Criminal Law Risk Management and Prediction Method based on Echo State Network

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Abstract—Criminal law plays an important role in maintaining social security and achieving effective social control. However, criminal law has hidden risks that cannot be ignored at the legislative, judicial and theoretical levels. This paper starts from all aspects of criminal law, analyzes criminal law risk and its management measures, and predicts and analyzes criminal law risk through echo state network model. The prediction results of the echo state network model fit well with the actual situation, and its verification can provide reference for the study of criminal law risk prediction and management systems. Legislative risk and theoretical risk belong to social factors and are also fundamental risks of criminal law. Judicial risk is mainly manifested in the level of judicial power. Criminal law is closely related to the political environment, social system, economic system, etc. In criminal law legislation, we should pay attention to the balance between criminal law rules and realistic social functions, and properly control social risks, so as to avoid the criminal law risks brought by the establishment of risky criminal law, and provide the necessary guarantee for the national security system.

Keywords—Echo state network; model; criminal law; risk prediction; risk prediction

I. INTRODUCTION

Since the implementation of the reform and opening-up policy in 1978, both China's national home-building and criminal rule of law processes have made great strides; in particular after the comprehensive revision of the Criminal Code in 1997, my country has successively introduced 1 single criminal code, 10 criminal code amendments, into one criminal code A new era of active legislation. Overall, over the past two decades, Criminal law intervention is early and active, and the criminal circle continues to expand. It has become the main development trend of my country's criminal law. This is for China's current Criminal law concept has had a significant impact, risk criminal law concept, positive criminal law Legislative view, preventive criminal law view, and functionalist view of criminal law have appeared one after another field, trying to theoretically interpret and judge this trend. Approximately In terms of criminal law, the above-mentioned concept of criminal law is explanatory or affirmative to the expansion of criminal law attitude and require moderate restrictions. At the same time, critical attitude insights hold that this (or "some") expansion of criminal law is a in "symbolic legislation", "emotional legislation" or new criminal law instruments" doctrine, and even advocated that "our country should stop the criminalization of criminalization "legislation" [1,2]. Some of the above differences of opinion are principled, and they are

quite. To a certain extent, it explains our basic criminal law about the development of China's current criminal law. There is also a need for an in-depth review of the legal concept. The idea of criminal law is that people The nature, function, crime, punishment, relationship between crime and punishment, system of criminal law understanding, view, mentality and value of a series of issues such as determination and implementation general term for orientation. A well-established view of criminal law is important for judgment and instruction. It is of great significance to guide the development of criminal law, reviewing the development since the reform and opening up Chinese social changes, correct interpretation and evaluation of the criminal law since 1997 The development of criminal law legislation is conducive to the scientific level of criminal law legislation improve [3,4].

It's essential to understand the evolution of China's criminal law within the context of the country's broader societal transformations. Since the initiation of China's reform and opening-up policy in 1978, remarkable strides have been made in both national construction and the administration of criminal law. This progress became particularly evident with the comprehensive revision of the Criminal Code in 1997, marking the beginning of an era characterized by proactive criminal law legislation. This period saw the implementation of one single criminal law and ten subsequent amendments.

Despite these advancements, the period following China's reform and opening-up does have its share of limitations. The promulgation of the Criminal Code in 1979 represented a departure from a 30-year period without a criminal code. While this was a significant improvement over the prior reliance on policy-driven case handling, the adoption of a planned economy and the prevalent thinking of centralized societal control by government forces led to the "instrumental criminal law concept" taking a dominant position. The Criminal Code didn't stipulate the principle of statutory crime and punishment, instead providing an analogy system. This empowered authorities to dictate the definition of crimes, thereby limiting citizens' freedoms. However, with the comprehensive revision of the Criminal Code in 1997, the principle of legality was explicitly stipulated, which reflected the "view of criminal law of civil rights" to a considerable extent. Additionally, the in-depth progress of China's reform and opening up coincided with academic reform in the realm of criminal law. This paved the way for a gradual deviation from the Soviet Union's "nationalist criminal law concept," marked by strong class struggle undertones, and led to the absorption of Western criminal law concepts. Influenced

significantly by the Enlightenment and modern criminal law ideologies, especially those initiated by Beccaria, the "classical liberal view of criminal law" became widely recognized. This view, advocating for human freedom, opposing feudal cruelty, and favoring state power restrictions, has significantly impacted China's criminal law policies. However, it's critical to acknowledge that, much like everything else, criminal law is not without its risks, which are present in legislation, judiciary, and theory. These risks can directly impact lives, highlighting the necessity for suitable control measures.

The creation and dissemination of legal risk and the terror created and fostered by risk are equally thorny issues. While we recognize and promote the continuous impact of science on the law, we must also pay attention to the new risks that the new development of science may bring to the criminal law. The new risk is a broader view of the "scientific generalization" alienated from the healthy development of science and its possible adverse effects. For a long time, science has had a self-evident "correctness" for the general public because of its great achievements [7]. In a lot of difficult situations, science is often used as the ultimate endorsement to provide certainty for a certain solution. Along with the great achievements of science, a large number of pseudo-scientific and non-scientific contents have been mixed into the category of science, which is essentially an anti-scientific force. This kind of generalized science, in the name of science and with the veil of science, invades the category stipulated by the essence of criminal law, and has begun to produce bad tendencies [8,9]. Therefore, we must further clarify the difference between science and criminal law and the boundary of science's role in criminal law formed based on this difference. We must further analyze the risks of generalization of science to criminal legislation and criminal justice, as well as the possible risks and consequences based on such risks potential adverse effects. To this end, this paper analyzes and demonstrates the challenges existing in our country's criminal law, especially the problems that scientific generalization may promote and breed, and clarifies how criminal law, as a tool and means of national governance, should better play its role in the new era. The role of punishing crimes and building collective consensus is particularly important [10].

At present, criminal law risk prediction is mainly based on the research of past criminal law, as well as sampling analysis of the actual situation, and judging the future risk of criminal law has been controlled. This paper uses the echo state network (ESN) model to predict criminal law risks, and puts forward corresponding control measures, which provides a scientific basis for criminal law risk prediction, and is of great significance for the study of criminal law risk characteristics and management measures.

This work aims to explore and critically analyze the evolution of China's criminal law, particularly in light of the expansive and active intervention of criminal law in the country's legislative system since the comprehensive revision of the Criminal Code in 1997. The main ideas and the actual purpose embedded in this work involve charting the progression of China's criminal law, understanding the implications of its expansion, and seeking effective control mechanisms, thus providing valuable input to the formulation of strategies ensuring the effective functioning of the criminal law in contemporary China.

II. CRIMINAL LAW RISK ANALYSIS AND CONTROL

A. Criminal Law Risk Analysis

Criminal law plays an important role in maintaining social security and achieving effective social control. However, criminal law also has hidden risks that cannot be ignored. In response to the problem of prediction accuracy, German Professor Jaeger proposed the ESN in 2001, and the prediction accuracy is 2400 times higher than that of the traditional network. Therefore, this paper uses the ESN model to predict criminal law risks.

First, the criminal legislation process may be deficient at the level of rational discourse. In an era of frequent social risks and emphasis on democratic legislation, the impact of the public's safety demands on legislation cannot be ignored. When social risks show an intensifying trend, the public tends to rely on criminal legislation to help them achieve their safety needs. If legislators fail to respond to public demands and do not take a positive stance against risks, they will lead to dissatisfaction and criticism from the public. Secondly, the lack of rational negotiation in criminal legislation can easily turn preventive criminal law into symbolic legislation and passion legislation. Because preventive criminal law focuses on responding to people's expectations for safety, the function of preventive criminal law to manage social risks is often paid the greatest attention or even exaggerated, while the danger of its possible violation of civil liberties and rights is infinitely reduced or even ignored. Finally, excessive criminalization can easily cover up the defects of other social governance systems. Criminal law is not the best means to govern society, nor is it the least costly means. When other social governance means other than criminal law can effectively reduce social risks, other social governance means other than criminal law should be given priority. The attitude of preventive criminal law to take the initiative to manage social risks has certainly increased the public's sense of security to a certain extent. It is even undeniable that it has also reduced social risks in practice.

For defensive criminal law, its setting is ambiguous to a certain extent, and it is easy to breed a crisis of arbitrary judicial arbitrariness. In the provisions of preventive criminal law, legislators often use evaluative concepts, such as illegal use, extremism, and drunk driving. Although the evaluative concept can enhance the applicability of criminal law norms, because it is a value statement of things, different judgment subjects are prone to different judgment conclusions. The extensive use of evaluative concepts creates conditions for the expansion of judicial power, which can easily breed a crisis of judicial arbitrariness. Second, some preventive criminal law provisions. There is ambiguity in the provision of crimes. The fuzzification of crime regulations objectively reduces the elements of crime that need to be proved, reduces the difficulty of proving a crime, and can more effectively punish dangerous behaviors. However, it reduces, transfers or even cancels the burden of proof on the perpetrator's subjective

guilt, which can easily lead to unjust or completely wrong penalties, and also makes it difficult to implement the principle of the unity of subjective and objective in preventive criminal law. The presumption of guilt lays hidden dangers, seriously undermining the criminal law's function of guiding judges' adjudication and guiding the behavior of the public [11].

The primary goal of criminal law is to maintain social security and stability by expanding the state's power to punish offenders. However, if we excessively prioritize the state's objective of maintaining social security, it can potentially jeopardize the freedom and rights of individuals. Firstly, criminal law serves the dual purpose of safeguarding both legal interests and human rights, which are mutually reinforcing. The protection of legal interests is widely accepted as the fundamental aim of criminal law within the academic community. Nevertheless, this does not negate the fact that criminal law also plays a role in protecting human rights while fulfilling its function of safeguarding legal interests. Secondly, the concept of preventive criminal law poses a challenge to the protective function of criminal law. Proponents of preventive criminal law argue for shifting the threshold of prevention forward, so that criminal liability is no longer based solely on actual harm or the appearance of specific danger, but rather on the offender's failure to fulfill their expected social role. Finally, as the protective function of criminal law weakens, so too does its ability to uphold human rights [12].

The above describes the risks of criminal law from three aspects: legislation, judiciary and theory of criminal law. Legislation is the beginning of criminal law risk, judiciary is the embodiment of criminal law risk, and theory is the foundation of criminal law risk.

B. Criminal Law Risk Management

Criminal law risk management and control should explore targeted criminal risk prevention and control programs from three perspectives: pre-prevention, in-process control, and post-event crisis comprehensive disposal.

1) Establish a three-dimensional legal risk prevention and control system: First of all, it is necessary to combine the components of static and dynamic criminal legal risks to build a corresponding risk prevention and control system. Among which, static elements mainly refer to the main body and its behavior activities and operating environment, and the latter refers to the causes, specific events, carriers and risk effects of criminal legal risk. Secondly, the three-dimensional criminal legal risk prevention and control system should be constructed from the two dimensions of crime and victim, so as to ensure that the system can achieve the prevention and control effects of the prevention and control in advance, control in the event and crisis disposal after the event, so as to avoid criminal legal risks.

2) Criminal legislation should follow the principle of modesty: This principle requires that when criminal legislation regulates behavior, the scope and degree of punishment should be appropriately clarified. That is, if other laws are used to

suppress a certain illegal behavior and can achieve the effect of comprehensively protecting the legitimate rights and interests of the public, it should not be included in the criminal law. Relatively speaking, if a lighter sanction method can effectively suppress a certain criminal behavior and protect the legitimate rights and interests of the public, a heavier sanction method should not be prescribed. In addition, judicial organs should also adhere to this principle of modesty in judicial practice. Except for alienated risk-based crimes such as fund-raising fraud, other Internet crowdfunding activities that are within the legal red line should be given certain encourage and support the development of new things, especially for those crowdfunding behaviors whose nature is not clear and the legal provisions are unclear, the punishment at the criminal law level should be reduced as much as possible. However, severe criminal sanctions should be imposed on those crowd-funding behaviors that have great social impact and harm and have numerous victim groups and have been brought into the scope of criminal law [13].

3) Criminal legislation should respect man's subjective status: No matter how the criminal law develops, it must always respond to the issue of human rights. It is an appropriate policy to take a relativistic position on the protection of human rights from a rational point of view. Whether it is criminal legislation or criminal justice, it is necessary to take a restrained attitude towards the protection of power, because criminal law itself is full of factors of public power, and in addition to criminal law, public power can also use other means and measures to restrict the human rights of citizens. Therefore, restraint and prudence of criminal law can correct the easy expansion of public power to a certain extent, and make it continue to play the role of the last line of defense. Therefore, the study of human rights in criminal law is to return to the human rights of individuals, to avoid the use of group or collective human rights to obliterate individual human rights, to pay attention to clarifying the difference between the relativity of the nature of human rights and the improper derogation of human rights, and to avoid using a zero-sum game of rights and interests within individuals to cover up the erosion of power by power.

The control of criminal law is a comprehensive measure. First, there should be a principle of control, and secondly, a risk control system should be established with people as the main body, so as to provide good guidelines for the control of ideas.

III. MODEL INTRODUCTION

At present, more mature network learning methods include Bayesian, wavelet analysis, support vector machine learning and neural network. However, after continuous experiments and application verification, it is found that most of the algorithm also has the problem of forecasting accuracy is not enough, even some algorithms for application scope restrictions, limited to a fixed application scenario, cannot training learning in other areas [14]. In response to the problem of prediction accuracy, German Professor Jaeger

proposed the ESN in 2001, Its echo state network, also known as reserve pool calculation, uses a reserve pool composed of randomly sparsely connected neurons as a hidden layer for high-dimensional and nonlinear representation of input，and the prediction accuracy is 2400 times higher than that of the traditional network. Therefore, this paper uses the ESN model to predict criminal law risks [15,16].

A. Model Principle

The ESN includes an input layer with K input neurons, a reserve pool with N neurons, and an output layer with L output neurons. ESN differs from other neural networks in that it includes a dynamic reserve pool with many randomly sparsely connected neurons and a simple training process in which only the output weights are adaptive [17]. The structure diagram of ESN is shown in Fig. 1.
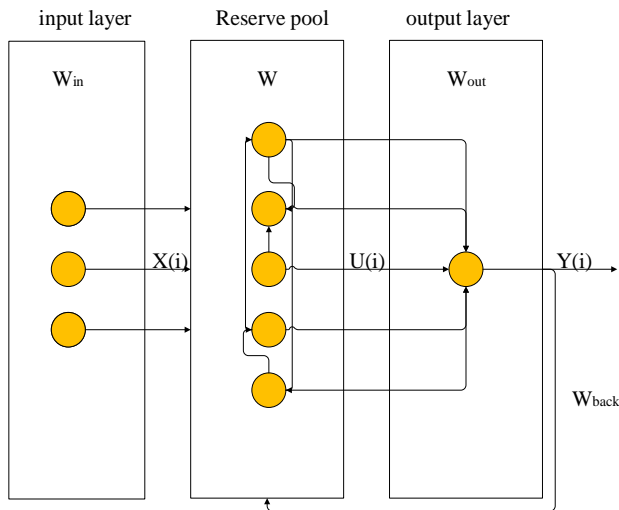

Fig. 1. ESN structure diagram.

The state of the reserve pool is updated according to formula (1):

$$x(n+1) = f(W^{in}u(n+1) + W^{res}x(n) + W^{back}y(n)) \quad (1)$$

where: $u\ (n+1)$ is the input at time $n + 1$; $x(n)$ is the state of the reserve pool neuron at time n; f is the activation function of the reserve pool neuron; W^{in} is the input weight matrix; W^{res} is the reserve pool weight matrix; W^{back} is the feedback weight matrix. To make the ESN work normally, the ESN should have the echo state attribute, and the spectral radius of W^{res} should be less than 1. To guarantee the echo state property, the final W^{res} will usually be scaled according to formula (2).

$$W^{res} = \alpha(W^{res}/|\lambda_{max}|) \quad (2)$$

α is the scaling parameter, between 0 and 1, and λmax is the spectral radius of W^{res}. The output of ESN can be represented as follows:

$$y(n) = f^{out}(W^{out}x(n)) \quad (3)$$

where: f^{out} denotes the activation function of the neuron; W^{out} is the output weight $L×(N+K)$. During the training process, the states of the neurons in the reserve pool are collected into a state matrix M, see equation (4):

$$M = \begin{bmatrix} X^T(t) \\ X^T(t+1) \\ M \\ X^T(t+k-1) \end{bmatrix} \quad (4)$$

Then, the corresponding output vectors are collected into the target matrix T, see equation (5):

$$T = \begin{bmatrix} y(t) \\ y(t+1) \\ M \\ y(t+k-1) \end{bmatrix} \quad (5)$$

where t is the length. K is the sample size. f^{out} is an identity function, using the pseudo-inverse algorithm to calculate the output weight matrix W^{out}, see formula (6):

$$W^{out} = M^{+}T \quad (6)$$

where M^{+} is the generalized inverse of the state matrix M, and formula (6) is modified as follows:

$$W^{out} = (M^T M)^{-1} M^T T \quad (7)$$

B. Model Parameter Optimization

The essence of the model is also a recursive structure generated by random motion. There are four basic parameters to be optimized: 1) The spectral radius (SR) of the network connection weight matrix in the reserve pool. SR is not only the largest eigenvalue of the absolute value of the internal connection weight function matrix, but also an important parameter to ensure the security and stability of the entire network. 2) The size G of the reserve pool. The larger G is, the more accurate the dynamic description of the entire network model is. 3) The input cell scale (IS) of the reserve pool, that is, the cell scale control factor. Normally, the larger the object scale that the network model needs to deal with, the larger the IS. 4) The sparsity (SD) of the reserve pool. SD is mainly used to represent the ratio of the two interconnected neurons in different reserve pools to the total number of neurons. The larger the value, the stronger the linear approximation ability [18,19].

Among the techniques employed to optimize the four parameters of the ESN model, commonly used methods include cross-validation and grid search. However, these parameter optimization methods still exhibit technical limitations in practical calculations. For instance, they often involve a large number of computations and result in long operation times. To overcome these challenges, the genetic algorithm is utilized as an efficient computational method for globally searching optimal solutions within a network. The genetic algorithm offers several advantages. Firstly, it effectively avoids the network search model from converging

towards local optima. Additionally, it utilizes adaptive control search to obtain the optimal solution. In order to achieve better parameter optimization within the reservoir pool, the genetic algorithm is selected to fine-tune the parameters [20,21].

IV. MODEL ESTABLISHMENT AND APPLICATION

A. Data Sources

According to the development of society and the actual situation of the criminal law process, criminal law risk mainly includes three first-level indicators: legislative risk U_1, judicial risk U_2 and theoretical risk U_3, as well as legislative constitutionality risk u_{11}, legislative scientific risk u_{12}, and legislative democracy risk u_{13}, legislative timeliness risk u_{14}, judicial disclosure risk u_{21}, judicial integrity risk u_{22}, judicial fairness risk u_{23}, low judicial efficiency risk u_{24}, theoretical objectivity risk u_{31}, theoretical purpose ambiguity u_{32}, theoretical deviation u_{33} and theoretical violation u_{34}, among which , legislative risk U_1 and theoretical risk U_3 mainly depend on the degree of social development, which belong to social factors and are also the fundamental risks of criminal law. Judicial risk U_2 is mainly manifested in the level of judicial power. These indicators can reflect the risk factors in the process of China's criminal law from generation to implementation.

Through statistical analysis of the probability of occurrence of each risk index and the value of the degree of influence, the relationship between the probability of occurrence of risk and the value of the degree of harm is obtained (Fig. 2). According to the analysis, the degree of impact and the possibility of risk occurrence are divided into five levels, among which the degree of impact is divided into "intolerable", "significant impact", "significant impact", "tolerable" and "negligible". The probability of risk occurrence is divided into "very likely", "probable", "probable", "unlikely" and "negligible". When the probability of risk occurrence is "negligible", it indicates the possibility of the risk occurrence Low, the risk can be ignored; when the probability of occurrence is "probable" or "probable", the risk factor needs to be paid more attention; when the probability of occurrence is "very likely", it means that this risk is easy to occur, and great attention is needed. According to the risk analysis of criminal law, legislative risk U1 and theoretical risk U3 belong to social factors and are also fundamental risks of criminal law [18]. Risks have a high probability of occurrence and have a significant impact on society. Judicial risk U2 is mainly manifested in the strength of the judiciary and the probability of occurrence.

B. ESN Training and Testing

First, normalize the dataset to the [0,1] interval, which is expressed as:

$$f : x \rightarrow y = 2 \times \frac{x - x_{\min}}{x_{\max} - x_{\min}} + (-1)$$
(8)

In network training, a limit is added to enhance the stability of network training. The limit is a uniformly distributed number on [-0.002, 0.002], and the mean square error of training ESN is the smallest. In order to improve the performance of the network, many experiments were conducted on the four parameters of ESN: the number of SR neurons N, the SR reality sd, the spectral radius ρ of w in SR, and the SR input connection weight scaling scale IS, according to the empirical value. ($N \in [20,100]$, reality $sd \in [0.01,0.05]$, spectral radius $\rho \in [0.5,0.98]$, SR input weight scaling $IS \in [0.01,1]$) to set the final optimal. The parameter combination is shown in Fig. 3.
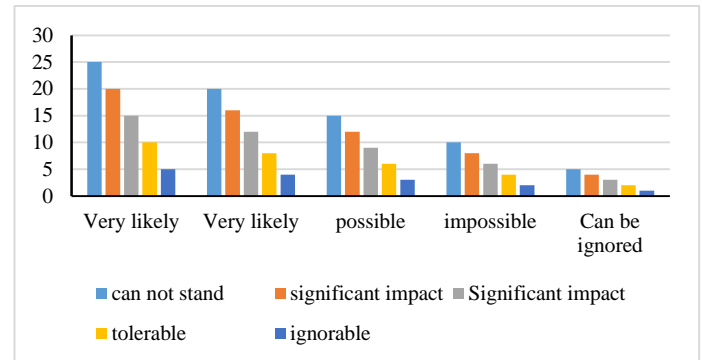

Fig. 2. The relationship between the probability of occurrence of risk and the degree of harm.
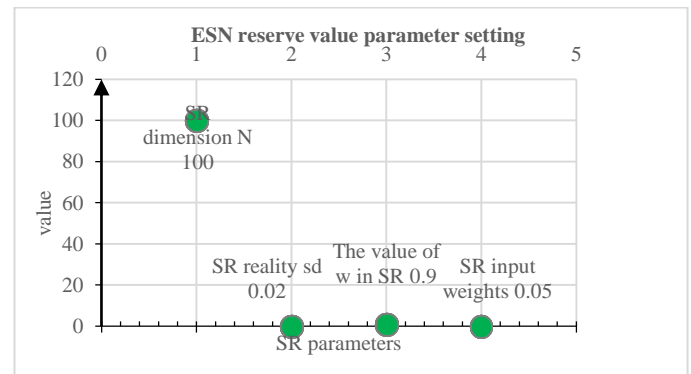

Fig. 3. Optimal parameter value diagram.

C. Simulation Experiments and Results

The accuracy of model prediction is not only related to the structural parameters of the model itself, but also depends on whether the selection of model predictors is reasonable. Therefore, this paper draws on the prediction factor selection method of previous research, and uses autocorrelation and partial correlation to analyze the predictors. The sample autocorrelation analysis is shown in Fig. 4, and the partial correlation analysis is shown in Fig. 5.
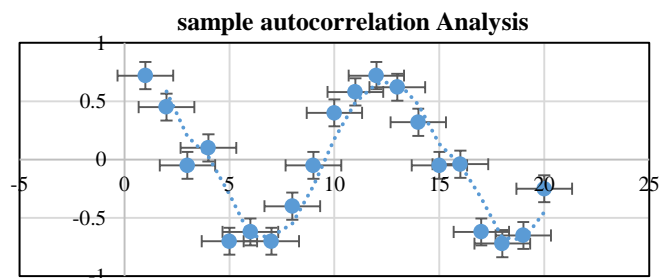

Fig. 4. Autocorrelation analysis plot.

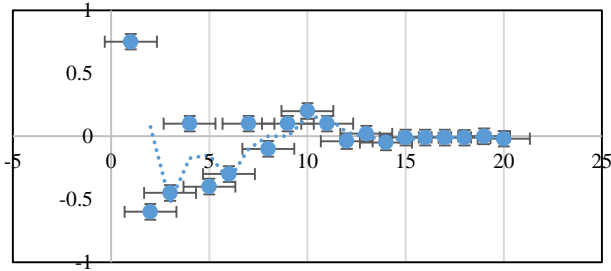**Sample Partial Correlation Analysis**

Fig. 5.   Partial correlation analysis.

This paper divided the processed dataset into two parts. Meanwhile, Root Mean Squared Error (RMSE), Efficiency (E) and Correlation Coefficient (CORR) were selected to evaluate the prediction results. The closer RMSE is to 0, and the closer E and CORR are to 1, the higher the accuracy of the model [20]. The specific formulas are as follows:

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(x_1 - y_i)^2} \tag{9}$$

$$E = 1 - \sum_{i=1}^{n}\frac{(x_i y_i)}{\sum_{i=1}^{n}(x_i - \bar{x})^2} \tag{10}$$

$$M = 1 + \sum_{i=1}^{n}(x_i + y_i) \tag{11}$$

$$CORR = \frac{\sum_{i=1}^{n}x_i y_i - \frac{\sum_{i=1}^{n}x_i \sum_{i=1}^{n}y_i}{n}}{\sqrt{\left(\sum_{i=1}^{n}x_i^2 - \frac{\left(\sum_{i=1}^{n}x_i\right)^2}{n}\right)\left(\sum_{i=1}^{n}y_i^2 - \frac{\left(\sum_{i=1}^{n}y_i\right)^2}{n}\right)}} \tag{12}$$

This paper uses MATLAB software to program the ESN. The key to model prediction is the selection of model parameters, and the key parameter of ESN is the scale N of the reserve pool. The optimal scale of this parameter is obtained through repeated experiments (Fig. 6). The size of the reserve pool N mainly includes 50, 60 and 65. The predicted performance results of different reserve pool sizes are shown in Fig. 7 According to the comparison of the prediction performance of different reserve pool sizes, this paper chooses the reserve pool size as 65, that is, 65 different types of criminal laws are selected as the reserve pool, the other parameters are set as follows: the number of training set samples is 65, and the number of test set samples is 60, the number of samples in the initialized reserve pool is set to 150, SD is 10%, W spectral radius is 0.8, IS is 0.3 , and the excitation function is selected as 'tanh'. Through the operation and mathematical analysis of the model, the probability

distribution of 12 secondary risk indicators is finally obtained (Fig. 8).
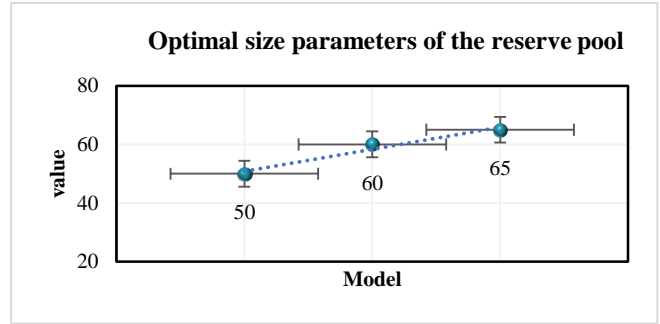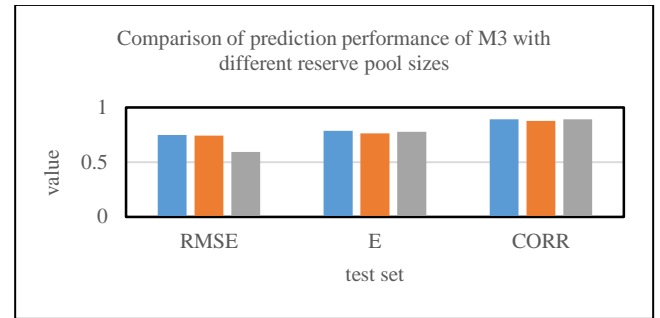

Fig. 6.   ESN optimal parameter scale.

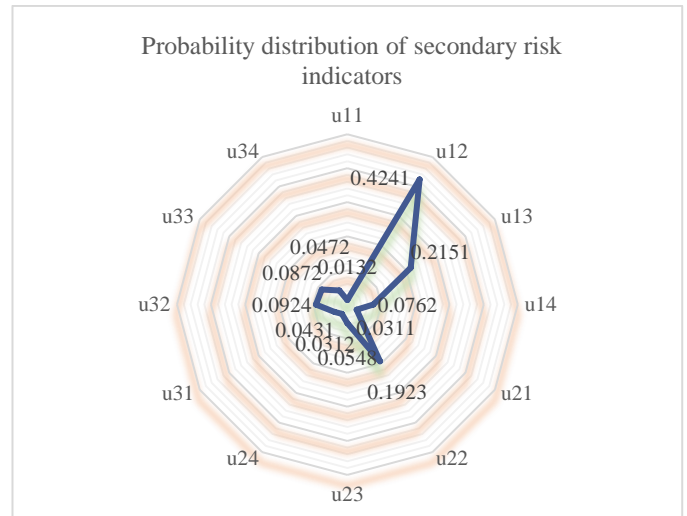Fig. 7.   Prediction of different reserve pool sizes.

Fig. 8.   Distribution of secondary risk indicators.

In addition, in order to verify the application effect of ESN model in criminal law risk, this paper also uses BP neural network for comparative analysis. In the last layer of building the BP neural network, the output feature vector of the RBM (Restricted Boltzmann Machine) network is regarded as the output vector of the BP network, which can effectively supervise and train the entity relationship analyzer. The set BP network can only ensure that the mapping of weights to feature vectors in this level is optimal, but cannot ensure that the mapping of feature vectors in the entire DBN (Deep Belief Network) is optimal. Therefore, the BP network may propagate the problematic information to the RBM of each

layer, and play a small adjustment role for the entire DBN. The RBM network training model is the initialization process of the weights of a deep BP network. This process enables DBN to overcome the problems of increased training time and prone to local optima due to random changes in the initialization of BP network weights. It can be seen that the application of the ESN model in criminal law risk has many advantages over the application of the BP network model, which is also an affirmation of the application of the ESN model [21].

V. ANALYTICAL DISCUSSION

According to the distribution of secondary risk indicators (Fig. 8), the maximum value is 0.4241, which corresponds to u12. According to the second-level indicators of legislative risk, the risk factor represented by it is legislative scientific risk u12, and this influencing factor is very important. The second value is 0.2151 corresponding to u13, which represents the risk factor of legislative democratic risk u21, which plays an important role in the formulation of criminal law, and the second value corresponding to the risk of judicial integrity u22 is 0.1923，Other legislative constitutionality risk u11 is 0.0132, legislative timeliness risk u14 is 0.0762, judicial fairness risk u23 is 0.0548, judicial efficiency risk u24 is 0.0312, theoretical objectivity risk u31 is 0.0431, theoretical purpose vague u32 is 0.0924, theoretical deviation u33 is 0.0872 and the theoretical violation u34 is 0.0432. All three of these indicators are major risk factors for criminal law, and greater attention is being paid to them. All other values are less than 0.1, indicating that other factors have great influence or can be ignored. By analogy, the final weights are ranked as follows: purpose ambiguity u32, theoretical deviation u33, legislative timeliness u14, interoperability hinders great justice u23, theoretical violation u34 and theoretical objectivity u31, etc. Legislative risk is the most critical, and also the beginning and foundation of the law. Regarding criminal law risk management and control, we should have corresponding measures. First, we should take people as the main body and the rule of law as the criterion, establish a good risk prevention system, and do a good job in risk management and control in advance to prevent problems before they occur. To sum up, in the practice of criminal law legislation to judicial practice, the law not only has sufficient tenacity, but also has many risk factors. Among them, legislative risk is the most critical, and it is also the beginning and foundation of the law, which should be considered in future law formulation. Its associated risks provide a good basis for the enforcement of the law.

To compare the performance of ESN in predicting criminal law risks, this study also employs BP neural network to forecast the aforementioned models. Fig. 9 illustrates the prediction outcomes of both ESN and BP neural network for the three models. By comparing the evaluation metrics RMSE, E, and CORR, it becomes evident that ESN outperforms BP neural network in terms of predicting criminal law risks. Additionally, due to the simplified regression calculation involved in the internal adjustment of the ESN reservoir pool, its running time is significantly reduced compared to BP neural network. In regard to the individual prediction performance of ESN, the values of RMSE are arranged in

ascending order as M3, M2, and M1; whereas the values of E are ranked in descending order as M3, M2, and M1. Similarly, the values of CORR are sorted from highest to lowest as M3, M1, and M2. Considering all three indicators, M3 demonstrates the highest prediction accuracy, followed by M2, and finally M1. This can be attributed to the fact that M3 incorporates four input factors, M2 includes three, while M1 only has two. Hence, the accuracy of ESN prediction exhibits a certain correlation with the number of effective input factors, indicating that a higher number of relevant inputs leads to improved prediction accuracy. It is worth mentioning that in this study, the ESN model reserve pool size is set at 65, which proves to be suitable and yields high model accuracy.
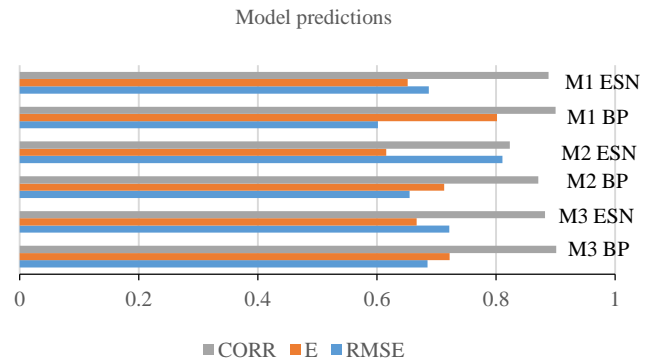

Fig. 9. Model predictions.

The model's prediction serves as a tool, but in order to comprehend and manage the risks associated with criminal law, it is crucial to reflect upon the theory of criminal law. The concern regarding the relationship between law and society stems not only from the limitation of a narrow internal perspective in criminal law research but also from recognizing that the evolutionary power of the legal system does not primarily arise from internal forces alone. As the external social environment grows increasingly complex, the study of criminal law must incorporate the dimension of social structural change to observe and address how the criminal law system can be adjusted and reconstructed.

In bridging the gap between social theory and criminal law theory, researchers should strive to understand and grasp the fundamental consensus within contemporary social theory. Furthermore, they should integrate this consensus into the legal dogmatic system in an identifiable manner. This integration facilitates the self-renewal of the criminal law system. By examining the efforts made by Heike, the founder of interest law, to methodologize and technically develop Yelling's teleological thought, we discover the potential for academic innovation—a combination of thought and technology—to drive the systematic renewal and advancement of criminal law.

VI. CONCLUSION

The transitional modern society is characterized by a plethora of highly intricate and uncertain risks. The number and uncertainty of these risks are constantly on the rise. This is evident in three aspects: at the legislative level, an excessive emphasis on preventive criminal law in social governance can

lead to concerns about excessive criminalization; at the judicial level, the vague standards for determining crimes conceal the risk of judicial arbitrariness; at the theoretical level, relaxing restrictions on the state's penal power can easily result in an imbalance between societal protection under criminal law and the safeguarding of human rights. These developments in criminal law arise not only as a response to the security needs of citizens during periods of social transition but also due to the failure to establish new standards that can restrict criminal legislation after breaking free from the constraints imposed by traditional criminal law theories. To address potential risks associated with criminal law, it becomes essential to establish reasonable boundaries for preventive criminal law. The prediction of criminal law risk based on ESN model established in this paper mainly draws the following three conclusions:

1) In order to better predict criminal law risks and provide corresponding guarantees for social security, the ESN model proposed in this paper has further improved the accuracy of various risk predictions. After verification, it can provide reference for criminal law risk prediction and management system research.

2) The experimental results show that the ESN model proposed in this paper has a good fitting effect with the actual situation, and is better than BP model in terms of error and fitting degree.

3) Criminal law is built on the background of social risk. In the risk society, the variability, complexity, multiple occurrence and unpredictability of social risk have a great impact on the original criminal law system. Therefore, we should think about the criminal law from three aspects: legislation, judicature and theory, analyze the foreseeable risks of the criminal law, and put forward corresponding risk management measures to ensure the safety of the national criminal law system.

4) Legislative risk U_1 and theoretical risk U_3 belong to social factors and are also fundamental risks of criminal law. Judicial risk U_2 is mainly manifested in the level of judicial power. The influencing factors of legislative scientific risk are very important. The formulation of democratic risk criminal law plays an important role, followed by judicial integrity.

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