Forecast the Stock Volatility of Ping an Bank Based on HAR-RV Model

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ABSTRACT

The importance of Ping An Bank in the Chinese stock market is obvious, and does the smallness of investors have an impact on its stock market? Based on heterogeneous autoregressive theory, I collected the close price of Ping An Bank stock market from January 2019 to March 2022, which will be divided into daily, weekly and monthly observations of volatility. Through the results of HAR-RV model, I found that the different type of investor does have an impact on the stock. While the daily results have a negative impact on the stock market, the weekly and monthly results have a positive impact on the stock market. And the article finds that the affection of volatility of the investor becomes stable through time.

Keywords: *HAR-RV model, stock price, investor.*

1. INTRODUCTION

Ping An Bank is a cross-regional joint-stock commercial bank owned by Ping An Insurance (Group) Company of China, one of the 12 national joint-stock commercial banks in mainland China. Ping An Insurance (Group) Company of China, Ltd. ("Ping An of China") and its holding subsidiaries hold a total of approximately 2,684 million shares of Ping An Bank.

The investor's impact on stock price is not clear [1-3]. In this paper, we use a HAR-type model on the closing price of Ping An Bank stock market and its volatility to analyze whether investors' consumption has an impact on its stock market. In detail, the results show that while the daily data have a negative impact on the stock market, the weekly and monthly results have a positive impact. And by looking at the adjusted R square value, it is easy to see that the stability of the data is increasing over time. In addition, the article also divided the daily, weekly, and monthly samples into three equally and conducted a sample robustness test to further confirm the reliability and stability of the model.

The paper find that the adjusted R square value of the three samples of daily data fluctuates the most, while the adjusted R square value of the three samples of monthly data fluctuates the least and is closer to 1 - proving the stability and accuracy of the data.

We can conclude from these tests - that consumer behavior does have an impact on the stock market, but its impact becomes increasingly smaller over time.

The remainder of the paper is organized as follows: Section 2 describes the sample and data; Section 3 introduced the basic equation of HAR-RV type models; Section 4 analysis the data and the result, and conducts a robustness test for in samples; Section 5 presents the conclusion.

2. DATA

This data is collected from Yahoo finance and records the closing price of Ping An Bank from January 2, 2019, to March 2, 2022. The volatility pair is calculated from the closing price and the data is analyzed by applying the HAR-RV model, and robustness test.

Figure 1 shows the closing price of the Ping An Bank Stock Market Closing Price. In the graph, the closing price increases from Jan 2, 2019, until Mar 2 in the same year, it became decreasing, until the end of May in 2019, then back to a smooth upward trend, with slight ups and downs from around October 2019 to January 2020, then a steady decline until the end of May 2020, and a steady rise from June of the same year until the end of 2020. There are slight ups and downs from the end of 2020 to June 2021 (the lowest point in this period is at the end of April 2021). It ends up with a continuous decline from June 2022 until March 2022. The highest closing price

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happened in April 2021, and the lowest closing price happened in January 2019.

Figure 2 shows the daily, weekly, and monthly realized volatility which is analyzed by the HAR-RV modal. The maximum of the realized volatility happened in February 2020, for daily results. By looking at the three data, we can see that the volatility of the three data is almost the same, but the daily volatility has more ups and downs, while on the contrary, the monthly volatility is more balanced and tends to be more of a straight line.

Figure 1. Ping An Bank Stock Market Closing Price

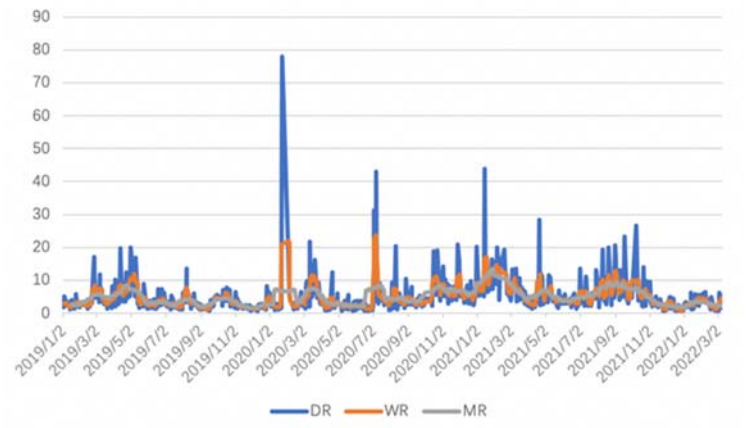

Figure 2. The Daily/Weekly/Monthly Realized Volatility

3. HAR-RV MODAL

The calculation method of realized volatility invented by Andersen and Bollerslev usually set T as the trading day and divides the daily trading into N groups [4-6]. $P_{t,i}$ represents the close price number i in the trading day t, whereas the $i = 1, \dots, N$. Set the $r_{t,i}$ as the return rate of the i period in trading day t [7].

$$r_{t,i} = 100 * (\ln P_{t\,i} - \ln P_{t,i-1}). \quad (1)$$

Based on the understanding of the previous work, we showed the HAR-RV modal as follows:

$$RV_d^t = \sum_{i=1}^{M} r_{t,\ i}^2 \quad (2)$$

$$RV_t^w = \frac{RV_t^d + RV_{t-1}^d + RV_{t-2}^d + \cdots + RV_{t-5}^d}{6} \quad (3)$$

$$RV_t^m = \frac{RV_t^d + RV_{t-1}^d + RV_{t-2}^d + \cdots + RV_{t-24}^d}{25} \quad (4)$$

The average of RV from trading day t to $(t + H)$ is defined as

$$\overline{RV_{t+H}} = \frac{1}{H}\sum_{i=1}^{H} RV_{t+i}^d \quad (5)$$

According to Andersen et al., it can also perform and performs better than the linear HAR modal in a logarithmic form [8-10].

$$ln\overline{RV_{t+H}} = \beta_0 + \beta_d lnRV_t^d + \beta_2 lnRV_t^w + \beta_m lnRV_t^m \quad (6)$$

4. DATA ANALYSIS

According to the following descriptive statistical analysis of the main variables (Table 1). The RvD represents the daily realized volatility. The daily volatility is in a range of 0.474 to 77.859, having a mean of 4.98, with a standard deviation of 0.192. The weekly realized volatility (RvW) ranges from 0.592 to 23.655, having the same mean as the daily realized volatility,

with a standard deviation of 0.124. The monthly realized volatility (RvM) is in a range of 1.56 to 13.4, with the same mean of 4.98, and has a standard deviation of 0.0860. Both daily, weekly, and monthly realized volatility shares the same mean, but have a different standard deviation and range.

Table 1. Descriptive of Data

Variable	Mean	Std.Dev.	Min	Max
RvD	4.98	0.192	0.474	77.9
RvW	4.98	0.124	0.592	23.7
RvM	4.98	0.0860	1.57	13.5

Table 2. The Result of Linear Regression

	RvD	RvW	RvM
$\beta 0$	0.00926	-0.049	0.049*
	(0.0282)	(-0.45)	(1.74)
RvD	-0.170***	0.05***	0.001
	(-4.62)	(4.08)	(0.168)
RvW	1.26***	0.769***	0.003
	(17.1)	(31.3)	(0.548)
RvM	-0.091	0.192***	0.548***
	(-1.03)	(6.51)	(131)
Adjusted R square	0.462	0.857	0.981

Table 2 shows the linear regression result of the realized volatility of daily, weekly and monthly. The adjusted R square is different for them. The monthly result has the highest adjusted R square, with mean's the model or the result is more stable. The daily realized volatility has the lowest adjusted R square. Since that it has a value of 0.462. The significance of the p-value is shown by the * in the table. Hence * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. There are a few values in the table with a p-value smaller than 0.01, showing the result we end up with is statistically significant. As an example, the X Variable 1 has a realized daily return of -0.170***. That means the result is -0.170 if the unit increases by 1, which shows the effect of the previous day to the day after.

To test the stability of the data, the application of a robustness test is necessary. The test is applied to all the data - daily realized volatility (RvD), weekly realized volatility (RvW), and monthly realized volatility (RvM), and the data will be divided into three samples.

After applying the robustness test to daily realized volatility, the three adjusted R square values are 0.799 (1-253) for group 1, 0.971 (254-506) for group 2, and 0.523 (507-760) for group 3. The original adjusted R square value, or the adjusted R square value for the complete daily realized volatility is 0.462. Compared to the R-value of group 1, there is a difference of 0.337, compared to group 2, there is a difference of 0.509, Since R square shows how accurate the data is, it's often better when it's closer to 1. Through the test result, the adjusted R square result of group 2 is the largest and the closest since there's only a difference of 0.092 to 1. The second-largest result is from group 2, then the smallest result is 0.523 from group 3, which is closer to the result of the original adjusted R square value of 0.462. The difference t between the ranges of adjusted R square result tells the

stability of the daily realized volatility, in which there is a quite large difference, and also tells that there's quite a difference in accuracy and the stability between the three ranges.

The adjusted R square values of the weekly realized volatility are 0.799 for group 1, 0.879 for group 2, and 0.860 for group 3, the original adjusted R square value for weekly realized volatility is 0.857. Compared to the group result for daily realized volatility value, the weekly group values are obviously smaller fluctuations, only with a difference of 0.08 between the maximum group value (group 2) and the minimum group value (group 1). But in common, group 2's value is more approach to 1. The accuracy of the weekly data obviously rises, compared to the daily, there's a difference of 0.276 between the minimum adjusted R square result of the groups of both weekly realized volatility and the daily realized volatility.

Finally, the adjusted R square value of the monthly realized volatility is 0.971 for group 1, 0.975 for group 2, and 0.987 for group 3. Compared to the previous value, there's a rise in stability, since the fluctuations are smaller. the minimum of the R square value in monthly groups is 0.971, compared to the weekly R square minimum there is a difference of 0.172, which is a huge rise. The difference between the maximum R-value monthly and the minimum decreases compared to the previous, which is only 0.016. Hence the modal is more stable in the monthly results, least stable in the daily results.

In sum, the modal is accurate and stable, since the adjusted R square values are quite close to 1, other than the group 3 of the daily realized result. The group with the best stability in group 3 of the monthly result.

5. CONCLUSION

In this paper, the main utilizes the HAR-RV model to observe and analyze the closing price of Ping An Bank and its volatility. Based on the HAR-type model, stability tests are used to enhance the accuracy of the analysis results.

By regression analysis of the HAR-RV data, it can be seen that Rvd has an impact of -0.170 on the day after and RvM owes an impact of -0.091 on the day after, which shows that the daily data has a negative impact on the stock market. However, the the weekly volatility data turns positive and the RvM remains positive, which proves that the impact of consumers on the stock market decreases over time.

The same can be seen in the volatility table - the daily volatility data line has the largest ups and downs, while the monthly volatility has the smallest ups and downs and is closest to a straight line, more flat, while the weekly data is in between, but the flatness of the weekly data is also significant compared to the daily data. The adjusted R-squared results from the stability test also show this - the R2 data for the monthly data is closer to 1, and the adjusted R-squared results for the three samples of monthly data are also very similar, with a difference of only 0.016 in the monthly data sample compared to 0.448 in the daily data sample, proving the prediction that the impact becomes smaller over time.

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