Data Asset Pricing Model for Power Grid Corporations

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Abstract. [Purpose/Meaning] As a new key production element, data element fully shows huge profit potential in the production and operation activities of power grid companies. Power grid companies should maximize the value of power data by means of pricing in the current market environment. [Method/Process] Firstly, analyze the application scenarios, advantages and limitations of different pricing methods. Secondly, combined with the characteristics of power data, the comprehensive data asset pricing model of power grid companies is constructed; Finally, some suggestions are put forward for the internal system construction and multi-entity collaborative activities of grid enterprises. [Result/Conclusion] The current data asset pricing methods applicable to grid corporations mainly include costing method, revenue approach, and market approach. It is recommended that the grid companies use the integrated method to weight the monetary value of data assets calculated by the costing method, market approach, and revenue approach.

Keywords: Data assets, pricing model, grid corporations, power data

1 Introduction

In practical exploration, power grid corporations regard digitalization as the basic content of technological innovation in the context of the new era, and put forward strategic theoretical decisions such as "Big Data Strategy" and "Digital State Grid" according to their own development needs, which not only meet the current development needs, but also can effectively respond to the relevant needs raised by the innovation of the era. It not only meets the current development needs, but also can effectively respond to the relevant needs raised by the innovation of the times. In the new era, a comprehensive control of digital development opportunities will help grid corporations to break through the traditional development model and find a clearer development path in the increasingly innovative market environment.

For research related to data asset pricing, Sun et al[1] combed through the relevant theoretical results in recent years and concluded that the current research is broadly divided into the analysis of pricing models and pricing factors, the analysis of transaction mechanisms, and the comprehensive discussion of pricing strategies and pricing models, pointing out that data pricing suffers from insufficient data transactions affecting data asset value mining, insufficient standardization of data quality in segmented

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areas, and insufficient data connotation and value discovery. However, no new and specific data asset pricing models are proposed in their study. Che et al [2] quantified the subsequent auxiliary services provided by sellers as influencing factors related to transaction prices, and constructed a three-stage bargaining model to provide a new mathematical approach to data asset pricing. Based on the disciplinary framework of "monetary banking", Lu [3] derived a data model with information entropy as the core, and provided an innovative and quantifiable solution for the pricing of outsourced data. Li [4] introduced game theory into the pricing of data assets for the transaction profile of big data assets, and then compared the basic methods of asset valuation to form a reasonable proposal for improving the pricing of big data assets. Chen [5] studied the utility-based big data pricing method, established the data utility function by machine learning model to quantify the value of data, while focusing on user interests, constructed a big data pricing model based on Stackelberg game, and finally applied the pricing method by using the second-hand house appraisal data as the case data. Wu [6] established an option pricing model for data assets by transforming and improving the relevant variables in the classical B-S model according to the option characteristics of data assets.

For the pricing of electric power data assets in power grid corporations, Li [7] proposed a course of action for the future development of data asset pricing in power grid corporations, pointing out that in the pricing mechanism, the multiple, diverse and combined characteristics of data products should be focused on, and on the basis of the cost-price method, the factors affecting the realization of data value are also considered comprehensively. Yu et al [8] incorporated data value realization risk and market supply and demand factors into a power data pricing model, and verified the effectiveness of an optimized model for pricing power data assets using an energy efficiency monitoring product as an example. Wu [9] applied the three-stage bargaining theory to power data pricing and constructed a fee pricing model for paid services.

2 Basic approaches to pricing data assets for power grid corporations

Data asset pricing is different from data asset valuation. Data asset valuation is a study based on the seller's perspective for the value of data assets themselves, and is the basis for data asset pricing, equity, cost and revenue management. Data asset pricing is to determine a fair price based on the asset attributes of data, after fully considering the buyer's data analysis technology and use valueand the analysis of asset valuation theory. The current data asset pricing methods applicable to grid corporations mainly include costing method, revenue approach, and market approach.

2.1 Data asset operation costing method

The costing method accounts for the price of data assets based on the cost of forming them. Despite the inherent weak correspondence between the cost and value of intangible assets and the incompleteness of their costs, there is some justification for applying the costing method to pricing some data assets. When using the costing method to perform data asset pricing, the applicability of the costing method is first considered by analyzing the degree of correlation between the value of the data asset and its cost based on all the inputs used to form the data asset. Then the replacement cost of the data asset has to be determined. The replacement cost of data assets includes reasonable cost, profit and related taxes. Reasonable costs then include direct costs and overheads.

Based on the replacement cost to measure the monetary value of the data assets of the power grid corporations, the cost required to reacquire the data assets of the power grid corporations under the point-in-time market conditions is assessed. Power data assets suitable for cost accounting should meet the conditions of

(1) being able to be used normally or in use,

(2) being able to be obtained through the replacement route,

(3) the replacement cost and related depreciation being able to be reasonably estimated,

(4) the data quality reaching the base level for exchange or trading.

In the costing method, the acquisition cost of data assets needs to be counted in stages according to the process characteristics of creating the life of data assets. The cost of data assets of grid corporations is the total cost incurred from the generation of data assets to the date of data transaction, which mainly includes planning cost, construction cost, maintenance cost and other costs. From the perspective of data asset lifecycle management, planning cost is the cost invested by grid corporations in the overall planning of data asset lifecycle; construction cost is the cost invested by grid corporations in data collection, data import and pre-processing, data statistics and analysis, data mining, etc.; maintenance cost is the cost invested by grid corporations in maintaining and governing data; other costs are the cost invested by grid corporations in software and hardware, infrastructure, public management, etc. infrastructure, public administration, etc.

Therefore, the data asset operation cost accounting formula for grid corporations isph text. Paragraph text. Paragraph text. Paragraph text. Paragraph text. Paragraph text.

$$V_C = \sum_{i=1}^{n}(C_{i1} + C_{i2} + C_{i3} + C_{i4} + t_i + p_i) \tag{1}$$

where V_C is the cost of data assets to be evaluated, n is the number of data sets included in the data asset, C_{i1} is the replacement planning cost for the i-th data set, C_{i2} is the replacement construction cost of the i-th data set, C_{i3} is the replacement maintenance cost of the i-th data set, C_{i4} is the other replacement cost for the i-th data set, t_i is the taxes and fees for the i-th data set in circulation, and p_i is the profit of the i-th data set in circulation.

Data asset planning usually includes the pre-data asset management process such as data asset requirement analysis, research and analysis, system development, and online operation. Data asset construction can be summarized as data collection, data import and pre-processing, data statistics and analysis, and data mining. Among them, data acquisition belongs to the data asset acquisition stage, and the last three steps belong to the data asset development stage. Data asset maintenance is an inevitable guarantee for timely update, safe transaction and circulation of data assets, which belongs to data asset service cost. Other inputs of data assets include the inputs of grid corporations in software and hardware, infrastructure, public management, etc., which are apportioned to data assets according to a certain ratio.

From the perspective of the grid corporation, the data of the grid corporation is passively acquired in its own operation and production, if it is to form data assets, it also requires the grid corporation itself to carry out a large number of resources data cleaning, research and development and deep mining, in the data acquisition stage corporations pay less cost, so in the acquisition stage, you can only consider the data storage and other costs incurred, the cost focus falls on the data asset development stage. Costs incurred in the R&D stage usually include equipment depreciation, R&D staff salaries and other costs.

Based on the traditional intangible asset costing method, a costing method model for data asset value evaluation can be established by considering the cost depreciation and expected use premium of data assets, and adding data asset value influencing factors to modify the asset value. The expression of the costing method model is

$$P_C = V_C \times \ (1 + R) \times U \times \ (1 - \lambda) \tag{2}$$

where V_C is the cost of data assets to be evaluated, λ is the data asset depreciation rate, which mainly includes functional and economic devaluation. Poor timeliness of customer data and low accuracy of device data can affect the depreciation of data assets. Data utility U is a collection of factors that affect data value realization and is used to correct the return-on-investment R of data asset cost. Data quality, data circulation, and data value realization risk all have an impact on data utility U.

2.2 Data asset service revenue accounting method

The monetary value of data assets of grid corporations is measured based on expected earnings, and the expected future earnings are discounted to the current period's present value earnings through expected life and discount factors. The revenue approach assumes that the data assets are profitable in the future and have an inherent fixed value. Grid corporation data assets suitable for revenue accounting should meet the conditions that

(1) future earnings can be reasonably expected in monetary terms,
(2) the discount rate of expected earnings can be reasonably measured,
(3) the expected life can be determined or reasonably expected.

The revenue of data assets of power grid corporations refers to the monetary value that can be created by applying data assets under the influence of different usage scopes, usage scenarios, expected benefits, expected life, discount rate and application risks. The scope of use can be distinguished according to the specialty and hierarchy. The use scenario is based on the specific usage, openness, frequency of use, and update cycle, etc. The value of the same data resources in different use scenarios varies. Expected benefits refer to the economic and social benefits generated by the data in the process of use, where the economic benefits include the direct and indirect benefits obtained by the data user, and the social benefits are the benefits created by the data serving government departments or social welfare. The life expectancy needs to consider the natural benefit period and the compliance benefit period. The discount rate needs to consider the risk-free rate of return and the risk rate of return comprehensively. Application risks include management risks, circulation risks, security risks, ownership risks, compliance risks, supervision risks, etc.

Therefore, the data asset benefit accounting formula for grid corporations is

$$V_I = \sum_{i=1}^{n}\left(\sum_{t=1}^{m_i}\frac{R_{it}}{(1+r_i)^t}\right) \tag{3}$$

where r_i is the discount rate that converts expected future earnings to present value, calculated by the risk-free rate of return and the risk-return rate of the i-th application scenario, which reflects the financial cost of data assets. The discount rate can be determined by analyzing the interest rate and return on investment on the valuation base date, as well as the technical, operational, market and financial factors in the implementation of data asset rights. The discount rate of data assets can be determined by using the risk-free rate of return plus the risk-based rate of return. The discount rate of data assets is consistent with the caliber of expected returns.

m_i is the life expectancy of the i-th application scenario, which refers to the remaining time that the data asset is still capable of generating value, and is determined by the minimum of the natural return period and the compliance return period. When using the revenue approach to perform data asset valuation business, the revenue period needs to be determined by taking into account the duration of legal protection, the duration of the relevant contractual agreement, the generation time of data assets, the update time of data assets, the timeliness of data assets and the rights status of data assets. The revenue period shall not exceed the reasonable revenue period of the product or service.

V_I is the benefit of data assets to be evaluated, n is the number of application scenarios included in data assets, R_{it} is the expected return in year t for the i-th application scenario. Expected benefits from data assets are the additional benefits that result from the use of data assets, and cash flows from data asset benefits are the cash flows attributable to data assets after all benefits are deducted from the contributions of other assets. Expected benefits can be calculated based on transactions of data products and services, or the use of data to improve products and services.

Calculating expected revenue based on data product and service transactions

When the business model is based on data product and service transactions, such as pay-per-use data queries, authorized access to data, etc., the data assets are directly related to the products and services provided by the grid corporations, and the direct method or the difference method of the excess revenue model is suitable for estimating the expected revenue at this time.

Direct estimation model is given by

$$R_1 = [(P_2Q_2 - C_2Q_2) - (P_1Q_1 - C_1Q_1)] \times (1 - T) \tag{4}$$

where P_1 and P_2 are the prices of the product or service before and after using the data asset, Q_1 and Q_2 are the numbers of sales before and after using data assets, C_1 and C_2 are the average costs before and after using data assets, and T is the income tax rate applicable to the product or service.

Difference-based estimation model is given by

$$R_2 = \text{EBIT}(1 - T) - A \times \text{ROA} \quad (5)$$

where EBIT (1-T) is the profit after tax before interest on data products or services, A is the total amount of data assets, and ROA is the average return on assets for data products or services.

Using data to improve products and services to calculate expected revenue

When using data assets to improve one's products or services, the role of data is essentially the same as that of a patent, so it is appropriate to use the share rate method of assessing patents to determine the expected revenue. The share rate method includes the sales share rate method and the profit share rate method, which correspond to the promotion relationship of patents to sales and the promotion relationship of patents to profits, respectively, and the caliber of revenue calculation with a more stable relationship to data should be selected according to the characteristics of products or services and historical experience. For revenue measurement, it is recommended to adopt a combination of top-down and bottom-up methods to forecast the contents of the income statement (like product sales, unit price, production cost, manufacturing cost, administrative cost, selling cost) and, if necessary, the contents of the balance sheet, and then calculate profit/sales based on the forecast results. For the calculation of the share rate, it is recommended to evaluate the legal, technical and economic factors that have an impact on the share rate, determine the degree of influence of each factor on the value of the share rate, and then use the hierarchical analysis method to convert the scores of several experts into factor weights, and finally determine the share rate.

In the above equation, the discount rate can be calculated using the WACC inverse method or the cumulative method.

(1) Calculation of discount rate based on WACC inverse method

When comparable listed companies exist, the discount rate of intangible assets can be calculated using the WACC inverse method commonly used in asset valuation.

The calculation of WACC inverse method is given by

$$r_1 = \frac{\text{WACC-}w_c \times r_c - w_f \times r_f}{w} \quad (6)$$

$$\text{WACC} = r_e \frac{E}{E+D} + r_d(\text{1-T})\frac{D}{E+D} \quad (7)$$

$$r_e = r_k + \beta \times (r_m - r_k) + r_s \quad (8)$$

where r_1 is the discount rate, WACC is the weighted average cost of capital, w_c is the current asset weights, r_c is the return on current assets investment, w_f is the weight of fixed assets, r_f is there turn on fixed assets investment, w is the intangible asset weights, r_e is the return on equity investment, r_d is debt investment return, T is applicable tax rate, E is the equity value of comparable companies, D is the value of interest-bearing debt of comparable companies, r_k is the risk-free rate, r_m is the market return, and r_s is the special risk adjustment.

(2) Calculation of discount rate based on cumulative method

When the discount rate of data assets cannot be back-calculated using comparable listed companies, the discount rate of data assets needs to be calculated using the cumulative method, i.e., the discount rate is equal to the sum of the risk-free rate of return and the risk rate of return.

$$r_2 = r_0 + r_k \tag{9}$$

where r_2 is the discount rate, r_0 is the risk-free rate, r_k is the risk-return rate. The risk-free rate of return uses the most recently issued treasury bonds with a remaining maturity of more than 10 years to calculate the yield to maturity based on their coupon rates. The risk rate of return is the rate of compensation for the additional risk required by the organization that owns or controls the data assets to assume the risk. The risk factors need to be considered and the weights of each risk factor are determined using hierarchical analysis.

2.3 Data asset market value accounting method

Measuring the monetary value of data assets of grid corporations based on market value is to calculate the value of data assets under the premise of having a reference trading market, by selecting the prices of similar products or services transacted recently or in previous periods as a reference and correcting the influencing factors with specificity and individuality. The company's data assets suitable for market accounting should meet the conditions that the reference has an open market, the market transactions are more active, and the necessary transaction information is available.

Data assets of power grid corporations are circulated and traded in the market, and are influenced by supply and demand, historical transactions, etc. Supply and demand refers to the scarcity of data and market size, and its changes can cause data price fluctuations. Historical trading situation refers to the consumer price index at the point of trading in the industry to which the data belongs, and its changes can affect the value of data assets towards.

The formula for accounting for the market value of data assets of grid corporations is given by

$$V_M = \frac{\sum_{i=1}^{n}(V_i \times f(X_{i1}) \times g(X_{i2}) \times X_{i3} \times X_{i4})}{n} \tag{10}$$

where V_M is the cost of data assets to be evaluated, n is the number of data sets included in the data asset, V_i is the price of the i-th reference data set, $f(X_{i1})$ is an empirical function of the quality adjustment factor for the i-th data set, $g(X_{i2})$ is the empirical function of the supply and demand adjustment factor for the i-th data set, X_{i3} is the point-in-time adjustment factor for the i-th data set, and X_{i4} is the quantity adjustment factor of the i-th data set.

3 Data asset pricing model for grid corporations

In practice, the value of data assets is underestimated or overestimated by using the costing method, market approach and revenue approach. Compared with intangible assets, data assets also have the characteristics of "short validity, unlimited sharing and higher value of collective use". Each of the three traditional valuation methods is applicable to the valuation of data assets, but they also have limitations.

The costing approach is easy to understand, and the analysis method based on cost components is simple to calculate, and the calculation is based on cost summation. The limitation is that it is not easy to distinguish the costs corresponding to data assets, which are derivatives of production and operation, and for some data assets, there are no direct costs corresponding to them, and the apportionment of indirect costs is not easy to estimate. The revenue approach reflects the economic value of data assets and can reflect the correspondence between data assets and the related revenue. The limitation lies in the fact that it is not easy to estimate the license fee; the license fee rate of data assets has not yet formed a clear industry standard in the market, which is more difficult to estimate; the usage period is not easy to determine; data assets are dynamic, which leads to another difficulty in determining the usage period of data assets.The market approach can objectively reflect the current market situation of assets, and the evaluation parameters and indicators are obtained directly from the market, which is relatively real and reliable. The limitation is that an open and active market needs to exist as the basis.

Therefore, taking into account the characteristics of data assets and transaction scenarios of specific transactions, this paper uses the integrated method to weight the monetary value of data assets calculated by the costing method, market approach, and revenue approach. The pricing model for grid corporations is given by

$$V = \alpha_1 \times V_C + \alpha_2 \times V_I + \alpha_3 \times V_M \tag{11}$$

$$\text{s.t. } \alpha_1 + \alpha_2 + \alpha_3 = 1$$

where V_C is the monetary value of data assets calculated by the costing method, V_I is the monetary value of data assets calculated by the revenue approach, V_M is the monetary value of data assets calculated by the market approach, α_1 is the weight of the result from the costing method, α_2 is the weight of the result from the revenue approach, and α_3 the weight of the result from the market approach. In practice, according to the characteristics of data assets and transaction scenarios, all three basic methods mentioned above can be applied, or one or two of them can be applied, and the hierarchical analysis method is used to transform the scores of several experts into the weights of the three types of methods.

For example, a power grid company cooperates with external commercial institutions to develop data value-added services, and needs to purchase batch data. The main purpose of external commercial institutions using the data of power grid companies is to obtain greater profits through the data. Therefore, in this scenario, the grid company should focus on the market value-added benefits brought by data, and take this part of benefits into account in the pricing strategy. Therefore, according to the data asset pricing model designed above, the pricing strategy of data value-added services includes three aspects: costing approach, revenue approach and market approach. Among them, the cost approach, revenue approach and market approach are valued at 50000 yuan, 100000 yuan and 80000 yuan respectively, with weights of 0.2, 0.4 and 0.4 respectively. The final price of batch data is 82000 yuan.

4 Conclusions

As a new type of asset for power grid corporations, power data has certain generality but also has great specificity, which makes its value restricted and influenced by factors such as quality, application scenarios and legal ethics. In view of the fact that there is no mature and accurate data asset pricing method for power grid corporations, this paper proposes a comprehensive pricing model for data assets of power grid corporations based on a systematic review of common data asset pricing methods.

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