlation with Asian stock market volatility, and The relationship between the volatility effect and the volatility of the Asian stock market is not significant; the horizontal and volatility effects of the US dollar against the RMB exchange rate have a significant negative correlation with the stock market volatility.

The main structure of this paper is as follows: Section 1, this part mainly introduces the background, research purpose and research significance of the thesis, and further determines the research content and research methods and the innovation of the thesis. Section 2 is related theoretical research and research methods. From the theoretical analysis and empirical methods, the paper introduces the research results of domestic and foreign scholars on the macroeconomic impact of stock price fluctuations in Asia. By reviewing the existing research, it summarizes the existing research situation and finds their lack of research methods. Section 3, this chapter theoretically combs the impact of macroeconomic exogenous variables on stock market volatility. From the perspectives of money supply, inflation, interest rate and exchange rate, the mechanism of the impact on stock prices is explained in depth. At the same time, the corresponding changes in stock price fluctuations when Asian macroeconomic factors change in recent years are analyzed in each section. Section 4 introduces the sample data needed in the empirical research, and preprocesses the sample data, and gives descriptive statistics of the sample data. Then the improved GARCH-MIDAS model is used to empirically study the effects of selected macroeconomic indicators on stock price fluctuations, including single factor GARCH-MIDAS model research and multi-factor GARCH-MIDAS model research, from horizontal effect and wave effect respectively. Angle to conduct empirical research. Section 5 summarizes the main conclusions of this study and summarizes the tasks and achievements of the Institute.

2. Proposed Method

2.1. Related Work

Prüser used the time-varying parameter FAVAR model to study the impact of economic policy uncertainty on the broad macroeconomic variables of the 11 European Monetary Union countries.

First, he can distinguish between a group of fragile states and a group of stable countries, the former suffering the most from EPU shocks. Second, he found that EPU shocks affect financial markets and the real economy, and private investors and financial market participants are more sensitive to consumers' reactions to EPU shocks than consumers. Third, we find that the propagation of EPU shocks is fairly stable over time [11]. Fang applied the GARCH-MIDAS model to test whether the information contained in the Global Economic Policy Uncertainty (GEPU) helps predict the short- and long-term components of the gold futures yield variance. His results show that GEPU positively and significantly predicts the future monthly volatility of the global gold futures market. The predictive power of GEPU is still strong in the sample setup. In addition, further sampled samples show that the GARCH-MIDAS model with GEPU and volatility is superior to all other specifications, indicating that the inclusion of low-frequency GEPU information in the GARCH-MIDAS model significantly enhances the model's predictive power [12]. Shu investigated the cross-market relationship between the volatility index and the US and non-US stock market returns. He found widespread VIX impact in the US and non-US stock markets. VSTOXX and VKOSPI capture the major impact of the global economy and show changes similar to VIX. Empirical results show that changes in the volatility index are very important for explaining stock returns. He also studied the spillover effects of the volatility index. The VIX in these spillover effects is the primary transmitter and VKOSPI is the primary receiver. The results show that VIX is in a leading position in the international market [13]. Apergis examined the link between the European Central Bank (ECB) announcement and emotional changes in stock returns. The analysis builds a new index that describes the emotional tone of these announcements, covering the period from January 2002 to June 2016. The novelty of this work relies on the development of a unique sentiment index related to the information conveyed by ECB activities. And the impact of the index on the average and volatility of certain major international stock markets. In this case, the sentiment index exists in the conditional mean and volatility equations. The survey results show that there is a significant impact on the mean and volatility of earnings, while the news sentiment/stock yield correlation is enhanced during the crisis [14].

Fang applied the GARCH MIDAS model to examine whether the information contained in the Global Economic Policy Uncertainty (GEPU) could help predict the short- and long-term components of the gold futures yield differential. The results of the study indicate that GEPU positively and significantly predicts the future monthly volatility of the global gold futures market. In the absence of samples, GEPU's predictive power is still strong [15]. Yu investigated the long-term factors of how uncertainty in US economic policy drives industry-level stock market volatility. Using the revised GARCH-MIDAS specification, EPU has been found to increase long-term volatility in the industrial and materials industries and reduce volatility in four of the 10 industries considered here: consumer necessities, healthcare, information technology and materials. The results show that the Republican presidency has weakened the impact of EPU on long-term volatility in consumer staples, healthcare and the information technology industry. MIDAS regression using the beta weighting scheme also confirmed the weakening effect of PLC on the relationship between EPU and long-term fluctuations in industry-level returns [16]. Prüser used the time-varying parameter FAVAR model to study the impact of economic policy uncertainty on the broad macroeconomic variables of the 11 European Monetary Union countries. First, a group of fragile states (GIIPS countries) and a group of stable countries (northern countries), the former being the most affected by the EPU shock. Second, it was found that EPU shocks affect financial markets and the real economy, and private investors and financial market participants are more sensitive to consumers than EPU shocks. Third, it was found that the spread of EPU shocks was quite stable over time [17]. Yu studied the long-term factors of how global economic policy uncertainty drives the volatility and correlation of crude oil and US industrial stock markets. Using improved generalized autoregressive conditional heteroscedastic mixed data sampling (GARCH-MIDAS) and dynamic conditionally correlated mixed data sampling (DCC-MIDAS) specifications, it was found that GEPU is positively correlated with long-term volatility in the financial and consumer discretionary industries; however, it negatively related to information technology, materials, telecommunications services and energy. Unlike the mixed role of GEPU in long-term fluctuations, long-term correlation is positively correlated with GEPU for the entire industry [18]. Blanchard believed that the current DSGE models are flawed, but they contain the right foundation and must be improved rather than discarded. In addition, different types of macroeconomic models are needed for different purposes. Specifically, there should be five general equilibrium models: a common core, plus basic theories, policies, toys, and predictive models. Different categories of models learn a lot from each other, but the goal of full integration has proven to be counterproductive. For everyone, no model can be a good thing [19]. Bhowmik used the generalized autoregressive conditional heteroskedastic (GARCH) type model to investigate the volatility of Bangladeshi stock markets. The results of this study show that the fluctuation characteristics of the index change over time. The survey results show that the risk premium and volatility of GARCH model parameters in different periods continue to change. Serious “high-risk-related low-yield” phenomena were discovered during the crisis, and “leverage effects” occurred during each period. The assumptions of investors based on the risk and return characteristics of assets are irrational. Therefore, the market is not as mature as developed markets [20].

2.2. MIDAS Mixed Data Sampling Method

When processing time series data of different frequencies, the high frequency data is generally converted into data of low frequency or the same frequency, and the processing method is highly likely to lose the validity of other information in the mixed data. The main point of the mixed data sampling method is to assign corresponding weights to the lag period value, so that the low-frequency data is regressed to the weighted lag term of the high-frequency data, similar to the distributed lag regression model, and the distributed lag regression model is based on the lag of the variable itself. To perform regression, the expression for the distributed lag regression model is given below:

$$\mathrm{Y_t} = \beta_0 + \beta_1 \mathrm{B(L)} \mathrm{x_t} + \varepsilon_t \tag{1}$$

Here, *B (L)* is a finite or infinite lag polynomial operator, where model verification is performed based on the same-frequency data. While introducing a single influencing factor, this paper also considers the model of the horizontal value and volatility of multiple influencing factors. The main difference between the multi-factor mixing model and the single-factor mixing model is the setting of long-term components. When the influencing factors include two or more, the resulting mixing model is considered to be a multi-factor GARCH-MIDAS model.

The mixed data sampling method is not a distributed lag regression model in a strict sense. Compared with the distributed lag regression model, mixed data sampling can better process the mixed data and obtain more ideal effects. For mixed data sampling, *X (m)* the sampling frequency is m times the sampling frequency of Y_t. In economic terms, that is, if Y_t is annual data, then *X (12)* is expressed as monthly data and *X(4)* is expressed as quarterly data. The expression of MIDAS mixed data sampling can be expressed as follows:

$$\mathrm{Y_t} = \beta_0 + \beta \mathrm{B}(L^{\frac{1}{M}}) x_t^m + \varepsilon_z^{(m)} \tag{2}$$

K is the lag order of high-frequency data. In general, the problem of excessive parameters is solved by limiting the parameters, which is related to the selection of weight functions. The weight functions are in various forms, such as the exponential Almon and Beta polynomials. Also, the method of discrete normal distribution using mixed data sampling can not only apply the data processing problem of large mixed frequency, but also can be applied to the data processing of the same frequency, by using the same core thought method, the value of the dependent variable lags. Corresponding assignments can be used to estimate the effect of different weight estimation lag values on the different degrees of the independent variables. Correct and reasonable selection of weight functions can also enhance the effectiveness of reducing the parameters to be estimated.

2.3. Improve the GARCH-MIDAS Wave Rate Model

The method converts high-frequency macro factors into low-frequency volatility and then incorporates them into the low-frequency wave equation of the GARCH-MIDAS model. This way, on the one hand, it makes full use of the macro-frequency information, and on the other hand, it improves the prediction accuracy. Level. Different information events have different effects on financial markets, depending on their short-term or long-term effects. With the rapid development of the volatility model, it has attracted the attention of many scholars at home and abroad. Based on the GARCH-MIDAS model based on the assumption of unanticipated returns, the stock price volatility is modeled as follows:

$$\mathrm{r_{i,t}} = \mu + \sqrt{g_{\nu,t\bar{l}_{-L}}}\Sigma_i, t \tag{3}$$

Let the dynamic component of the daily volatility obey the GARCH (1,1) process:

$$\mathrm{g_{it}} = (1 - \alpha - \beta) + \mathrm{a}\left(\mathrm{r_{i-1,t}} - \mathrm{n}\right)^2 + \beta g_i - I_3 t \tag{4}$$

Using the realized volatility to characterize low frequency fluctuations, the MIDAS regression method is used to represent the components as follows:

$$\mathrm{T_t} = \mathrm{m} + \theta \sum_{k=1}^{k} \varphi^k(\mathrm{w_1}, \mathrm{w_2})\mathrm{Rv_t} - \mathrm{k} \tag{5}$$

The maximum lag order of the low frequency variable is expressed in the equation, indicating that the realized volatility in t month is as follows:

$$\mathrm{Rv_t} = \frac{\mathrm{N_t}}{\mathrm{i=1}} \mathrm{r_{i_1}^2 t} \tag{6}$$

From the model setting, it can be seen that unlike the traditional research macroeconomic impact stock price model, the traditional model is mainly limited by frequency, and the improvement of GARCH-MIDAS has the following advantages: First, the improved GARCH-MIDAS model can make full use of the stock market. The low frequency and high frequency data break through the frequency limit. Secondly, the improved GARCH-MIDAS model can fully consider the influence of the horizontal value and volatility of each factor on the fluctuation of the Shanghai Stock Index, and is not affected by the stability. The improved GARCH-MIDAS model can not only measure the effect of the lag period of the influencing factors on the volatility of the Shanghai Stock Index, but also compensate for the lack of interpretation ability of the impulse response function. The weight function in the equation is a weight equation constructed based on the Beta function. The flexibility of the Beta weight function can adapt to the hysteresis distribution of various shapes. The specific expression is as follows:

$$\varphi_k(\mathrm{w_1}, \mathrm{w_2}) = \frac{-\mathrm{f(k)k_{w_{1,1}}N}}{\sum_{1\Leftarrow 1}^{-1^a} + (\mathrm{w1+w2})} \frac{1}{\mathrm{n_1, w_{\ 2}}'} \tag{7}$$

The weight function not only saves the estimated parameters, but also makes it easier to compare the estimated results of different frequency data, and it is also convenient to make corresponding economic explanations. Generally, it is preferable to use the estimated weight parameters. The above constitutes a GARCH-MIDAS model based on realized volatility, which increases the setting of the composition equation. As mentioned above, the long-term component of stock price volatility is highly correlated with the volatility of its influencing factors. The paper establishes an improved GARCH-MIDAS mixing model based on the horizontal effects and volatility effects of its influencing factors. After the original value of the variable is unified by the order of magnitude, it is replaced by the formula:

$$T = \mathrm{m_L} + \theta_\mathrm{L} \sum_{k}^{k_t} k^{(w_1,w_2,t)} x_{t-k}^{mv}\, \varphi \tag{8}$$

This chapter first introduces the more traditional methods of processing mixed data, and gives a detailed derivation process of the mixed data sampling method (MIDAS model). It is found that the mixed data sampling method can be applied to the mixed frequency data processing problem. Apply to the same frequency of data processing problems. Based on this, the classical GARCH-MIDAS model with mixed data sampling method is introduced and its detailed derivation process is expounded. At the same time, the improved multi-factor GARCH-MIDAS model and GARCH with high frequency exogenous variables are also given in detail. - The detailed derivation process of the -MIDAS model, the main improvement is to adopt the same processing method as the high-frequency dependent variable for the high-frequency macro factors, that is, the method of realizing the volatility, converting the high-frequency macro factors into the low-frequency volatility, and then Incorporated into the low frequency wave equation of the GARCH-MIDAS model.

3. Experiments

3.1. Selection and Testing of Data Samples

This paper selects the "Shanghai Composite Index" as the volatility of the stock market, mainly through the closing price of the Shanghai Securities Composite Index to construct stock volatility indicators, calculated based on the closing price information to achieve realized volatility after 2005, with the implementation of a large number of IPOs, Asia The stock market has also entered a period of rapid development, and market confidence has driven the stock index to keep rising. However, since the end of 2007, as the financial crisis spread around the world, the Asian stock market is also unable to escape the bad luck. The Shanghai Composite Index once fell to the level before the stock index rose, and the stock index volatility. The reason for the large fluctuations in 2015 is mainly due to the tight funding in the middle of the year and the rapid expansion of new shares. The main reason is that the previous market has risen too much and there is a certain amount of profit. When we analyze the rate of return on financial products, we tend to assume that their distribution is normally distributed, but the reality is that financial asset returns are not all subject to normal distribution.

As shown in table 1, we can see from 1 that the average of the two yield variables of the Shanghai Composite Index and the Shenzhen Component Index are slightly larger than 0, which means that the current income of the Shanghai and Shenzhen Stock Exchanges is slightly lower than the previous period. Better, it means that the Shanghai and Shenzhen stock markets are growing slowly between 2006 and 2010, and their positive and negative returns are often alternated. The results of statistical tests also indicate

In the classical linear regression model, there is no autocorrelation between the interference terms. However, the time series often have its own cycle law, and the Chinese stock market may also have autocorrelation. Therefore, before establishing a regression model, strict statistical methods are needed to test whether there is significant autocorrelation.

Table 1. Statistical analysis of the return rate of Shanghai and Shenzhen stock markets

Statistics	Shanghai Composite Index	Shenzhen Composite Index
Sample size	1167	1167
Mean	0.0008	0.0013
Median	0.0025	0.0029
Skewness	-0.4360	-0.4440
Kurtosis	2.2280	1.5880
Maximum	0.0903	0.0916
Minimum value	-0.0926	-0.0975
KS statistic	0.0000	0.0000
ARCH-LM test	18.3457	13.2518

Since the application of the model requires that the time series studied must be stationary, it is necessary to test the stability of the two times series. The most common measure of stability is the unit root test. We will use an augmentation test to verify that the data studied in this paper has a unit root, and the software used is. Here, the maximum lag order is 22, and the test results are shown in table 2.

Table 2. Unit root test result

	Inspection form	Test value	P value	Conclusion
Shanghai Composite Index	(c, l, p)	-33.9115	0.0000	Smooth
	(c,0,22)	-33.9847	0.0000	Smooth
	(0,0,22)	-33.8745	0.0000	Smooth
Shenzhen Composite Index	(c,0,22)	-32.4146	0.0000	Smooth
	(c,t,22)	-32.4674	0.0000	Smooth
	(0,0,22)	-32.3276	0.0000	Smooth

3.2. Model Design Process

On July 21, 2005, exchange rate reform was implemented in Asia. In the international financial crisis that broke out in 2008, Asia appropriately narrowed the volatility of the RMB to cope with the international financial crisis. Many countries' exchange rates have depreciated against the US dollar. The exchange rate was basically stable. On the basis of the 2005 exchange rate reform in Asia, in 2010, it was proposed that the market supply and demand should be used as the cornerstone. At the same time, with reference to a basket of currencies, the stock market experienced a relatively complete cycle of rising and then falling.

When studying stock price fluctuations, the influencing factors are mainly divided into microeconomic factors and macroeconomic factors. Microeconomic factors mainly include transaction itself, transaction volume, transaction price, etc., and microeconomics is only a local influencing factor, while macroeconomic factors are global factors that can affect stock market price fluctuations. In order to examine the overall influencing factors, we must first select the stock market volatility index and the corresponding macroeconomic factor indicators. The change in money supply is a direct manifestation of national policies, which has a major impact on both industrial and financial investment, especially on the operation of the stock market and the direction of investors' investment. In general, the money supply mainly affects the price of the stock market through the following two paths:

(1) Flow-oriented model. This model mainly explains the impact of exchange rate on stock

prices from two perspectives: assets and liabilities denominated in foreign currencies and international competitiveness of import and export listed companies. From the perspective of assets and liabilities denominated in foreign currencies, when the local currency appreciates, the actual assets denominated in foreign currencies will decrease, and the profits reflected will be reduced accordingly, which will lead to a decrease in the stock price of listed companies.

(2) Portfolio balance model. The model assumes that there are no barriers between capital markets in each country, and that domestic and foreign securities are completely substitutable. When a country's exchange rate decreases, then the return on assets denominated in local currency will be higher than the return on assets denominated in foreign currencies. Investors will regroup their portfolios and increase the holdings of assets denominated in local currency. Currency-denominated asset holdings, this combination change will be reflected in the securities market, causing stock prices denominated in local currency to rise, and vice versa.

(3) Influence the stock price through the operator. First, changes in interest rates affect the company's operating profit, which in turn affects the stock market price. When the interest rate is low, it will increase the liquidity of funds in the financial market, bring convenience to the enterprise financing, promote the company to gain greater profit margins, and then the stock price will rise accordingly; when the loan interest rate increases, the cost of corporate financing will increase. In the case of constant income, the cost will increase; reducing the profit rate of the company, and thus the stock price will decrease accordingly.

(4) Influencing stock prices through investors. Changes in interest rates will cause changes in the price of financial instruments in the money market and capital markets, causing investors to re-select portfolio products and form a portfolio effect.

(3) Affect the stock price through exchange rate expectations. Interest rate changes can not only affect domestic liquidity, but also affect foreign capital's domestic liquidity. For example, raising interest rates can be used as an indirect means to increase the exchange rate between the country and the region against other currencies. That is, raising interest rates will promote the appreciation pressure of the local currency. Foreign investors will foresee the appreciation of the RMB, so that they will flood into the Chinese stock market in various ways and improve the supply of funds in the stock market has caused the stock price to rise in the short term. Once the funds are withdrawn from the stock market, it will cause a large drop in the stock price, resulting in a shock in the stock market.

4. Discussion

4.1. Volatility Prediction Analysis Based on Improved GARCH-MIDAS Model

In order to detect the prediction ability of the model, according to the estimated model parameter results, the daily high-frequency volatility estimated by the model can be calculated, and the achievable model can be further calculated according to the obtained daily high-frequency volatility. Volatility RVF, this paper also gives a graphical comparison of the monthly realized volatility estimated by the model and the realized volatility calculated using the raw data.

Table 3. Model prediction ability comparison

Model	Shanghai			Shenzhen		
Forecast indicator	MSE	MAE	MAPE	MSE	MAE	MAPE
Fuzzy GJR-GARCH	0.0083	0.0461	0.0456	0.0105	0.0691	0.0721
Fuzzy GARCH	0.0112	0.0573	0.0546	0.0145	0.075	0.0823
GJR-GARCH	0.0183	0.0638	0.0732	0.0212	0.1281	0.0923
GARCH	0.0251	0.0915	0.0795	0.0314	0.1934	0.1143

As shown in table 3, the predictive ability of each model is shown. It can be seen that the empirical results of the Shanghai and Shenzhen markets indicate that the prediction ability of the Fuzzy GJR-GARCH model and the Fuzzy GARCH model is better than the traditional GARCH model. The prediction of the GARCH model the worst ability. Among them, the values of MSE, MAE and MAPE of the Fuzzy GJR-GARCH model are small, so the prediction ability of the Fuzzy GJR-GARCH model is slightly better than the model. It can be seen that the traditional GARCH model family loses some "fuzzy" information during the prediction process, which reduces the predictive ability, while the Fuzzy GARCH model and the Fuzzy GJR-GARCH model can not only deal with the asymmetry, but also capture part of the lost information, so that improved forecasting ability.

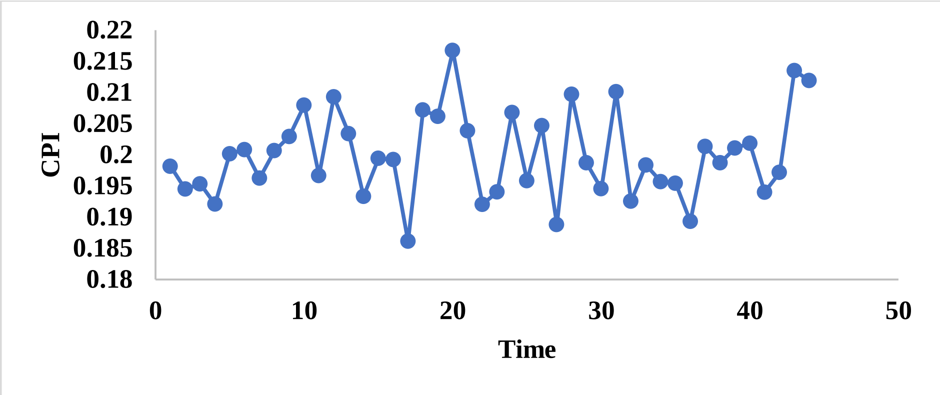

Figure 1. CPI level effect model has achieved volatility prediction

As shown in figure 1, the realized volatility of the single-factor horizontal effect model based on the consumer price index and the US dollar against the RMB exchange rate, where RVF is the monthly realized volatility estimated using the model, and RV is calculated using the raw data. Volatility has been achieved. At the same time, the paper also gives the realized volatility prediction based on the multi-factor wave effect model of money supply and consumer price index, as shown in Figure 1. Similarly, RVF represents the monthly realized volatility estimated using the model, and RV represents the realized volatility calculated using the raw data. It can be seen from the figure that the RVF and RV trends of the multi-factor GARCH-MIDAS model are very similar, and the two curves are close to coincidence, which also fully demonstrates that GARCH-MIDAS is very powerful in predicting volatility.

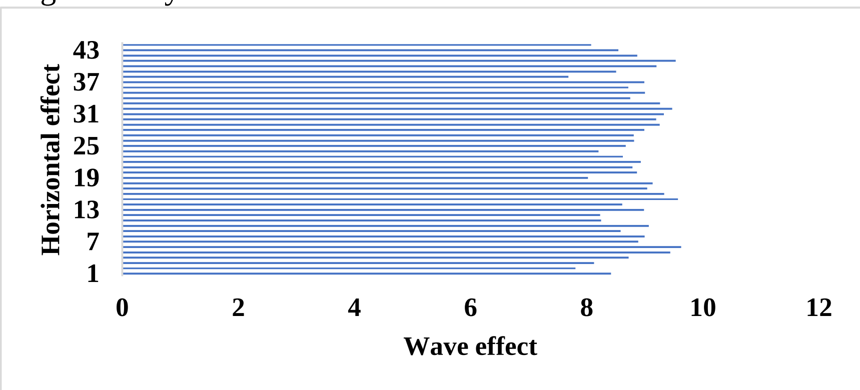

Figure 2. GARCH-MIDAS model predicts parameter results

As shown in figure 2, it can be seen from the parameter estimation results in the figure that whether it is the single-factor GARCH-MIDAS model or the multi-factor GARCH-MIDAS model, the root mean square error RMSE in the fitted sample in the model estimation result is The RMSE out is larger than the RMSE outside the fitted sample. This indicates that the model estimated by the fitted sample is effective in estimating the data outside the fitted sample, and there is no over-fitting.

In summary, whether it is a single factor model or a multi-factor model, the monthly volatility estimated by the GARCH-MIDAS model and the graphical trend of the realized volatility calculated using the raw data are very similar. Therefore, the GARCH-MIDAS model is very powerful and accurate in predicting volatility.

4.2. Model Testing and Comparison

In this paper, all the variables included in the model are statistically significant. Two single factor horizontal effect models of consumer price index and US dollar against RMB exchange rate are selected, and a two-factor wave effect model based on money supply and consumer price index is selected. The short-term conditional variance and long-term component used to predict stock price volatility.

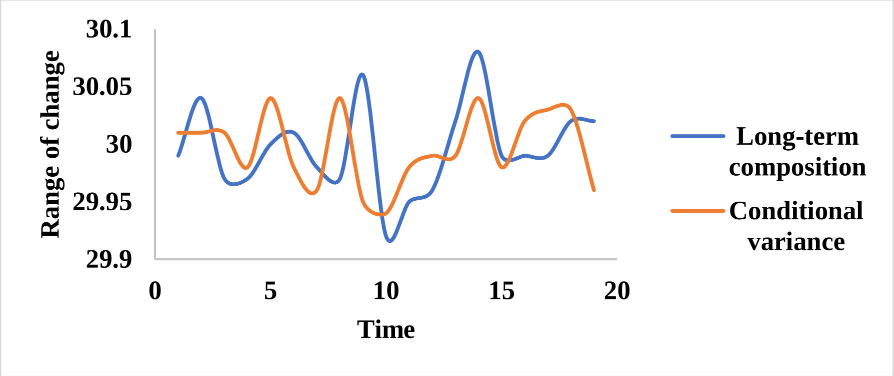

Figure 3. Long-term component and conditional variance estimated by the M1+CPI wave effect model

As shown in figure 3, the change range of the long-term component is smaller than the change of the conditional variance, and the trend of the long-term component and the conditional variance is about the same, which means that the long-term component better reflects the approximate range of the stock price fluctuation; Compared with the factor-mixed volatility model, the long-term component described by the improved GARCH-MIDAS two-factor mixing volatility model can better identify the stock volatility trend, especially in the long-term component of the global financial crisis from 2007 to 2008. It is consistent with the trend of stock price fluctuations.

In addition, in addition to finding that the trends of the three are consistent, the variance of the conditional variance is larger than that of the long-term component, while the trends of the two are roughly the same, and the long-term component can better describe the general trend of stock price changes. Long-term composition, conditional variance and realized volatility fluctuations are mainly concentrated at two time points, which are near 2008 and 2015, while in other time periods, long-term composition, the conditional variance and realized volatility In the gentle.

As shown in figure 4, this paper also presents a graphical representation of the Va R risk measure for the model, using the single-factor GARCH-MIDAS model and the multi-factor improved GARCH-MIDAS model's output Va R risk prediction map as an example, single-factor GARCH. The -MIDAS model takes the GARCH-MIDAS model with high and low frequency exogenous variables (consumer price index and USD/RMB exchange rate) as an example. The multi-factor improved GARCH-MIDAS model is based on the fluctuation effect model of money supply and consumer price index.

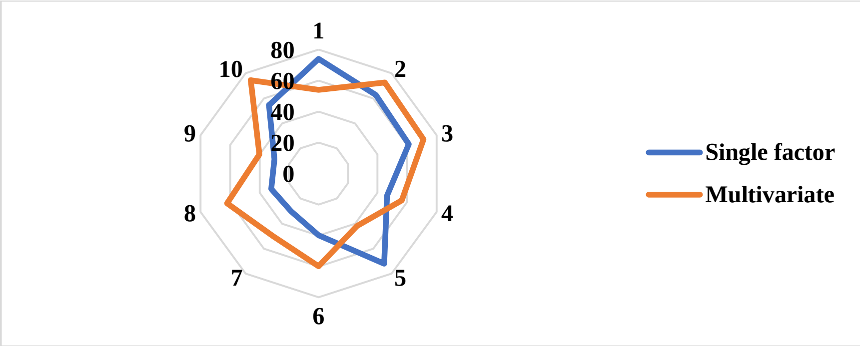

Figure 4. Va R risk measurement radar chart

This chapter is a complete empirical analysis section, ranging from the selection of sample data to the determination of sample variables to the final estimation of results based on the GARCH-MIDAS model. This module is used to analyze the correlation between consumer price index, money supply, social financing scale, foreign direct investment and crude oil price 5-month macroeconomic explanatory variables, and finally retains the consumer price index and money supply. The monthly macroeconomic explanatory variables, together with the daily macroeconomic explanatory variables, constitute a complete exogenous variable. Then the research variables are preprocessed, and the macroeconomic variables are processed at the same level in the horizontal effect; in the wave effect, the autoregressive model is used to capture the macroeconomic wave dynamic potential, and the appropriate one is determined according to the AIC information criterion. The lag order is simultaneously squared by the residual of the corresponding AR (p) model to construct the fluctuation effect value of the exogenous explanatory variable. At the same time, this chapter gives the data descriptive statistics of macroeconomic explanatory variables, and shows the data characteristics of macroeconomic variables.

5. Conclusion

(1) Based on the test of the ability of the improved GARCH-MIDAS model to study the macroeconomic explanatory variables, it can be found that the increase in the level of money supply and the increase in volatility have a significant impact on the price fluctuations in the Asian stock market, both of which are significant positive relationship.

(2) Regardless of whether it is a one-factor model or a multi-factor model, the monthly volatility estimated by the GARCH-MIDAS model and the graphs of the realized volatility calculated using the raw data are very similar. Therefore, the improved GARCH-MIDAS model has good predictive power.

(3) According to the Va R risk prediction map of each single factor and multi-factor model, the results of the model test are obtained. It can be seen that there is no over-fitting problem in the GARCH-MIDAS model, indicating that the GARCH-MIDAS model estimates the volatility. Accurate, predictive of financial time series volatility.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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