A Forecasting Model for Fixed Assets Depreciation in Chinese Provincial Power Grid Enterprises

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Abstract: The depreciation scale of fixed assets is an important parameter that affects the operational profits of power grid enterprises and transmission and distribution pricing. The forecasting of depreciation scale is of immense significance for power grid enterprises to comprehend their profitability and the transmission and distribution pricing trends, in advance. In this paper, we analyze the main factors affecting the depreciation level of fixed assets in provincial power grids, distinguish the structure of existing assets and incremental assets, build a depreciation forecasting model, and further conduct an empirical study to quantitatively analyze the influence of different business strategies on depreciation. The study results can support management and decision-making optimization of power grid assets and provide support for scientific decision-making by government departments.

Keywords: Existing Assets; Incremental Assets; Influencing Factors; Depreciation forecasting.

1 Introduction

With increased power reform and supervision, intensive and refined management of power grid enterprises is bound to extend to all aspects of daily management. The depreciation cost of provincial power grid enterprises accounts for a large proportion of the transmission and distribution cost. The scale of depreciation not only directly affects transmission and distribution prices, but also has an important impact on enterprise profitability and cash flow from operating activities. The study can provide support for power grid enterprises to optimize asset management and operation decisions, and also provide reference for government departments to improve power grid investment and price policies.

In terms of literature, by analyzing the relationship between fixed assets and annual depreciation, Han et al. (2011) proposed a forecasting model based on historical investment information and financial statements. Tamulevičienė and Mackevičius (2019) considered the impact of information users on fixed assets and proposed a complex analysis method. Isfani et al. (2019) analyzed the relationship between the fixed asset accounting treatment and fairness in preparing financial statements. Indayani (2020) proposed a calculation method of fixed assets depreciation according to the government financial statement accounting standards. Shao et al. (2020) explored adjustments in the asset depreciation policy, aged assets, and user asset management,

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and built a depreciation calculation model based on fixed asset cards. Hajiyev(2021) made a comparative analysis on the calculation of fixed assets depreciation in accounting and tax accounting. Recently, some scholars have carried out relevant research on the power grid enterprises. Wu and Xue (2020) proposed depreciation adjustment strategies from four aspects to optimize the transmission and distribution cost structure, reduce costs, and increase the efficiency of power grid enterprises. Liu et al. (2021) established a dynamic adjustment mechanism for the annual depreciation rate.

In general, existing research and studies on power grid asset depreciation have not systematically analyzed the depreciation forecasting method for power grid fixed assets, nor have they calculated and analyzed factors such as asset classes and macro environment that affect the depreciation period of power grid fixed assets. Based on the sensitivity analysis method, this paper analyzes the main factors affecting the fixed assets depreciation of provincial power grid enterprises, and the impact of different strategies on the assets depreciation by building the asset depreciation prediction model.

2 Depreciation Forecasting Models

2.1 Calculation of the Scale of Asset Depreciation

2.1.1 Scale of Existing Assets Depreciation

(1) Scale of Existing Assets

The scale of existing assets refers to the original value of existing fixed assets at the beginning of each year after deducting aged assets, as in Eq. (1) and (2).

$$EA_t = EA_{t-1}^e - ESA_t - NRA_t \tag{1}$$

$$EA_{t+1}^b = EA_t^b + NCT_t + NUA_t - ESA_t - AA_t \tag{2}$$

where EA_t is the scale of existing assets in the current year, EA_{t-1}^e is the scale of existing assets, which including scale of aged assets at the end of the previous year, ESA_t is the scale of early-scrapped assets this year, and NRA_t is the scale of normal retiring assets this year. EA_{t+1}^b is the scale of existing assets at the beginning of next year, EA_t^b is the scale of existing assets at the beginning of this year, NCT_t is the scale of new capital transfers this year, NUA_t is the scale of new user assets this year, and AA_t is the scale of aged assets this year.

(2) Scale of Aged Assets

The scale of aged assets is calculated based on the ratio of the original value of aged assets over the past years to the original value of the classified existing fixed assets, as in Eq. (3).

$$AA_t = EA_t^b * a \tag{3}$$

where a is the proportion of aged assets in the scale of existing assets at the beginning of this year.

(3) Scale of early-scrapped assets

The scale of early-scrapped assets is calculated based on the ratio of the original value of early-scrapped assets to the original value of classified existing fixed assets each year, as in Eq. (4).

$$ESA_t = CFA_t^b * b \tag{4}$$

where CFA_t^b is the original value of the classified fixed assets at the beginning of the year, and b is the proportion of the original value of the early-scrapped assets.

Considering that the scale and number of fixed assets of provincial power grid enterprises is large, the depreciation scale of existing assets is calculated in the form of original value of fixed assets * comprehensive depreciation rate, as in Eq. (5).

$$DEA = (EA_{t-1}^e - FERA_t - AA_t) * c + FNESA \tag{5}$$

where DEA is the depreciation scale of existing assets, $FERA_t$ is the original value of the forecasted early retirement assets in this year, c is the comprehensive depreciation rate of the classified assets, and $FNESA$ is the forecasted net value of the early-scrapped assets.

2.1.2 Scale of Incremental Assets Depreciation

Scale of incremental assets mainly includes the scale of new self-built assets and the scale of newly received user assets.

(1) Scale of Newly Transferred Assets

The scale of the newly transferred assets this year is based on the historical investment amount of various projects and the proportion of various assets formed by transfer. Combined with future investment plans, the scale of future classified asset transfer is forecasted, as in Eq. (6).

$$\mathrm{DNAA} = (\mathrm{NTA_t} + \mathrm{NRUA_t}) * \mathrm{d} \tag{6}$$

where $DNAA$ is the depreciation scale of newly added assets, and d is the comprehensive depreciation rate of classified assets.

(2) Scale of Newly Added User Assets

The scale of the newly added user asset structure is based on the average proportion of various user assets received in historical years as the classification ratio of user assets received in the future.

2.2 Sensitivity Analysis of the Scale of Asset Depreciation

Sensitivity analysis is a method to quantitatively describe the importance of model input variables to output variables. Generally, in the application process, the factors that have a high impact on the output value are mainly considered to improve the accuracy of the model. Based on the sensitivity analysis, this paper calculates the impact of investment scale, user asset receiving scale and depreciation period on the asset depreciation of provincial power grid enterprises.

2.3 Forecasting of the Scale of Assets Depreciation

Based on the above calculation of depreciation of various fixed assets and analysis of influencing factors, the comprehensive prediction model of fixed assets of power grid enterprises constructed in this paper is as follows:

$$\mathrm{DFA_t} = \left(\mathrm{EA_t^b} - \mathrm{FAA_t} + \mathrm{NTA_t} + \mathrm{NRUA_t}\right) * \mathrm{d} \qquad (7)$$

where DFA_t is the depreciation scale of fixed assets this year, $FESA_t$ is the forecasted original value of early-scrapped assets this year,FAA_t is the forecasted original value of aged assets this year, $FNESA$ is the forecasted net value of early-scrapped assets.

3 Empirical Analysis

3.1 Indicators and Data Description

We conducted empirical calculations after taking a provincial power grid enterprise as an example. we collected and compile the data of all the voltage levels and asset value based on original value data.

3.2 Calculation Results and Analysis

3.2.1 the Influence of Investment Scale

Based on the impact of changes in the future investment scale on the depreciation scale (as shown in Figure 1), the results demonstrate that: when the investment scale decreases by 20%, the depreciation amount first drops significantly, there is an upward inflection point in the following year. When the depreciation amount is reduced by 30%, the depreciation scale continues to decline, and there is no upward inflection point. This shows that it is feasible to improve the overall investment benefit by reducing the scale of investment in the future; at the same time, it results in reduction in the allowable income level of power grid enterprises, which adversely affects the power grid enterprises and their future operation.

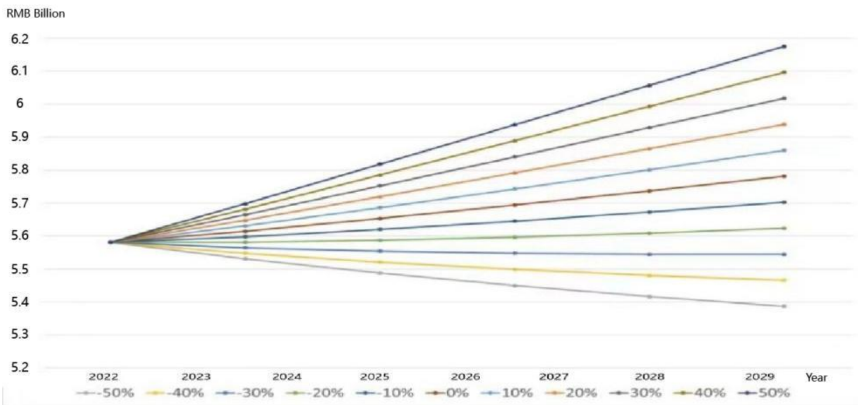

Fig. 1. Influence of Changes in Investment Scale on the Depreciation Scale

3.2.2 Influence of the Receiving Scale of User Assets

Overall, since the receiving scale of user assets accounts for a small proportion of the total assets, the current receiving scale of user assets has little effect on the depreciation scale. When differentiating the continuous and stable receipt of user assets and not including user assets received in the future in the calculation, the results demonstrate that in the case where new user assets are no longer received, there is a less than 2% decrease in the future depreciation scale of power grid enterprises.

3.2.3 Influence of Depreciation Period

The average actual service life of classified assets is calculated and compared with the range of the discount period for the verification price. The results demonstrate that the actual service life of most major power transmission and transformation assets are lower than the minimum value of the scope of price verification, and there is a large gap; the actual service life of most of the non-main power transmission and transformation assets exceeds the depreciation period.

Based on the calculation results, a differentiated treatment method is adopted for the depreciation period. For non-major power transmission and transformation assets, the depreciation period of the verification price is directly adopted as the depreciation period of the assets. For the main power transmission, transformation, and distribution assets, the following factors are considered based on the median depreciation period of the verification price: the differences in regional environmental factors, economic level factors, asset quality factors, the level of operation and maintenance and the operation time.

3.2.4 Forecasting Results of Depreciation Scale

The depreciation scale is forecasted based on the proposed model. The results demonstrate that the depreciation scale of power grid enterprises increases steadily in future years while maintaining the current investment and user asset receiving scale(as shown in Figure 2); when it is 7% lower than the previous year, the depreciation scale of the power grid enterprises shows an inflection point in 2026(as shown in Figure 3). It can be concluded from this that the scale of asset depreciation does not change significantly under the premise of stable investment plans and stable user asset receiving scale. However, with the changes in the external economic environment, the reduced investment scale and slowdown in receipt of user assets can lead to a downward trend in the enterprise's depreciation scale.

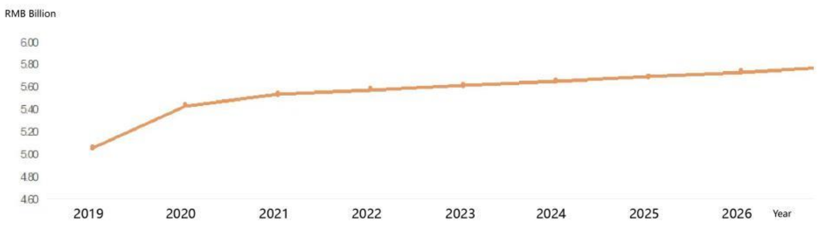

Fig. 2. Forecasted trend of depreciation scale based on current investment level

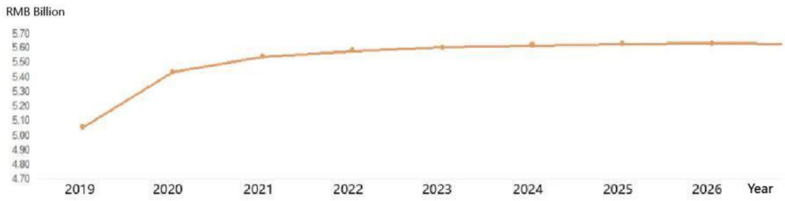

Fig. 3. Forecasted trend of depreciation scale based on decreasing investment

4 Conclusion

In order to promote the high-quality development of power grid enterprises and the power grid, and improve the asset performance management level of power grid enterprises, this paper constructs the depreciation prediction model of provincial power grid enterprises, and carries out relevant empirical analysis.

Research reveals that the scale of investment, scale of user assets, and depreciation period have an impact on the depreciation of power grid companies. In terms of investment scale, a reduction in investment scale in the future can improve the overall efficiency. However, a sharp drop in investment scale can affect depreciation, thereby reducing the allowable income. The final impact depends on the future investment scale and the change range of depreciation period. Receipt of user assets has a limited impact on the depreciation scale, but it can increase the operation and maintenance expenditure of power grid enterprise. Finally, the depreciation period varies by asset type and region.

The study results of this paper can promote lean management of power grid enterprise assets. Power grid companies can take the following measures: First, adopt a differentiated depreciation strategy. Considering that the actual service life of assets is affected by environmental and policy factors, it is necessary to formulate differentiated depreciation strategies for assets according to different influencing factors. Second, adjust the user asset receiving strategy. To reduce the operational risks brought about by the receipt of user assets, it is necessary to strengthen the evaluation before the receipt of user assets, comprehensively evaluate the input and output benefits of user assets, and scientifically arrange the operation and maintenance strategies for the technical transformation of user assets.

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