Analysis of the Impact of Digital Currency on Traditional Banking and Financial Stability

Pengmai Gao

Beijing Concord College of Sino-Canada, Beijing,China

gaopengmai@163.com

Abstract. Digital currency, as a representative product of blockchain technology, such as Bitcoin and Ethereum, has begun to have a far-reaching impact on traditional banking business, but also brought new challenges to financial stability. This article studies the financial risk assessment and pre-alarm model based on support vector machine (SVM) algorithm, aiming at accurately assessing the risks in digital currency market and providing timely pre-alarm. Through comparative experiments, it is found that the algorithm has obvious advantages in dealing with high-dimensional and nonlinear problems, and can accurately classify and warn financial risks. The accuracy of the model is as high as 96.88%, and the average absolute error is reduced by 40.22%, which proves the effectiveness and superiority of the model. Generally speaking, the financial risk assessment and pre-alarm model studied in this article provides a scientific and effective method for digital currency market risk management, which has important application value. Regulators need to invest more resources and energy to monitor and analyze the dynamic changes in the digital currency market and reduce financial risks.

Keywords: Digital currency; Banking business; Financial stability; Risk assessment.

1. Introduction

With the rapid growth of technology, the emergence of digital currency is gradually changing the pattern of the financial industry. The rise of blockchain technology makes decentralized finance possible and leads a new round of innovation in the financial field. Digital currency, as a representative product of blockchain technology, such as Bitcoin and Ethereum, has begun to have a far-reaching impact on traditional banking business, but also brought new challenges to financial stability [1]. In traditional banking, the growth of digital currency has promoted the upgrading and reform of financial services. The fast, safe and low-cost transaction services provided by digital currency make traditional banks need to re-examine and optimize their business models [2]. Some banks have begun to explore digital currency-related businesses, such as launching digital currency wallets and participating in blockchain transactions, to meet the growing needs of customers. At the same time, digital currency has also promoted financial innovation and provided new development opportunities for traditional banks.

The rise of digital currency has increased the complexity of the financial system, which makes the regulators face greater challenges. The digital currency market is highly volatile, and the price fluctuation is influenced by many factors, including market supply and demand, policies and regulations, and technological innovation [3]. Therefore, regulators need to invest more resources and energy to monitor and analyze the dynamic changes in the digital currency market and reduce financial risks. This article puts forward a risk assessment and pre-alarm model of digital currency market based on SVM algorithm, so as to find abnormal behaviors or events in the market in time and take corresponding risk control measures. It is hoped that this study can provide useful reference and enlightenment for financial institutions, policy makers and regulators, so as to better cope with the challenges and opportunities brought by digital currency. The main innovations of the study are as follows:

(1) This article introduces SVM algorithm, an advanced data analysis tool, into the research of digital currency market. By using SVM algorithm, we can analyze and understand the dynamic changes of digital currency market more accurately.

(2) Different from the traditional risk assessment methods, the model constructed in this article can process the complex data of digital currency market in real time and automatically identify abnormal behaviors or events, thus providing more accurate and timely risk warning for financial institutions.

(3) Through the discussion of digital currency and traditional banks, financial stability and SVM algorithm, the study deepens the understanding of the financial field and provides new perspectives and ideas for policy makers and regulators.

2. Related works

Many scholars have conducted in-depth research on the influence of digital currency on traditional banking and financial stability. Nguyen et al. [4] discussed the influence of digital currency on the traditional banking system, and pointed out that the emergence of digital currency will promote the innovation of traditional banks in business model and risk management. Liyanagamage et al. [5] analyzed the influence of digital currency on retail banking, and found that digital currency will have a far-reaching impact on retail banking, and promote the digitalization and intelligence of banking. Vives[6] studied the influence of digital currency on financial stability, and pointed out that the volatility of digital currency market had a certain threat to financial stability. Ojukwu-Ogba[7] discusses the influence of digital currency on the global financial system, and thinks that the growth of digital currency will increase the fragility and uncertainty of the financial system. Belguith et al. [8] applied SVM algorithm to the evaluation of financial wind direction, and found that this algorithm can effectively identify the risks of financial markets and give pre-alarm. Rusmanto et al. [9] applied SVM algorithm to stock price prediction, and proved the effectiveness and superiority of this algorithm in stock price prediction. The research of these scholars provides us with valuable reference and enlightenment, and also provides us with an important theoretical basis for further studying the influence of digital currency on traditional banking and financial stability.

This article puts forward a risk assessment and pre-alarm model of digital currency market based on SVM algorithm, which can process the complex data of digital currency market in real time and automatically identify abnormal behaviors or events, thus providing more accurate and timely risk pre-alarm for financial institutions and providing new perspectives and ideas for policy makers and regulators.

3. Digital currency market risk assessment and pre-alarm model

Digital currency, especially the growth of decentralized finance brought by blockchain technology, has had a far-reaching impact on traditional banking and financial stability. The emergence of digital currency enables participants in the financial system to trade and store in a decentralized way, without the intermediary of traditional banks or financial institutions. This new financial model has brought challenges to the traditional banking business model, service scope and market position. Digital currency's market is highly volatile, and its price is easily influenced by market supply and demand, policies and regulations, technological innovation and other factors. In addition, the anonymity and cross-border characteristics of digital currency make it difficult for financial regulators to track and monitor transactions, which makes it more difficult to prevent and control financial risks. Studying the influence of digital currency on traditional banking can help traditional banks understand how to use digital currency and blockchain technology to innovate and upgrade their business and improve service efficiency and customer experience.

In this section, we will introduce how to combine SVM algorithm to build a market risk assessment and pre-alarm model in digital currency. The model aims at finding abnormal behaviors or events in digital currency market in time, and taking corresponding risk control measures. First of all, it is needed to make clear the construction ideas of digital currency market risk assessment and pre-alarm model. The model is mainly divided into three stages: data preprocessing, model training and

application, risk assessment and pre-alarm. The risk identification framework of money market based on multi-source data is shown in Figure 1.

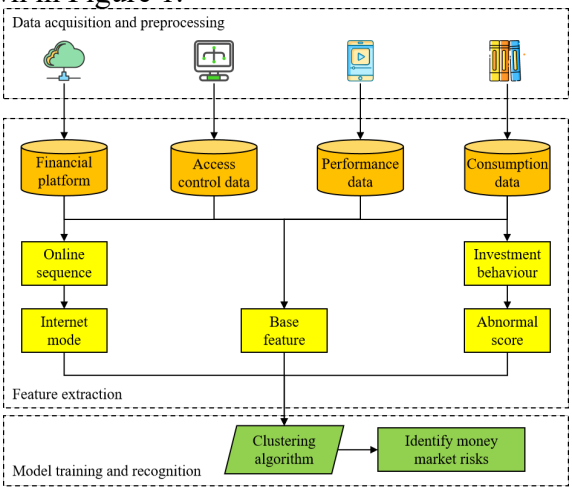


Figure 1 Risk identification framework of money market based on multi-source data

In the data preprocessing stage, it is needed to collect and sort out the relevant data of digital currency market, such as price fluctuation, trading volume, market value, etc. These data need to be cleaned, sorted and standardized to ensure the quality and effectiveness of the data. In the stage of model training and application, SVM algorithm will be used to train the preprocessed data. Through training, the model will learn the characteristics and laws of digital currency market and provide support for risk assessment and pre-alarm. In the stage of risk assessment and pre-alarm, the trained SVM model will be applied to risk assessment of real-time data in digital currency market. By analyzing the dynamic changes of the market, the model will output a risk warning signal, which will provide a basis for financial institutions to take corresponding risk control measures.

This article will introduce a time-dependent strength function $\Phi(t_n)$, which is defined as follows:

$$\Phi(t_n)=\frac{1}{\alpha}e^{\int_{t_n}^{t_a}\rho(t)dt+\int_{t_n}^{t_a}\theta(t)dG(t)} \tag{1}$$

Among them, α is the time intensity coefficient greater than 0; t_n is the latest value in the data set; t_a is a random value in the data set; $\rho(t)$ is the drift function; $\theta(t)$ is the volatility function; $G(t)$ is a random process. $\rho(t)$ is defined as follows:

$$\rho(t)=\frac{1}{(c+t)^2} \tag{2}$$

Among them, c is the number of samples. The definition of $\theta(t)$ is as follows:

$$\theta(t)=\sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(x_i-\bar{x})^2} \tag{3}$$

Where $\bar{x}$ is the mean of the sample. $G(t)$ is a random process and satisfies the following conditions:

$$G(0)=0 \qquad E[G(t)]=0 \qquad t>0,\ G(t)\sim N(0,\sigma^2 t)\ (\sigma>0) \tag{4}$$

In the stage of building the market risk assessment and pre-alarm model of digital currency, SVM algorithm plays a core role. The SVM algorithm is trained by training set, and a classifier is obtained. The classifier can output the corresponding risk level according to the input feature vector. In the training stage of the model, it is needed to select appropriate hyperparameters such as kernel function and penalty parameters to improve the classification performance of the model. Based on the trained SVM model, the risk assessment and pre-alarm of digital currency market can be carried out. For each new input feature vector, the model will automatically calculate its risk level and send out an

pre-alarm signal according to the risk level. In the stage of risk assessment and pre-alarm, it is needed to evaluate and update the model regularly to ensure its accuracy and timeliness.

Assume that the innovation sequence □et□ of k asset liquidity obeys a multivariate normal distribution with a mean value of 0 and a covariance matrix of H_t. This k asset is also an independent and identically distributed white noise process, namely: $e_t|\Omega_{t-1} \sim N(0, N_t)$. Ω_{t-1} is the information set of r_t at time t, and the dynamic correlation structure is set as:

$$r_t = u_t + e_t \tag{5}$$

$$e_t|\Omega_{t-1} \sim N(0, H_t) \tag{6}$$

$$H_t = D_t R_t D_t \tag{7}$$

$$Q_t = \left(1 - \sum_{m=1}^{M} a_m - \sum_{n=1}^{N} \beta_n\right)\overline{Q} + \sum_{m=1}^{M} a_m\left(\varepsilon_{t-m}\varepsilon_{t-m}^{'}\right) + \sum_{n=1}^{N} \beta_n Q_{t-n} \tag{8}$$

Where $\overline{Q} = T^{-1}\sum_{t=1}^{T} \varepsilon_t \varepsilon_t^{'}$, is the unconditional variance matrix of standardized residuals. $R_t = \left(Q_t^*\right)^{-1} Q_t \left(Q_t^*\right)^{-1}$, Q_t^* is the number on the diagonal of Q_t.

The output results of SVM algorithm are well interpretable, which can provide clear risk analysis and pre-alarm basis for financial institutions. This will help financial institutions to better understand the source and degree of risks, so as to take effective risk control measures.

4. Result analysis and discussion

The experimental link needs to collect historical and real-time transaction price, transaction volume, market value and other data covering digital currency market; Cleaning, sorting and standardizing data to ensure data quality; Choose characteristics that can reflect market risks, such as price volatility, trading volume, market value and market sentiment; Use SVM algorithm to train data, and use test set to evaluate model performance; Based on the trained model, real-time market risk assessment and pre-alarm are provided to support financial institutions to take risk control measures. In Figure 2, the comparison between the output of risk assessment data and real financial data is shown. It is obvious from the figure that the model can converge to the real data and approximate the original data well.

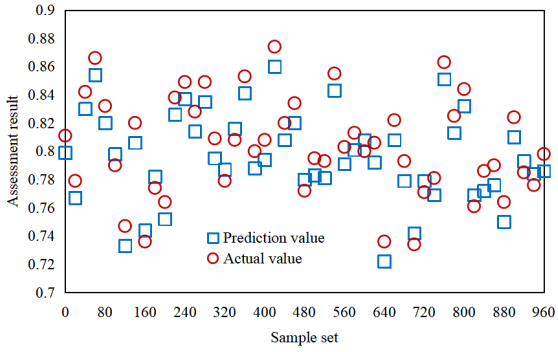
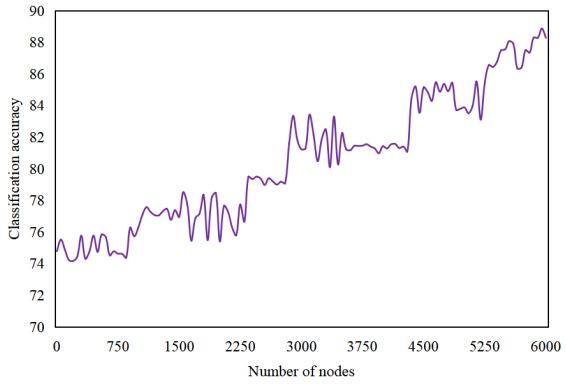


Figure 2 Model learning results

The model shows good results in local data and long-term trend fitting, which shows that the model has good adaptability and forecasting ability.

Under the information-based financial mode based on digital currency, the precision of different financial risk pre-alarm algorithms is one of the important evaluation indicators. As can be seen from Figure 3, with the increase of the number of samples, the prediction accuracy is improved. This is because when the number of samples increases, the model can learn more data characteristics and patterns, so as to better identify and predict financial risks.



(a) Algorithm in this article

(b) Random forest (RF) algorithm

Figure 3 Prediction precision of different algorithms in financial stability analysis

For the information-based financial model based on digital currency, besides the accuracy of financial risk pre-alarm algorithm, other factors need to be considered, such as computational efficiency, interpretability and privacy protection. These factors also need to be comprehensively considered and optimized according to specific application scenarios and requirements.

By comparing the accuracy and average absolute error between the financial risk identification model in this article and RF algorithm, we can find that the accuracy of this method in financial risk identification is obviously better than RF algorithm. In Figure 4, the accuracy of the proposed method is gradually improved with the increase of iteration times, and finally stabilized at 96.88%. In contrast, the accuracy of RF algorithm is low, only 85.20%. This means that using this method to identify financial risks is more accurate and can better help financial institutions find and deal with potential risks in time.

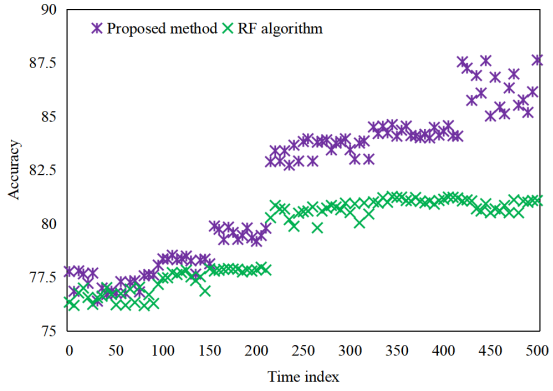


Figure 4 Accuracy test

In Figure 5, the Mean Absolute Error(MAE) of this method is low. This shows that the prediction result of this method is closer to the real value and has smaller error when predicting financial risks.

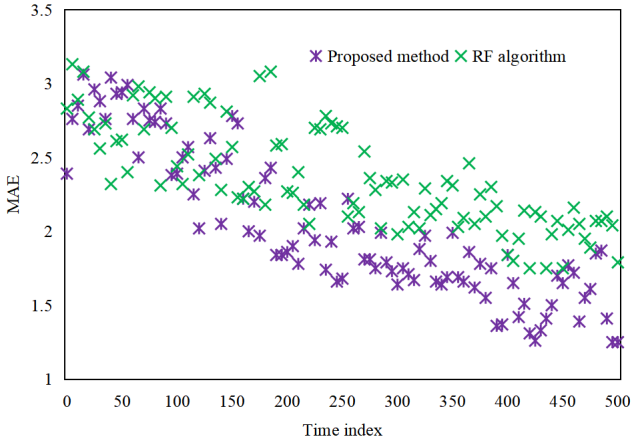


Figure 5 MAE test

After many iterations, the accuracy of this method is obviously better than the comparison algorithm in financial risk analysis, with an accuracy of 96.88% and an error of 40.22%. On the whole, the accuracy and MAE of this method in financial risk identification are better than RF algorithm.

Although the model has made some achievements in fitting real data, there are still some errors and uncertainties. This is mainly due to the complexity and volatility of the digital currency market. Therefore, it is needed to constantly improve and perfect the model to improve the accuracy and stability of its prediction. Financial institutions should strengthen their awareness of risk management and take effective risk control measures to ensure the stability and sustainable growth of financial markets.

By studying the influence of digital currency on financial stability, we can better understand and prevent the possible financial risks brought by digital currency market, and provide decision-making basis for policy makers and regulators. For financial regulators, understanding digital currency's influence will help to formulate more scientific and reasonable regulatory policies, and promote the healthy growth of digital currency market while protecting consumers' rights and fair competition in the market.

5. Conclusion

The rise of digital currency has increased the complexity of the financial system, which makes the regulators face greater challenges. With the growth of digital currency market, this article studies the financial risk assessment and pre-alarm model based on SVM algorithm. Through comprehensive analysis of all kinds of data in digital currency market, the model realizes accurate evaluation and pre-alarm of market risks, and provides strong support for risk management of financial institutions. The results show that after many iterations, the accuracy of this method is obviously better than the comparative algorithm in financial risk analysis, with an accuracy of 96.88% and an error of 40.22%. On the whole, the accuracy and MAE of this method in financial risk identification are better than RF algorithm. Through the application of this model, financial institutions can better understand the source and degree of risks in digital currency market, and thus take effective risk control measures. Although the model has made some achievements, it still needs to be continuously optimized and improved to adapt to the rapid changes and growth of digital currency market. In the future research, we can further explore more efficient algorithms and models to improve the accuracy and efficiency of financial risk assessment and pre-alarm.

References

[1] Pilko A D, Kramar V R. The Impact of Monetary Policy on the Financial Stability of the Banking System: Setting a Modeling Problem. Business Inform, vol. 2, no. 517, pp. 81-88, 2021.

[2] Ben Bouheni F, Hasnaoui A. Cyclical behavior of the financial stability of eurozone commercial banks. Economic Modelling, vol. 6, no. 11, pp. 392-408, 2017.

[3] Nelson B. Financial stability and monetary policy issues associated with digital currencies. Journal of Economics and Business, vol. 100, no. 11-12, pp. 76-78, 2018.

[4] Nguyen T T, Ho H H, Nguyen D V, et al. The Effects of Business Model on Bank's Stability. International Journal of Financial Studies, vol. 9, no. 3, pp. 46, 2021.

[5] Liyanagamage C. Determinants of Financial Sustainability of Financial Intermediaries: Evidence from Sri Lanka. International Journal of Finance & Banking Studies (2147-4486), vol. 10, no. 1, pp. 2021, 2021.

[6] Vives X. Competition and stability in modern banking: A post-crisis perspective. International journal of industrial organization, vol. 64, no. 5, pp. 55-69, 2019.

[7] Ojukwu-Ogba N. In Search of Financial Stability in Nigeria: From Legislation to Effective Regulation of Banks. African Journal of International & Comparative Law, vol. 25, no. 1, pp. 20-46, 2017.

[8] Belguith H, Bellouma M. Income Structure, Profitability and Stability in the Tunisian Banking Sector. International Journal Of Engineering Research and General Science, vol. 3, no. 5, pp. 31-45, 2017.

[9] Rusmanto T, Soedarmono W, Tarazi A. Credit information sharing in the nexus between charter value and systemic risk in Asian banking. Research in International Business and Finance, vol. 53, no. 4, pp. 101199, 2020.