The Construction of an Investment Risk Measurement Model and Risk Avoidance Strategy under the Financialization Mode of Chinese Artworks

SHANGJIN XIE*, QUANLIN LI
International College,
Krirk University,
Bangkok 10220,
THAILAND

*Corresponding Author

Abstract: - Along with the continuous development of artwork in the investment market, as a special investor asset, it plays an important role in dispersing the investment risk and stabilizing the investment income for the investors, and therefore it has become an important way of investor's asset portfolio allocation. The financialization mode of Chinese artwork has become an important research direction in recent years, and the investment risk under this mode is also a key factor that needs to be seriously considered. Based on this, this paper explores the analysis and prediction of the results such as the return of China's art index based on the GARCH model, and further explores the key factors affecting its risk, accordingly. It is verified that the GARCH model at the 5% confidence level plays a role in predicting the maximum loss of investing in Chinese artworks. At the same time, the corresponding optimization suggestions are put forward in terms of choosing formal purchasing channels, learning relevant appraisal knowledge, improving relevant laws, disclosing information on art securitization transactions, and using securitization and other channels. To be able to provide certain references for the construction of the investment risk metrics model and the avoidance of the risk under the mode of China's financialization of artworks.

Key-Words: - Art market, Art financialization, Investment risk, Metric model, Risk avoidance, Works of art, investment yields, price indices.

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1 Introduction

With the deepening financialization of artworks, the risk of investment is also increasing. Macro-wise, the economic downturn and the start of the bull market are some of the reasons for the shrinkage of the art auction market, [1]. In the short term, the volatility of China's art trading market has increased, and the investment risk has increased. How to effectively measure the risk of art investment returns and use relevant models to make predictions has an important role for art investment. Based on the optimal portfolio calculated from the 1875, S&P-2002 Treasury Index, the study shows that artwork can optimize the traditional asset portfolio in the specific proportions of 18.21%, stocks 27.69%, and bonds 54.10%, [2]. The results of a study on the returns of artworks from different genres and countries using the characteristic price method show that art is a high-risk, high-return asset, [3]. In this context, this paper takes China's art investment risk as an entry point, selects the most representative branch of China's art market - the painting auction market as a data sample, combs its investment risk factors, constructs China's art price index, establishes a financial measurement model to calculate the yield and volatility of art investment, and finally makes a recommendation on the future construction of China's art market.

2 The Construction of China's Art Index

2.1 Data Source

This paper adopts the statistical data of the Art Market Monitoring Center of Artron (AMMA) and selects the Chinese painting 400 and oil painting 100 component indices from 2006 to 2017 to construct China's artwork price index.

2.2 Index Construction

This paper draws on the method of constructing indexes by Wang Shuo (2016) to construct China's artwork index with the above two-component indexes as data samples and turnover as weights, and the expression is:

$$P_t = \omega_{G_t} P_{G_t} + \omega_{Y_t} P_{Y_t} \quad (1)$$

P_{G_t} and P_{Y_t} represent the National Painting 400 index and the Oil Painting 100 index in period t. G_t *and* Y_t denote the turnover weights in the corresponding periods.

3 Processing of Data and its Intrinsic Characteristics

3.1 Data Processing

Quarterly data is used in this paper. Therefore, the data are processed using the interpolation method to fill in the missing quarterly data and convert the frequency of the artwork index from semi-annual to quarterly.

3.2 Intrinsic Characteristics of Chinese Artwork Index Return Series

3.2.1 Descriptive Statistics and Normality Test

This paper uses the processed quarterly Chinese artwork index data, with a data volume of 48. Next, the quarterly return on Chinese artwork investment is calculated, ignoring the transaction fees and taxes of the artwork market in the calculation process, and the formula is as follows:

$$R_t = \log\left(P_t / P_{t-1}\right) \quad (2)$$

The quarterly rate of return of China's art index for the period of 2003-2014 will be made icons as follows Figure 1:

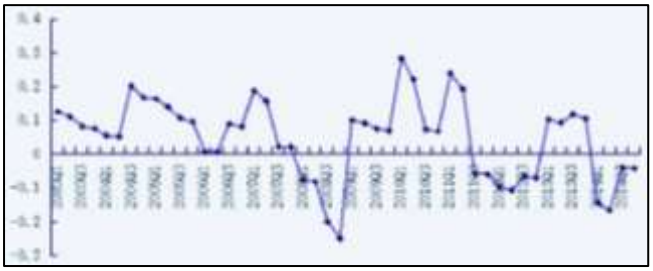

Fig. 1: Time series graph of quarterly return of China Art Index

From the time series graph of quarterly returns of the China Art Index in Figure 1, the quarterly returns of artworks reflect strong volatility. Therefore, for the reliability of the conclusions of the data analysis, the following test of data normality is conducted, and this paper uses the most widely used Q-Q (quantile-quantile) test, [4]. Figure 2 shows the histogram and descriptive statistics of the distribution of Chinese art index returns and the Q-Q plot of the normality test.

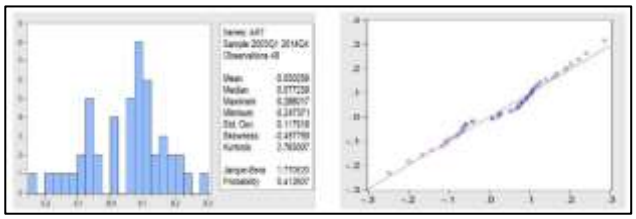

Fig. 2: Q-Q plot of the histogram of the distribution of returns of Chinese art index and descriptive statistics and normality test

The characteristic statistics and normality test results of artwork investment returns are given in Figure 2. From the results of descriptive statistics, from the mean return (Mean), the quarterly average return is 5.03%, relatively at a high level; from the standard deviation (StandardDeviation), the return fluctuates 11.79%, obviously with a large volatility, indicating that there is a considerable gain and loss in the investment of artworks, and its risk cannot be ignored; from the skewness (Skewness), the return fluctuates 11.79%, obviously with large volatility, indicating that there is a considerable gain and loss in the investment of artworks, and its risk cannot be In terms of Skewness and Kurtosis, the skewness coefficient of the return series is less than 0, and the kurtosis coefficient is slightly less than 3, which indicates that the series is generally consistent with the standard normal distribution, and the Jarque-Bera statistic does not reject the assumption that the time series is normally distributed at the 95% confidence level, which suggests that normal distribution is suitable for modeling the changes in quarterly returns of Chinese artworks, [5].

3.2.2 Smoothness Test

The GACRH model is only suitable for modeling smooth series, so the time series of yields are tested for unit root (Augmented Dichkey-Fuller Test, ADF), and the results of the ADF test are shown in Table 1.

Table 1. ADF unit root test results

		T-statistic	Prob.
ADF statistical values		-4.168423	0.0017
confidence level	1%	-3.550396	
	5%	-2.913549	
	10%	-2.594521	

The statistical value of ADF obtained through the unit root test is -4.168423, the absolute value is greater than the critical value at different confidence levels, which can indicate that the time series of China artwork index return is smooth, [6].

3.2.3 Serial Correlation Test

Before establishing the model, the correlation and autocorrelation of the time series data should also be examined, according to the autocorrelation function (Auto-Correlation Function (ACF)) and partial autocorrelation function (Partial-Auto-Correlation Function (PACF)) of the time series of the return on Chinese art index tR. The autocorrelation coefficient of the time series R_t as well as the partial autocorrelation coefficient are significantly non-zero, and the Q statistic is also significant, [7].

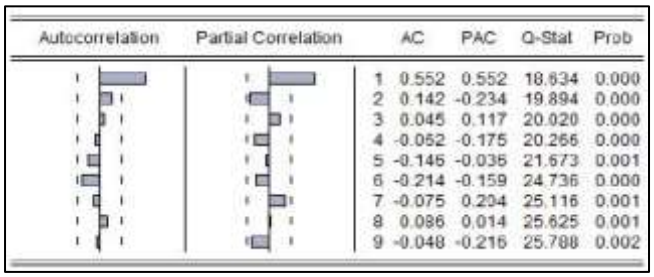

Fig. 3: Autocorrelation and bias correlation test plots of the return series of China's artwork index

By analyzing the correlation and partial correlation plots in Figure 3, it is known that the time series of quarterly artwork returns is smooth. The first-order autocorrelation coefficient is 0.552, the second-order autocorrelation coefficient is 0.142, but from the third order, the autocorrelation coefficients are close to 0. From the p-value, it can be seen that the autocorrelation coefficients and the bias correlation coefficients fall within the confidence interval and are statistically significant, [8]. Then the AR (2) model is established for research, and it is found that the residuals cannot satisfy the assumption of normality. The time series plot of the residuals is made as in Figure 4 and it is found that there is a volatility agglomeration in the time series of the artwork yield, and the variance of the residuals has the characteristic of changing over time, which shows that there is a phenomenon of conditional heteroskedasticity in the sequence of the error term.

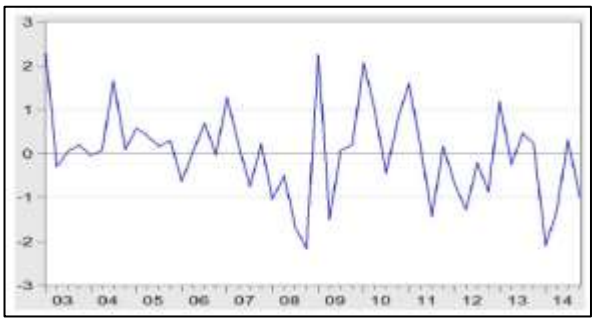

Fig. 4: Residuals series

3.3 Model Setting

3.3.1 Introduction of VaR methods

The VaR method is one of the most common and important financial risk measurement tools with the widest range of applications among many financial risk measurement methods, [9]. The standard method commonly used in modern financial risk measurement is the VaR (Valueat Risk) method, based on the characteristics of the VaR method which is concise and easy to understand, this paper selects the VaR method to study the investment risk of artwork. VaR (ValueatRisk) is essentially a quantitative study of the value of asset value fluctuations, and a key step in the process is to construct a probability distribution of the change in the value of the asset. probability distribution. [10].

3.3.2 Calculation of VaR based on GARCH Modeling

(1) Conditional Heteroskedasticity and GARCH Modeling

Some foreign scholars have studied the effectiveness of the art market from an empirical point of view, and their results show that there is autocorrelation in art returns. The most prominent feature of the ARCH model is that it gives the method of calculating the conditional variance of the time series, i.e., the conditional variance of the ARCH process can be derived by constructing a function of all kinds of stochastic disturbances in the previous time at each moment t. Therefore, the ARCH model can describe the volatility set because of external disturbances in a better way. Volatility agglomeration due to external disturbances. The model form of GARCH (p, q) is as follows:

$$Y_t = \xi_t \delta + \varepsilon_t$$
$$h_t = \omega + \sum_{i=1}^{P} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{P} \beta_j h_{t-j} \quad (3)$$

Where ξ_t is a vector of explanatory variables that

have an effect on Y_t, and the residual return term ε_t obeys mean $E_{t-1}(\varepsilon_t)=0$ with variance $E_{t-1}(\varepsilon_t^2)=h_2$. For the GARCH model to be meaningful, the following conditions must also be satisfied:

$$0\langle\left(\sum_{i=1}^{P}a_i+\sum_{j=1}^{q}\beta_j\right)\leq 1 \tag{4}$$

(2) ARCH effect test for serial residuals
The purpose of the ARCH effect test is to test whether the model describes the heteroskedasticity of the return time series well. It is common in academia to use the Lagrange multiplier method (ARCH-LM test) to test whether the random disturbance term εt in the model has an ARCH effect. Create an auxiliary regression equation:

$$h_t=\alpha_0+\alpha_1\varepsilon_{t-1}^2+...+\alpha_q\varepsilon_{t-q}^2 \tag{5}$$

Test for the presence of ARCH effects in the series, i.e., the regression coefficients $\alpha_1,\alpha_2,...,\alpha_{q-1},\alpha_q$ in the above equation at least one is not zero, the original and alternative hypotheses of the test are:

$$\begin{aligned}&H_0:\alpha_1=\alpha_2=...=\alpha_q=0\\&H_1:\exists\alpha_i\neq 0(1\leq i\leq q)\end{aligned} \tag{6}$$

Test statistic:

$$LM=nR^2\sim\chi^2(q) \tag{7}$$

Given the significance level α and the degree of freedom q, if $LM\rangle\chi^2(q)$, then H_0 is rejected and there is a q-order ARCH effect in the series; if $LM\leq\chi^2(q)$, then H_0 cannot be rejected, which indicates that the series does not have a q-order ARCH effect.

3.4 Tests and Analysis of Regression Results

3.4.1 Regression results

After the intrinsic characterization of the time series of China's artwork investment returns in the previous section, based on the results of the test results, the first-order lag R_{t-1} and second-order lag R_{t-2} as the independent variables of the regression equation, and tR as the explanatory variables. Regressions were done on the regression equations with different orders of p and q conditional variances, and the most appropriate orders of p and q in the GARCH model were selected based on the Lagrange multiplier test for the significance of the LM statistic and the values of AIC (Akaike Information Criterion) and SC (Schwarz Criterion) for the different orders of the model. The more significant the LM statistic is, the greater the possibility of ARCH effect in the residuals; at the same time, the predictive ability of the model changes with the values of AIC and SC, if the values of AIC and SC are smaller, it means that the selection of lag order of the variables in the model is more appropriate, and the predictive ability is more powerful (Table 2).

Table 2. AIC and SC results for different GARCH (p,q) models

	AIC	SC
GARCH (1,1)	-2.034953	-1.801052
GARCH (2,1)	-1.808299	-1.535416
GARCH (1,2)	-1.912437	-1.639554
GARCH (2,2)	-1.773409	-1.461542

Note 1: The values of AIC and SC increase when the order increases after p and q. The specific values are not listed here.

In this way the GARCH (1, 1) model was finally chosen:

$$\begin{aligned}R_t&=c_0+c_1R_{t-1}+c_2R_{t-2}+\varepsilon_t\\h_t&=\omega+\alpha_1\varepsilon_{t-1}^2+\beta_1h_{t-1}\end{aligned} \tag{8}$$

The logarithmic yield series {tR} is estimated using the great likelihood method. The final GARCH model is:

$$\begin{aligned}R_t&=0.018917+0.756436R_{t-1}-0.202251R_{t-2}+\varepsilon_t\\h_t&=0.015347-0.104199\varepsilon_{t-1}^2-0.815542h_{t-1}\end{aligned} \tag{9}$$

The regression uses a total of 48 data, and the R^2 is 0.3618, indicating that the model has a strong explanatory ability and better fits the data changes. From the results of the regression, the coefficients α and β are highly significant and satisfy the condition $0\leq(\alpha_1+\beta_1)\leq 1$, indicating that the model is meaningful. From the coefficients of the lagged one and two periods, it can be seen that the artwork yield fluctuates dramatically and is highly influenced by the previous period.

3.4.2 Result Analysis and Prediction of GARCH Model

(1) Result analysis
In this paper, concerning a large number of domestic research literature on GARCH model, the following four most commonly used indicators to measure the forecasting effect of time series are selected: ①The square root of the average forecast error sum of

squares (Root-Mean-SquareError (RMSE)), which indicates the degree of deviation of the forecasted value from the true value, and the smaller the RMSE the more accurate the result is ②Theil Inequality Coefficient (TIC), TIC between 0 and 1, when TIC = 0, it means that the predicted value and the actual value are in a state of the perfect fit, at this time the model has the strongest predictive ability; TIC = 1 is the worst predictive ability of the model ③Mean Absolute Error (MAE) ④ Mean Absolute Proportional Error (MAPE) (Table 3).

Table 3. GARCH model returns prediction error results

Norm	RMSE	TIC	MAE	MAPE
GARCHpredicted values	0.093214	0.428633	0.065717	79.4164

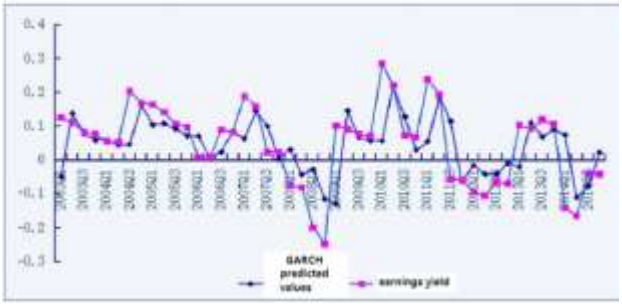

Fig. 5: Comparison of China Art Index Returns and GARCH Model Predicted Returns

From the prediction results (Figure 5), the predicted art investment return rate carried out by the GARCH model tends to be consistent with the actual art investment real value chart, with a good fit, and the four prediction errors of RMSE, TIC, MAE, and MAPE are within a reasonable range. The test results prove that the GARCH (1, 1) model applies to the time series of China's quarterly artwork returns, and can predict the short-term artwork investment returns more accurately within a certain error range.

(2) VaR predictive value

According to the above autoregressive conditional heteroskedasticity GARCH (1,1) model calculation results, the conditional variance th over time will be substituted into the formula $VaR_t = \hat{r}_1 - Z_\alpha \sqrt{h_1}$, where Z_α is the upper quartile of the standard normal distribution, without loss of generality, at the confidence level of 5%, that is $\alpha = 0.05$, the calculation of the artwork investment yield VaR value at time t. The calculated quarterly predicted VaR values for the artwork index are plotted on a graph with the corresponding actual values. As seen in Figure 6, the quarterly VaR curve calculated according to the model results is consistent with the trend of the real investment return curve, indicating that the GARCH model plays a role in predicting the maximum loss of investing in China's artworks at the 5% confidence level.

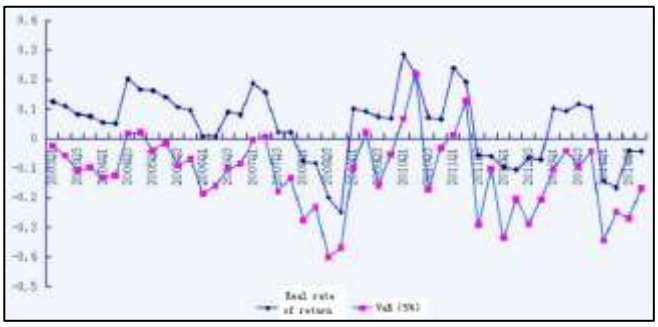

Fig. 6: Comparison of China Art Index Returns and VaR Values

This chapter uses financial risk measures and applies the GARCH model to model the value-at-risk (Va R) of art market returns in China, and empirically examines the volatility of art index returns using a sample of data from China's art auction market. It is found that (1) China's artwork quarterly returns have the characteristics of a general financial time series and are consistent with the assumption of normal distribution, which meets the conditions for risk measurement using the GARCH-VaR type model (2) China's artwork index return time series have strong autocorrelation, and measuring the risk of artwork investment returns can be done using the Va R method based on the GARCH model, which can better characterize the distribution of the art market yield series, make reasonable predictions and truly reflect the risk situation of the art market.

4 Art Market Investment Risks

4.1 Preservation Risk

The uniqueness of the artwork and the fixed nature of the product form and other characteristics of the artwork preservation have brought great difficulties. As we all know, the character of the artwork determines the preciousness of the artwork to a large extent, and most collectors are obsessed with pursuing the integrity of the artwork, which is also the reason why a large number of fakes are produced. However, those with historical and cultural precipitation of art, after years of baptism, can be preserved intact, and how many? Most of the collectors understand this truth - the storage of works of art is not an easy task, [11]. Of course, it is not possible to generalize, different works of art will have different impacts if they are subjected to the

same degree of wear and tear.

4.2 Risk of Authenticity

With the continuous development of the art investment market, the emergence of a large number of business opportunities at the same time also brings greater risk to the art buyer --- the authenticity of the artwork to identify. This is the most important point in the art investment risk. The asymmetry of information in auction houses often causes great difficulties for buyers, and many auction houses that do not operate in a standardized manner deceive buyers through this, taking the opportunity to make a lot of profit, and even forgeries can be sold at a pretty good price.

4.3 Market Risk

The art market, like the financial market, is divided into primary and secondary markets. The primary market consists of galleries, art suppliers, and art buyers; the secondary market is through the auction company and other media organizations, and will be sold in the primary market of art again into the market. The standardization of the art market is the standardization of the art primary market and secondary market participants, and our country currently does not have a strong management system in this regard. Auction houses, brokers, etc. in the evaluation of the merits of a work of art at the same time, but also to the buyer to bring a certain role in guiding, but also may be the buyer to make the wrong guidance, to the trading market to bring a great credibility crisis.

4.4 Realization Risk

Art investment for profit is based on a higher selling price than the purchase price. Internationally, the art investment cycle is generally the shortest for 3 years, as long as 10 years. Medium and long-term investment makes art more difficult to realize, if art holders in the holding period are in urgent need of cash, many times will have to sell at a low price, resulting in art investment to the investor to bring losses. The preferences of different collectors will also have a risk on the delivery of works of art, may bear the pain in the auction house to buy down the art simply cannot find the person who takes over.

5 Risk Avoidance Suggestions

5.1 Choose Formal Purchase Channels

By changing the purchase channel, investors can effectively avoid the market risk and the risk of authenticity. When choosing investment methods, we should try to choose a good reputation in the industry, which has become a large-scale company or auction house. Formal institutions have a certain identification ability, and can do for investors to art quality control, [12].

5.2 Learning Relevant Identification Knowledge, Increasing the Training of Talents

Investors should have a certain ability to identify the authenticity of works of art, in the purchase of investment art to maintain sanity, to maximize the avoidance of vicious price gouging, and due to the negative evaluation of art brokers brought about by the purchase of risk. Staying away from some of the more valuable masterpieces and choosing contemporary artworks that are easy to identify for investment is also a wise way to buy. On the other hand, each institution should increase the training of art appraisal talents, organize regular training of appraisal knowledge, optimize the art market environment suitable for the development of talent generation, and improve the credibility of the institution.

5.3 Publicize the Information on Art Securitization Transactions

The current serious information asymmetry between domestic auction houses and art investment institutions has brought serious obstacles to art securitization transactions and great risks to investors. Relevant policies should be formulated to disclose information on artwork transactions, number of transactions, sources of transactions, artwork business conditions, information on associated personnel, and assessment opinions of professional institutions, etc., to provide a relatively equal platform for securitization of artworks, and to make artworks better organically integrated with the financial market.

5.4 Through Securitization and other Channels, Let Artworks Go to Mass Consumption

Since artworks are generally expensive and have a high investment threshold, they are often favored by high-net-worth people. To effectively avoid the risk of realizing art investment, only by the high net worth crowd is not enough, should be art investment expand to the public investment, the formation of a large base population size of the investment market. This requires on the one hand to improve the artistic cultivation of the public, on the other hand, through

the securitization of artworks into multiple small shares, lowering the threshold of public investment.

6 Conclusion

This paper constructs an investment risk measurement model in the context of the financialization of Chinese artworks. At the same time, this paper further puts forward the main influencing factors of art market risk and risk avoidance strategies, to provide certain references for the efficient implementation of risk measurement and the long-term development of art financialization mode in China. However, because the investment in the art market integrates the influence of the government's macro-control, market operation mechanism, and other multiple factors, there are still some imperfections in the research process. In future research, we will study the risk of art market investment more comprehensively and deeply from multiple perspectives. Emphasis will be placed on the emerging art market (such as free trade zones), art investment model (network auction, art fund), and other aspects of the study.

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- Shangjin Xie contributed to the study conception and design.
- Quanlin Li carried out the material preparation, data collection and analysis.

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The authors have no conflicts of interest to declare.