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Research on the Index System of Economic Activity Analysis under Electricity Reform

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Abstract. To take the initiative to adapt to the electric power system reform and steadily improve operating benefit, the State Grid Fujian Electric Power Company clarifies the impact of the electricity reform policy on the corporation's operational activities, actively explores the index system of economic activity analysis under the influence of the new electric power reform environment, quantifies the impact of the power grid reform on the corporation's production and operation, timely affirms achievements, reveals problems, improves internal management, increases efficiency, and assists the operational decision-making.

1. Introduction

With the deepening of the reform of electric power system, transmission-distribution price reform, incremental distribution liberalization and power-sold side reform are the key points of the new round power system reform, which have a profound and complex impact on the economic benefit of power grid corporation.

In recent years, economic activity analysis has become an important means for power grid corporation to master the production and operation process and operation results. Conventional analysis content is difficult to adapt to the changes of external environment and electricity reform policy, so it is urgent to explore the impact of the new situation of power reform on the economic benefit of power grid corporation. We build an index system of economic activity analysis under the situation of power reform, quantify and calculate its impact on the economic benefit of power grid corporation, which helps to improve the effectiveness and adaptability of the index system of economic activity analysis and support the formulation of operation and development strategies of power grid corporation.

2. Electricity Reform Policy's Impact on Power Corporation's Operating benefit

By studying the major electricity reform policy documents such as transmission-distribution price reform, incremental distribution liberalization and power-sold side reform, we comprehensively summarized and sorted out the mechanism of power grid reform's impact on the operational performance of power grid corporation. It lays a solid foundation for clarifying the key influencing factors and building the index system of economic activity analysis which adapts to the power grid reform.

2.1 The Impact of Transmission-Distribution Price Reform on the Operational Activities of Power Grid Corporation

Transmission-distribution price reform is one of the important measures to promote the marketization



of electricity power trading. It has an impact on the cost control and investment of power grid corporation.

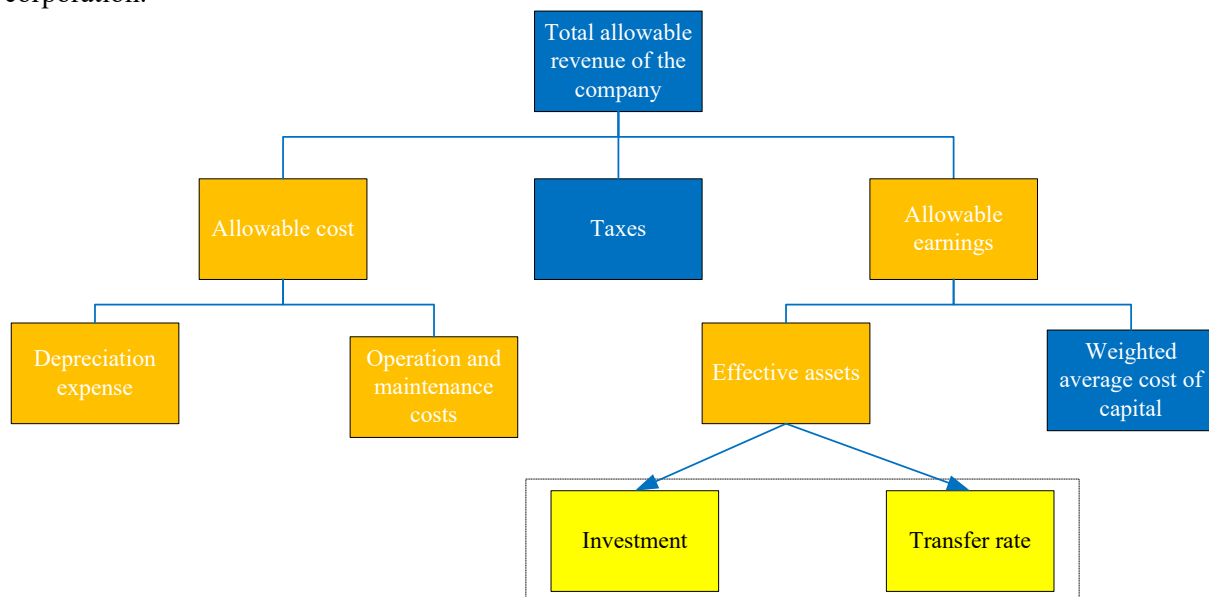


Figure 1. Important factors affecting the verification of transmission and distribution price

Firstly, we analyse the impact of transmission-distribution price reform on the cost control of power grid corporation. According to the requirement of transmission-distribution price reform for the approval of allowable cost, the regulatory authorities will strengthen the monitoring of the cost structure of power grid corporation, and identify specific quantitative requirements. The pressure of power grid corporation on cost control will increase. According to the pilot programme of transmission-distribution price reform in Shandong, Ningxia, Yunnan, Shenzhen and other places, power grid corporation has strengthened its management so that the actual cost is lower than the allowable cost, and part of the savings will be left to the corporation, and in the next regulatory period appropriate consideration will be given to rewarding power grid corporation by increasing the allowable rate of return.

Secondly, we analyse the impact of transmission-distribution price reform on grid investment. The level of transmission-distribution price affects the income and operating benefit of power grid corporation, and the level of operating benefit determines the size of interest-bearing liabilities, which in turn determines the size of investment capacity. The size of investment capacity affects the degree of financial security of the corporation's investment scale. Investment scale will affect the size and depreciation of effective assets, which in turn will affect the level of transmission and distribution price. Investment deviation can be divided into two categories, one is the total deviation, and the other is the timing deviation.

(1) In terms of total deviation, according to the current investment supervision regulations, if the actual new investment is lower than the approved new investment, 70% of the permitted income corresponding to the difference investment will be deducted, and reduce the identification of the scale of the effective assets of power grid corporation when entering the next regulatory period and, which may lead to the decline of the expected income of power grid corporation and the level of transmission and distribution price. If the actual new investment is higher than the approved new investment, the allowable earnings will not increase, so the deviation part cannot increase the income.

(2) In terms of timing deviation, if the investment or construction starts too early, the depreciation expense will incur in advance after the assets form, which means the effective assets size of the base period in the next period will decrease, thus affect the formation of the transmission-distribution price and actual profit.

However, if the investment is too late, it may not be able to turn into assets during this regulatory

period, and it will also affect the effective assets base of the next regulatory period, which is not conducive to the formation of electricity price.

2.2 *The Impact of Opening Power-Sold Side on the Operating Benefit of Power Grid Corporation*

With the further development of the power-sold side reform, the scope of the electricity purchase and sale business—traditional main business of power grid corporation, has been shrinking, which is determined by the price difference between purchase and sale acting on its operating benefit. So we urgently need to quantify the impact of the power-sold side reform on the operating benefit of electricity sale business of power grid corporation, and clarify the traditional electricity purchase and sale business differentiation form under the influence of the policy—bid-ask spread business, large user direct transaction, electricity sales business of electricity sales company. On the basis of understanding relevant policies, then we study its impact on the operating benefit of power grid corporation.

(1) The impact of bid-ask spread business on the operating benefit of Power Grid Corporation

Bid-ask spread business is the traditional electricity purchase and sale business of power grid corporation, which means that the corporation purchases electricity from various power sources according to the electricity price in the purchase catalogue, and then sells the electricity to various users according to the electricity price in the sales catalogue to obtain the electricity sales income. Under the influence of the electricity reform policy, the electricity sales business of power grid corporation may be compressed. In this study, the chain substitution method is adopted to calculate the influence of the change of electricity sold in the traditional bid-ask spread business and the change of relevant electricity price policy on the corporation's operating benefit under the influence of the electricity reform policy. The quantitative calculation logic is as follows:

$$J_1 = P_1 \cdot Q_1 = (P_i - P_j - P_s - P_g) \cdot Q_1$$

Among them, J_1 represents the gross profit of sale electricity in the bid-ask spread business;

P_1 represents the bid-ask spread;

Q_1 represents electricity sales in the bid-ask spread business;

P_i represents the average sale price;

P_j represents the average purchase price;

P_s represents line loss discount;

P_g represents government funds and surcharges.

Through the above formula, we can quantitatively calculate the impact of electricity and price change on the corporation's operating benefit under the influence of the electricity reform. The calculation formula is as follows:

Table 1. The Impact of Electricity and Price Changes on the Corporation's Operating Benefit under the Influence of the Electricity Reform Policy

Last period	Current period	Contribution of Incremental Profit	Practical meaning
$Q_0 \cdot P_0$	$Q_1 \cdot P_1$	$Q_0 \cdot P_0 - Q_0 \cdot P_0$	—
Chain substitution method			
The base period profit = $Q_0 \cdot P_0$			
1) Substitute factor1— $Q: Q_1 \cdot P_0$		The impact of changes in electricity sales on profits $= (Q_1 - Q_0) \cdot P_0$	Quantitative measurement of the impact of the change of electricity sale volume of the traditional bid-ask spread business on the corporation's operating benefit under the policy of transmission and distribution price.

2) Substitute factor 2—— $P: Q_1 \cdot P_1$	The impact of changes in average transmission and distribution price on profits $= Q_1 \cdot (P_1 - P_0)$	Quantitative measurement of the impact of electricity price policy on the corporation's operating benefit.
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Q_0, P_0 represents the previous data; Q_1, P_1 represents current data.

(2) The impact of large users' direct transaction on the corporation's operating benefit

The direct transaction of large electric power users refers to the trading activities that large users purchase electricity directly from power generation enterprises through independent negotiation or bidding, while power grid corporation only collects transmission-distribution price. The impact of large-user direct transaction on the corporation's operating benefit mainly depends on the loss caused by the game between the loss caused by the difference between transmission and distribution price and purchase and sale price difference and the increase in power transmission and distribution due to the decline in the cost of purchase electricity. The logic to quantify the impact of large users' direct transaction on the corporation's operating benefit is as follows:

① Assume that the sales quantity Q of power grid corporation is certain:

$$J_2 = (Q - Q_i) \cdot P_1 + Q_i \cdot P_2 = Q \cdot P_1 + (P_2 - P_1) \cdot Q_i$$

Among them, J_2 represents the transmission earnings of power grid corporation with direct transactions by large users;

Q represents the corporation's electricity sales;

Q_i represents the direct purchase of electricity by large users.;

P_2 represents approved average transmission and distribution price;

Through the above quantitative formula, it is obvious that

if $P_2 > P_1$, direct transactions by large users have a positive impact on the corporation's operating benefit;

if $P_2 = P_1$, direct transactions by large users have no impact on the corporation's operating benefit;

if $P_2 < P_1$, direct transactions by large users have a negative impact on the corporation's operating benefit.

② Assume that the transmission and distribution increases with the direct transaction size of large users:

$$J_3 = (Q - Q_i) \cdot P_1 + Q_i \cdot P_2 + Q_z \cdot P_2 = Q \cdot P_1 + (P_2 - P_1) \cdot Q_i + Q_i \cdot (q \cdot g) \cdot P_1$$

Among them, J_3 represents the benefit of power grid corporation;

Q_z represents the increase in electricity generated by large users directly trading to power grid corporation;

q is the electricity elasticity coefficient, and represents the percentage increase in electricity quantity caused by the reduction of purchase cost of 1 yuan in direct transaction;

g represents the average purchase price reduced by direct transaction.

(3) The impact of electricity sales business of power sales companies on the operating benefit of power grid corporation

The goal of the power system reform with the core of “controlling the middle and releasing the two ends” is to build a number of power sales entities, liberalize the user's choice and form a market structure of “multiple buyers and multiple sellers”. According to this, a large number of sales companies emerged.

For power grid corporation, power users are directly involved in the electricity market through the sale of electricity trading corporation agents, and power grid corporation charges electricity transmission and distribution price. If power grid corporation shares in the sale of electricity companies, then share participation in proportion to obtain dividends. The specific quantitative measurement logic is as follows:

$$J_i = (P_2 - P_1) \cdot Q_i - a_i \cdot N_i$$

Among them, J_i represents the impact of the size of the electricity company's transaction on the

sales revenue of power grid corporation;

a_i represents the shareholding ratio of the i -th electricity company held by power grid corporation;

N_i represents the net profit of the equity electricity company of power grid corporation.

2.3 The Impact of Incremental Power Distribution on the Operating Benefit of Power Grid Corporation

Incremental distribution network is the stock transformation and new construction of assets of non-grid enterprises. Its planning work is led by the government, meanwhile grid enterprises and social capital are encouraged to participate in the investment, construction and operation of incremental distribution network in the form of mixed ownership. According to the relevant policy requirements, there is a risk that the incremental power distribution market of power grid corporation's operating area will be squeezed by social capital.

For the incremental power distribution projects that power grid corporation does not participate in, the power grid corporation will lose all future benefit of them. For the incremental power distribution projects in which power grid corporation participates, the loss gains of power grid corporation are the gains from the shareholding ratio of other social capital. The specific formula is as follows:

$$J_z = p_i * q_i * (1 - b_i)$$

Among them, J_z represents the impact of the i -th incremental power distribution project on the operating benefit of power grid corporation;

p_i represents the distribution price of the i -th incremental power distribution project;

q_i represents the predicted power distribution of the i -th incremental power distribution project;

b_i represents the share of the i -th incremental power distribution project of power grid corporation.

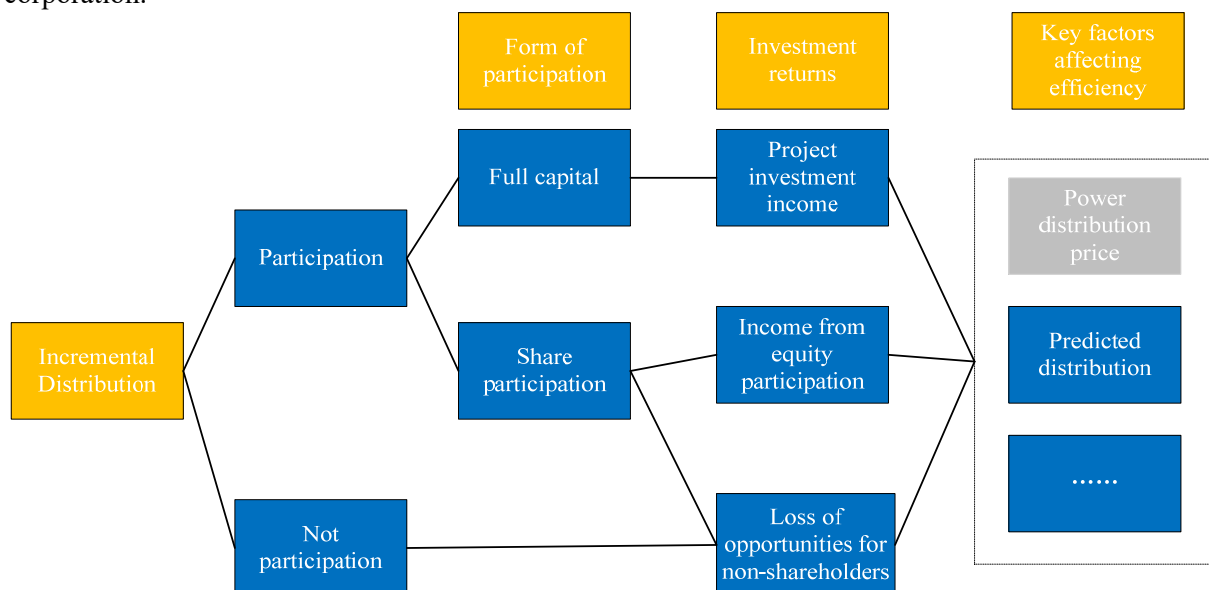


Figure 2. Mechanism of Incremental Distribution Affecting Corporate Operational Efficiency

3. Build New Indexes for Economic Activity Analysis Adapted to Electricity Reform

Focusing on the economic benefit of power grid corporation, we have sorted out the quantitative methods that influence the key factors on the operating benefit of power grid corporation based on different electric power system reform policies. Then, we construct an index system of economic activity analysis that adapts to the electricity reform, intuitively and quantitatively reflect the impact of the current environment on the economic benefit of power grid corporation, in order to accurately identify the key core factors that have an impact, and provide an effective analytical tool for power grid corporation's next strategy and development strategy. The specific index system is as follows:

Table 2. New Indexes for Economic Activities Analysis Adapted to Electricity Reform

Electricity Reform Policy	Evaluation Content	Quantitative Indexes
Transmission and distribution price reform	Analysis of factors affecting transmission and distribution price fluctuation	Monitoring permit cost (1) Deviation between the actual permitted cost and the approved permit cost (2) The impact of the permitted cost deviation on the transmission and distribution price
		Monitoring investment bias (1) Deviation between actual investment and approved investment (2) Impact of investment deviation on transmission and distribution price
	Monitor investment plan transfer rate	(1) Deviation between the actual investment plan transfer rate and the upper limit of the nuclear price transfer rate (75%) (1) The impact of changes in the proportion of large-scale direct-purchase electricity structure on the operating benefit of power grid corporation
		Electricity sales (2) The impact of changes in average transmission and distribution price on the operating benefit of power grid corporation
Electricity sales side reform	Monitor changes in electricity sales structure	(1) The impact of changes in the purchase structure of large-scale users' direct purchase business on the operating benefit of power grid corporation (2) The impact of changes in average price of electricity purchases on electricity purchase costs of power grid corporation
		Purchased electricity (3) The impact of changes in average price of electricity purchase on the operating benefit of power grid corporation
	The influence of electricity sales business of electricity sales companies on the economic benefit of power grid corporation	The influence of the size of the trading corporation's transaction on the operating benefit of power grid corporation
Incremental power distribution	Power grid corporation participate in the progress of incremental power distribution pilot projects	(1) Basic information of distribution network project: the number of participating projects, the mode of participation of the project, the proportion of shares held by the project, and the investment amount of the project, and the investment amount of the project (2) Investment feasibility index of incremental power distribution project: financial net present value, investment recovery period, financial internal rate of return
	Power grid corporation participate in the incremental economic distribution pilot project economic benefit	Impact of incremental power distribution projects on the economic benefit of power grid corporation

4. Conclusion

In this study, we study the main aspects of the impact of the electricity reform policy on the economic benefit of power grid corporation, and further analyse the impact of relevant policies on the operation of power grid corporation, clarify the quantitative indexes of relevant policies, and build the index system of economic activity analysis that adapts to electric power system reform. The application of the index system of economic activity analysis provides support for power grid corporation to fully grasp the economic benefit under the current environment, which is of great significance to help power grid corporation fully adapt to the environment and actively respond to national and industrial reform and development policy.

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References

- [1] Lin, B.Q. (2018) Promoting marketization is the key to a new round of power reform. China Securities Journal, A08.
- [2] JU, A.P. (2018) Research on price mechanism of market power sales of power grid enterprises. Knowledge-based economy, 7:76-77.
- [3] Gao, L. (2017) Analysis of economic benefit in power economic operation management. Low Carbon World, 31:251-252.
- [4] Mao, J.Y. (2016) Research on the Analysis of Economic Activities of Electric Power Enterprises. Science-Technology Enterprise, 3:62-63.
- [5] Sun, J.Q. (2015) Analysis and Application of Economic Activities of Electric Power Enterprises. Shandong Electric Power, 42(01):78-80.