Asset Impairment Prediction in the Age of Big Data and Machine Learning

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Abstract. In the context of a globalized economy, accurately predicting asset impairment is critical for maintaining the financial health of enterprises and guiding investment decisions. This paper provides a comprehensive review of the internal and external factors influencing asset impairment and explores how these factors collectively impact asset valuation. It examines asset impairment prediction methods from two perspectives: traditional financial analysis and emerging machine learning techniques. While conventional approaches rely on cash flow forecasting and discounting, machine learning leverages historical data to identify patterns and trends in asset impairment. Machine learning provides distinct advantages compared to traditional methods, such as its capacity to handle large datasets, capture non-linear relationships, and adapt to market fluctuations. These capabilities notably enhance the accuracy and reliability of asset impairment predictions, enabling enterprises to make better-informed investment and operational decisions in increasingly complex market circumstances. Furthermore, these advancements provide valuable insights for accounting standard setters and policymakers. With ongoing advancements in big data and computing power, machine learning holds immense potential in asset impairment forecasting. Its application is expected to enhance risk management for enterprises, paving the way for more effective decision-making and sustainable growth.

Keywords: Corporate Financial Health, impairment of assets, impairment of assets

1. Introduction

Under the double background of the global economy and modern enterprise management, asset impairment prediction has become a crucial link in enterprise financial management. The difference in accounting standards has a significant impact on the company's financial reporting. For instance, the Generally Accepted Accounting Principles (US GAAP) and the International Financial Reporting Standards (IFRS) differ in their treatment of asset impairment recognition, measurement, and reversal, which in turn impacts a company's financial reporting (Hong et al., 2018) . Asset impairment forecast is not only related to the authenticity of financial statements, financial stability, and sustainable operation ability of enterprises but also directly affects the business decisions of enterprises, market reputation, investor confidence, and stock price fluctuations. Research indicates that asset impairment tests utilizing model pricing for fair value measurement fail to enhance the quality and reliability of financial statements. Instead, they can become a means for earnings management, potentially encouraging unethical managerial practices (Dudycz & Praźników, 2020). Along with the swift advancement of the market economy and the continuous variation of the external environment, the risk of asset impairment is becoming more and more prominent. Accurately predicting asset impairment has become the focus of academic and practical circles. For investors, managers, and policymakers, the prediction of asset impairment is directly related to the effectiveness of investment decisions, risk management, and resource allocation. However, due to the complexity and uncertainty of asset impairment, traditional forecasting methods are often difficult to accurately capture dynamic changes, which requires more advanced technologies and methods to improve the accuracy and reliability of forecasting.

This paper aims to discuss the theoretical basis, influencing factors, forecasting methods, and practical application of asset impairment forecasting by summarizing the existing literature. In terms of influencing factors, asset impairment is influenced by a variety of internal and external factors, including management decisions, operational efficiency, and risk control, while external factors involve market demand, technological progress, natural disasters, laws and regulations, and other aspects. The interaction of these factors makes asset impairment prediction a multi-dimensional and

dynamic process. From these perspectives, this paper will systematically analyze and summarize the influencing factors of asset impairment to provide a theoretical basis for the subsequent research on forecasting methods.

In terms of forecasting methods, the traditional calculation methods mainly rely on the prediction and discount of future cash flow, but these methods are often inadequate in the face of complex and changeable asset impairment situations. In recent years, with the vigorous development of machine learning technology, its application in asset impairment prediction has been paid more and more attention. Machine learning models can not only automatically process and analyze large-scale historical data, improve efficiency and accuracy, and avoid manual bias, but also capture complex nonlinear relationships and find the relationship between potential influencing factors and impairment results, thereby improving the accuracy and reliability of forecasts. In addition, machine learning is highly flexible and adaptable, able to update and optimize according to new data and market environments, keeping forecasts current and accurate.

This paper will focus on the core issues such as the influencing factors of asset impairment, the application and effectiveness of traditional methods and machine learning methods in asset impairment forecasting, aiming to provide a comprehensive theoretical framework and practical guidelines for asset impairment forecasting, provide enterprises with more scientific decision support tools, and help managers better understand and cope with asset impairment risks.

2. Influencing Factors

2.1. Internal Influencing Factors

In the field of enterprise financial management, asset impairment is a complex and multi-dimensional problem, and its internal factors play a crucial role. These internal factors are closely related to management decisions, operational efficiency, and risk control, and exert a significant influence on the valuation of both current and non-current assets.

Improper inventory management is a key internal factor causing impairment of current assets, including expired, damaged, or obsolete inventory. This can stem from inaccurate demand forecasting, inadequate control of production or transportation costs, and flawed sales strategies. In addition, the impairment of accounts receivable is also closely related to internal factors, such as too loose credit sales policy, negligence of accounts receivable management, and errors in customer credit evaluation, which may lead to an increase in bad debt risk and insufficient provision for bad debts.

For non-current assets, the impairment of long-term investments may result from mistakes in investment decisions and poor supervision of investee enterprises. The decrease in the value of fixed assets could be associated with inadequate asset management and delayed decisions concerning technological upgrades. Similarly, the decline in the value of intangible assets and construction in progress might be influenced by internal factors, including postponed technology research and development activities and ineffective project management. The impairment of biological assets is closely related to internal factors such as poor management of biological assets and lag of breeding or planting technology. The impairment of goodwill may be due to mistakes in M&A decisions and poor integration of the acquired companies, and it is also found that analyst coverage is negatively correlated with goodwill impairment (Han et al., 2021).

At the same time, the motivation of management to write down the value of the impaired assets and the ability of the company to absorb the impact of the writedown on the financial statements will also affect the range of asset impairment (Cotter et al., 1998). Impairment recognition probability is positively affected by entity size and negatively affected by market value (Fernandes et al., 2016).

To sum up, the internal factors affecting asset impairment involve many aspects of the enterprise, including management decisions, operational efficiency, risk control, and so on. These combined factors can contribute to a reduction in the value of enterprise assets, ultimately increasing the risk of asset impairment.

2.2. External Influencing Factors

Compared with internal factors, external factors of asset impairment are usually beyond the direct control of the enterprise, but their impact on the value of the asset is just as important and profound. The declining state of the environment creates significant risk factors for asset impairment, such as climate change, changes in the integrity of the biosphere, and changes in the natural environment, which will affect the asset impairment of various industries and enterprises (Linnenluecke et al., 2015).

For current assets, changes in market demand, technological progress, and changes in laws and regulations are important external factors. Changes in market demand may cause the selling price of the inventory to fall or become unsalable, and technological progress may make the inventory obsolete and unable to meet market demand. At the same time, changes in laws and regulations, such as the implementation of environmental regulations, may make certain inventories unsalable, thereby affecting their value. The impairment of accounts receivable may also be affected by external factors such as the deterioration of customers' financial position, changes in the macroeconomic environment, and increased competition in the industry. For example, German savings banks and cooperative banks located in the affected areas experienced significantly higher, but short-lived, impairment flows in the years following the floods (Shala & Schumacher, 2022).

For non-current assets, the deterioration of the business conditions of the investee, changes in market demand, and changes in laws and regulations, such as tax policy adjustments, may cause the value of long-term investments to decline. Fixed assets may be affected by external factors such as changes in the economic environment, natural disasters, and technological progress. The stranded assets field, for example, has emerged as a result of business and policy research's absorption of the concept of carbon budgets and growing concern about the knock-on effects of large-scale value destruction in the fossil fuel industry. The valuation of intangible assets can be influenced by shifts in market conditions, advancements in technology, and alterations in legal and regulatory frameworks, including the expiration of patent protection. The decline in goodwill value may stem from worsening business conditions of the acquired enterprise, heightened market competition, and changes in laws and regulations. Construction in progress and biological assets may also be impaired by external factors such as changes in market demand, funding issues, natural disasters, and changes in laws and regulations.

To sum up, the external factors affecting asset impairment involve market demand, technological progress, natural disasters, laws and regulations, and many other aspects. Although these factors are beyond the direct control of enterprises, enterprises need to pay close attention to their changes in order to evaluate the value of assets in a timely manner and take corresponding measures to reduce the risk of impairment.

3. Asset impairment forecasting method

3.1. Traditional Methods

Traditional asset impairment forecasting relies on a series of calculation methods, which mainly revolve around the discount of expected future cash flows. In particular, it is first necessary to make a reasonable forecast of the cash flow that the asset is likely to generate over the future life of the asset, which usually takes into account factors such as the useful life of the asset, market demand, technological advances, maintenance costs, and possible competitive conditions. Next, choose a weighted average cost of capital (WACC) or a discount rate based on market data that typically reflects the specific risk of the asset and the expected return of the market on similar investments. Then, the predicted future cash flow is discounted according to this discount rate to obtain the present value of the asset. Finally, the present value is compared with the book value of the asset. If the present value is lower than the book value, it indicates that the asset has suffered an impairment, and the corresponding impairment provision is required.

According to the traditional method, people evaluate and forecast the asset impairment by predicting the cash flow. These methods mainly focus on the estimation of the future cash flow of tangible assets but often ignore the uncertainty of cash flow itself and the definition of value range. To improve on this deficiency, the present study introduces stochastic fuzzy numbers, which not only more accurately estimate the cash flows generated by the development of tangible assets, but also stratify the value range of these cash flows to more fully reflect the risk of asset impairment. On this basis, the objective function and constraint conditions based on the Lagrange multiplier are also proposed to minimize the standard deviation of cash flow generated by tangible assets and book value, and it is determined that the value of cash flow caused by impairment must be equal to the annual value of investment capital (Bolos et al., 2020). By employing these methodologies, the risk of asset impairment can be more precisely identified, thus furnishing a foundation for taking decisive measures to mitigate the adverse effects of accumulated impairment losses on the company's financial performance.

At the same time, the research also in-depth explored the relationship between asset impairment recognition growth rate and discount rate. Using 450 annual observation samples of 133 Australian listed companies from 2015 to 2018, it constructed a model that included asset impairment as the dependent variable and growth rate and discount rate as the independent variable. The estimation model is supplemented by several impairment indexes as control variables. The research results show that the decline of the growth rate, rather than the increase of the discount rate, has a significant impact on the recognition of impairment of large assets. Enterprises tend to reduce the growth rate to recognize impairment in the recognition year, while the discount rate will have an impact on asset impairment only when the change is higher than the industry average level, suggesting that the growth rate becomes a strategic tool for management in the recognition of asset impairment (Georges, 2020).

3.2. Machine Learning Methods

Machine learning relies heavily on in-depth analysis of historical data and pattern recognition when predicting asset value or performance. This process usually includes key steps such as data preprocessing, feature selection, model training, and prediction. First, machine learning algorithms extract valuable insights from extensive historical asset data, such as prices, trading volumes, financial data, macroeconomic indicators, etc., which are cleaned and pre-processed to build predictive models. In the feature selection phase, the algorithm will identify the most critical factors for asset prediction, such as the company's profitability, industry trends, and market sentiment. Then, using these features, the machine learning algorithm trains the model to minimize prediction errors by constantly adjusting the model parameters. Machine learning is increasingly used in the field of forecasting, which enables predictions about future events by learning from historical data and identifying underlying patterns and patterns. In the prediction process, machine learning uses a lot of models, including but not limited to logistic regression, support vector machines, random forests, random gradient lifting, neural networks, and deep learning models. Each of these models has its advantages and disadvantages and is suitable for different prediction scenarios and data characteristics.

In the field of finance and finance, machine learning has been widely used in bankruptcy prediction, stock price prediction, portfolio management, oil price prediction, and other aspects (Ahmed et al., 2022). For example, some studies have used stochastic forest and stochastic gradient lift models to predict future income changes and found that these models outperform traditional logistic regression models and professional analysts' predictions (Chen et al., 2022). At the same time, there are also studies using deep learning models and machine learning methods to predict the future performance of funds and risk events such as goodwill impairment (Li & Ye, 2023; Wang et al., 2024). These research results show that machine learning models have significant forecasting ability in predicting asset impairment, profitability, and other aspects, and can provide strong support for investors and decision-makers.

Using machine learning models to predict asset impairment is a complex but promising process that combines data analysis, model building, and forecasting techniques (Pechlivanidis et al., 2022). First, it is necessary to collect data related to asset impairment from financial statements, market data, industry reports, and other sources, and to clean, standardize, and divide the training set, validation set, and test set. Then, through feature selection and engineering, the data is analyzed and transformed to extract the most relevant features and create new, more predictive features. Then, the appropriate machine learning model, such as a regression or classification model, is selected and the training set data is used for training and hyperparameter optimization. During the model validation and optimization phase, model performance is evaluated using validation sets, overfits and underfits are checked, and different algorithms or model architectures are tried to improve performance. Finally, the trained model is deployed into production, making real-time predictions on new data, and periodically evaluating model performance, updating and optimizing for new data and market conditions.

Machine learning has shown significant advantages in the field of asset impairment prediction, mainly due to its ability to efficiently and accurately process and analyze large-scale historical data. This automatic processing not only improves the efficiency of data processing but also avoids the bias that may be introduced by manual operation, ensuring the objectivity of the predicted results. Using machine learning technology, it is possible to extract key information from massive amounts of financial, market, and industry data to build a solid database for asset impairment forecasts. In addition, machine learning models excel at capturing complex and non-linear relationships in data, which is critical for asset impairment forecasting because the relationships between many influencing factors and impairment results are often complex and difficult to quantify. While traditional models have limitations in dealing with this complexity, machine learning, with its powerful learning and generalization capabilities, can reveal these underlying relationships, significantly improving the accuracy and reliability of predictions. More importantly, the machine learning model is highly flexible and adaptable and can adapt to changes in the market environment and business model by updating and optimizing the model to ensure the accuracy and timeliness of the predicted results.

4. Conclusion

In today's rapidly changing market environment, asset impairment forecasting is of vital importance to the financial health and investment decisions of enterprises. This paper reviews the theoretical basis of asset impairment, discusses the internal and external factors that affect asset impairment, and analyzes the application and effectiveness of traditional methods and machine learning technology in asset impairment prediction. By considering factors such as management decisions, operational efficiency, market demand, and technological progress, this paper reveals the complexity and multi-dimension of asset impairment. At the same time, the paper also demonstrates the unique advantages of machine learning in processing large-scale historical data, capturing non-linear relationships, and adapting to market changes, demonstrating its potential to improve the accuracy of asset impairment prediction.

Although machine learning models have made significant progress in predicting asset impairment, there are still some limitations. For instance, these models necessitate substantial volumes of high-quality data for training, which might be challenging to acquire in certain industries or particular circumstances. In addition, the black-box nature of machine learning models also makes their forecasting process less transparent, which can be a challenge when it comes to financial reporting and compliance. Potential future research could delve into methods to enhance the quality and accessibility of data, as well as strategies to boost the interpretability of models.

Looking to the future, with the improvement of big data and computing power, the utilization of machine learning techniques in asset impairment prediction has a broad prospect. By continuously optimizing algorithms and models, combined with a wider range of data sources, machine learning is expected to provide enterprises with more accurate and timely asset impairment predictions, thereby

helping enterprises better manage risk and enable more informed investment and operational decisions. This holds significant importance not only for the enterprises themselves but also contributes positively to fostering stability and growth in the overall economy.

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