Research on GEVA in iron and steel industry based on expected eco-efficiency under tighter resource constraints and serious environmental pollution

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Abstract: In the face of tighter resource constraints and serious environmental pollution, the country has stepped up efforts in industrial pollution control, and environmental protection requirements have continued to be strict, and the transformation of the industrial field to a resource-saving and environment-friendly industry is inevitable. The Green Economic value added (GEVA) indicator quantifies the environmental protection investment of enterprises, so that the impact of environmental factors on the enterprise performance is taken into account in the process of enterprise performance evaluation. GEVA avoids the shortcomings of traditional EVA evaluation indicators and builds a more comprehensive and objective performance evaluation indicator. The paper uses the calculation of Baoshan Iron & Steel Co., Ltd.'s GEVA to further verify the operability and suitability of GEVA, and proposes a guarantee for the application of GEVA. GEVA reasonably quantifies the environmental protection investment, effectively solves the problems that environmental factors are not considered in the enterprise performance evaluation, and makes the enterprise performance evaluation system more comprehensive and objective. Furthermore, it can prompt enterprises to actively strengthen environmental protection work, which has certain practical significance.

1. Introduction

1.1 Literature Review

1.1.1 EVA. Economic Value Added (EVA) was developed by Stewart (1991) based on the Residual Income (RI) indicator proposed by Edwards and Bell (1961). Since 2010, the State-owned Assets Supervision and Administration Commission (SASAC) has formally introduced EVA indicators as the performance evaluation indicator for the managers of state-owned enterprise (SOE), and has formulated detailed calculation and evaluation methods [1].

The use of EVA indicators to evaluate the performance of an enterprise can reflect the amount of wealth created by the enterprise, which is conducive to a more comprehensive and true understanding of its own actual situation [2, 3]. After the implementation of EVA assessment by SOEs, the level of cash holdings has dropped significantly, while the value of cash holdings has increased significantly; the positive management level of R&D expenses has increased, which has led to an increase in innovation efficiency [4, 5]. In addition, timely, comprehensive, and high-quality disclosure of environmental information by listed companies will increase the EVA of enterprises [6].

In the research on the revision and improvement of EVA indicators, scholars have made certain corrections to some existing shortcomings of EVA or made improvements according to different industries [7, 8]. In terms of EVA evaluation of central SOEs, it is recommended to design targeted and differentiated WACC according to different types of central SOEs [9, 10].

Bluszcz A et al. (2015) discussed the application of EVA in the metallurgical and mining industries. Compared with traditional indicators, EVA is more tentatively used in the performance evaluation of the industry because of the more comprehensive considerations [11]. Yin Weiping and Zuo Yatao (2019) analyzed how metallurgical companies can improve EVA and put forward suggestions for increasing investment in environmental protection and scientific research [12].

1.1.2 Green financial management. Scot D (1988) pointed out the importance of environmental factors and tried to reflect the environmental factors in the balanced score card [13]. Clarkson PM (2011) analyses and sorts out the results obtained by companies that carry out environmental strategies, and fully demonstrates the significance of green financial management [14]. Currently environmental protection for enterprise and industry development is important, and the impact of environmental factors can promote enterprises to have more core competitiveness in the industry [15, 16]. Henry (2018) pointed out that the green revolution is indispensable under the current ecological environment and discussed the necessity of the green revolution [17]. Wenqing Wu (2019) used empirical results to conclude that environmental protection factors have a certain impact on corporate financing [18].

Zhao Ying (2016) discussed the significance of the green financial management system in the practice of Chinese enterprises, provided suggestions and countermeasures for the development of the green financial management system, and provided a theoretical basis for promoting corporate accounting on the path of sustainable development [19]. Wang Jia et al. (2019) pointed out that in response to the call for green development, enterprises, as an important part of the country, should also make due contributions to improving resource utilization and protecting the environment. Therefore, to quantify the costs and benefits of enterprises in environmental protection, the establishment of a green financial management system is imperative [6]. Wang Aiguo et al. (2019) constructed a corporate green development performance evaluation index system from the three dimensions of economic performance, social performance and ecological environmental performance [20]. Wang Huogen et al. (2019) constructed a GEVA indicator, considering the impact of ecological factors on the basis of EVA, thus reflecting the true value of the enterprise [21].

1.1.3 GEVA. Kei Gomi and Koji Shimada (2010) believe that low-carbon economy is an inevitable trend, and GEVA is the product of this trend [22]. Nishiani K and Kokubu K. (2012) discussed why companies' environmental protection will increase the value of companies, and believe that the application of GEVA indicators will have a positive impact on companies [23].

Long Jing (2006) suggested that the green economy value-added efficiency (GEVAe) should be used as the evaluation index to set a new goal—the maximum of GEVAe, and conducted theoretical calculations and analysis [24]. Yang Tingrong and Ding Huiping (2017) discussed that expected eco-efficiency is the minimum efficiency requirement of ecological resource owners for the use of ecological resources by enterprises, and constructed a GEVA index based on expected eco-efficiency, and suggested that SOEs in high-energy-consumption and high-polluting industries should try out first. Trial GEVA assessment [25]. Zhang Xiaoyang (2018) calculated the value of GEVA with a case, and compared with traditional EVA to verify the applicability and operability of GEVA, and at the same time put forward suggestions for the smooth promotion and application of GEVA [26]. Gao Jinming (2019) introduces the concept of eco-efficiency, draws on the calculation of green GDP, and uses traditional EVA as the basis to adjust the capitalized environmental protection expenditure and expense environmental protection expenditure of the enterprise by calculating the actual value of the company's eco-efficiency and the difference between the actual value and the standard value [27]. Ruan Xinyi and Wang Bangjiang (2020) analyzed the impact of corporate environmental cost internalization on value creation, and added environmental consideration in EVA calculation to construct a GEVA to measure the implementation effect of corporate environmental cost internalization [28]. Zheng Liqun et al. (2009) explored the shortcomings of GEVA, and analyzed the feasibility of combining the GEVA with the balanced score card (BSC) to evaluate corporate environmental performance [29]. Taking the theory of sustainable development as the guiding ideology, they constructed an environmental performance evaluation index system. Starting from different perspectives, scholars calculated GEVA by various methods and studied the application of GEVA in enterprises.

1.2 Research Background

In the face of tighter constraints on resources and serious environmental pollution, the 17th National Congress of the Communist Party of China first proposed "building an ecological civilization", and the report of the 19th National Congress once again clearly pointed out that the modernization to be built is a modernization in which man and nature coexist harmoniously. The 19th National Congress of the Communist Party of China emphasized that environmental management and control should play a guiding role in green development, effectively guide enterprises to transform and upgrade, promote technological innovation, and move toward green production.

The steel industry has traditionally been regarded as a highly polluting and energy-intensive industry, which puts tremendous pressure on the environment. At present, the steel industry is promoting the industry's low-carbon, energy-saving, environmentally friendly, and intelligent technology innovation with unprecedented strength, and is gradually shifting from a stage of high-speed growth of production capacity to a stage of high-quality development. The future development direction of ironmaking technology is the development and application of low-carbon, low-cost process technology and smart manufacturing equipment technology, especially the relatively energy-saving non-blast furnace process and short-flow process, which is the future development direction of ironmaking [30].

Ecological resources achieve its goal of pursuing efficiency through the government's good allocation mechanism. In the government's ecological resource allocation mechanism, the expected eco-efficiency of the enterprise is its core content. Under this configuration mechanism, companies with higher eco-efficiency than expected will be more likely to obtain ecological resources, while companies with lower eco-efficiency will be more difficult to obtain ecological resources, and some companies with severely low eco-efficiency will be deprived of the right to use ecological resources.

However, EVA, as the annual operating performance evaluation index of SOEs specified by the SASAC, does not consider the expected eco-efficiency requirements of the owners of ecological resources. Environmental protection investment and environmental protection achievements are not included in the performance evaluation of SOEs, resulting in a lack of assessment of environmental input and output of SOEs, and it is not a good incentive for SOEs to take the lead in improving eco-efficiency. Therefore, it is necessary to construct and verify the operability and applicability of GEVA indicators.

1.3 Research Purposes and Methods

This article selects Baoshan Iron & Steel Co., Ltd. (Baosteel), a leading enterprise in the steel industry, as the case object, and verifies the applicability of GEVA in the high-polluting and high-energy-consuming steel industry by calculating Baosteel's GEVA in 2019 and comparing it with its traditional EVA. This article believes that the inclusion of environmental protection investment in the performance evaluation of central enterprises in the steel industry can more comprehensively reflect the company’s ability to create value, and it will also help improve management’s investment in environmental protection, help promote the disclosure of environmental protection data across the industry, and pass Perform performance evaluation on environmental protection data and provide preferential measures such as corresponding tax reductions to enhance corporate enthusiasm.

2. GEVA calculation method based on expected eco-efficiency

2.1 Calculation of EVA in the performance evaluation of SOEs

EVA refers to the difference between the net operation profit after tax (NOPAT) of the enterprise and the total cost of capital invested in the operation of the enterprise during a certain period. The traditional EVA formula is expressed as:

$$EVA = NOPAT – (WACC \times Capital\ employed) \quad (1)$$

Thus, EVA is mainly composed of three elements that are NOPAT, Capital employed and weighted average cost of capital (WACC). Interest-free current liabilities require almost no cost to the enterprise, so they are deducted from the adjusted capital. The SASAC has clearly stipulated the calculation of EVA. The calculation of EVA assessment is as follows:

$$EVA = NOPAT\text{-}Cost\ of\ Capital = NOPAT - Adjusted\ Capital \times WACC \quad (2)$$

$$NOPAT = Net\ profit + (Interest\ expenditure + Adjustment\ of\ R\&D\ expenses - Non\text{-}operating\ income \times 50\%) \times (1\text{-}Tax\ rate) \quad (3)$$

$$Adjusted\ capital = Average\ owner's\ equity + Average\ liabilities - Average\ interest\text{-}free\ current\ liabilities - Average\ construction\ in\ progress \quad (4)$$

2.2 Calculation of GEVA

This paper calculates the GEVA based on the expected eco-efficiency. When the actual eco-efficiency of a company deviates from the expected eco-efficiency, the traditional EVA needs to be adjusted according to the amount of corporate environmental protection investment that causes the eco-efficiency deviation. Since corporate environmental protection investment includes expensed environmental protection investment and capitalized environmental protection investment, their impact on EVA is different and needs to be treated differently when adjusting.

GEVA can be obtained by adding or subtracting the impact of environmental protection input on the traditional EVA. This article first calculates EVA, and then uses the "Wole Rating Method" to calculate the comprehensive score of the company's actual eco-efficiency relative to the expected eco-efficiency, and then calculates the difference between its environmental protection investments.

$$GEVA = EVA + adjusted\ value = EVA + Expensed\ environmental\ protection\ cost\ contributed \times (1 - Tax\ rate) + Capitalized\ environmental\ protection\ cost\ contributed \times WACC \quad (5)$$

$$Expensed\ environmental\ protection\ cost\ contributed = (Comprehensive\ score - 100) \times 100\% \times Expensed\ environmental\ protection\ investment \quad (6)$$

$$Capitalized\ environmental\ protection\ cost\ contributed = (Comprehensive\ score - 100) \times 100\% \times Capitalized\ environmental\ protection\ investment \quad (7)$$

3. Application of GEVA based on expected eco-efficiency in Baosteel

Baosteel has carried out a series of trials and practices in the field of environmental protection, such as reducing pollutant emissions, adopting various methods to eliminate solid waste, controlling harmful elements into the furnace, optimizing the use of energy resources, and achieving low-fuel ratio production in high furnaces. (Yang Jun and Hua Jianming, 2019; Li Jie, etc., 2019; Pan Zhaobin and Qiao Jun, 2020; Zhou Maojun and Zhang Daihua, 2020) Baosteel began to publish a sustainability report in 2011, and the information disclosure was relatively sufficient. Therefore, this article chose Baosteel as the case company.

3.1 Calculation of EVA

First, refer to the calculation of EVA in 2.1, we calculate the EVA value of Baosteel. Table 1 calculates NOPAT according to formula (3). Table 2 calculates the adjusted capital according to formula (4).

Table 1. Calculation of NOPAT in the enterprise in millions of Yuan.

Indicators	2019
Net profit	13,469.01
Interest expenditure	2,438.00
Adjustment of R&D expenses	8,864.00
Non-operating income	-520.55

NOPAT	22,335.93

Table 2. Calculation of Adjusted capital in the enterprise in millions of Yuan.

Indicators	2019
Average owner's equity	190,230.50
Average liabilities	147,156.30
Average interest-free current liabilities	93,671.66
Average construction in progress	8,116.51
Adjusted capital	235,598.64

The SASAC stipulates that the WACC used by SOEs to calculate EVA is 5.5%. According to formula (2), EVA=22,335.93-235,598.64×5.5%= 9,378.00 million yuan.

3.2 Calculation of GEVA

Baosteel's expensed environmental protection investment in 2019 was 6385 million yuan, and its capitalized environmental protection investment was 4330 million yuan. According to the pollution emission information disclosed by Baosteel, this article uses the total permitted amount of major pollutants of the company in 2019 as the baseline value. The Wole Rating Method is used to calculate Baosteel's comprehensive eco-efficiency score in 2019.

Table 3. Calculation of comprehensive score of Baosteel's eco-efficiency in 2019.

Indicators	Particulate matter (t)	Sulfur dioxide (t)	Nitrogen oxides (t)	COD in wastewater (t)	Ammonia nitrogen in wastewater (t)
Reference value	22670.90	30623.61	60582.02	2102.80	177.78
Actual value	9574.67	14426.25	37622.26	827.14	82.76
Relationship ratio	1.58	1.53	1.38	1.61	1.53
Weights	20.00	20.00	20.00	20.00	20.00
Subitem score	31.55	30.58	27.58	32.13	30.69
Comprehensive score	152.53				

From Table 3, it can be found that Baosteel's pollutant emissions are far below the policy permitted amount, and the excess environmental protection investment ratio is 52.53%. According to formula (6) and formula (7), the expensed environmental protection cost and the capitalized environmental protection cost contributed are 3,354.04 million yuan and 2,274.55 million yuan. According to formula (5), GEVA = 9,378.00 + 3354. 04 × (1-25%) +2274.55×5.5%= 12,516.01 million yuan.

4. Conclusions

Through the calculation of GEVA based on eco-efficiency, it can be found that GEVA based on eco-efficiency can consider the eco-efficiency requirements of eco-resource owners, reflect the company's environmental protection results on financial indicators, and truly reflect the company's ability to create value under resource and environmental constraints. The use of GVEA helps guide companies to reduce resource consumption, protect the environment, improve eco-efficiency, and achieve sustainable value creation and value growth. To objectively evaluate the value creation ability of enterprises to break through the constraints of scarcity of ecological resources, the following recommendations are put forward for the promotion and application of GEVA indicators:

First, GEVA can be used to evaluate corporate green performance on a pilot basis in specific industries, and then GEVA can be gradually promoted in all industries. Through the GEVA performance evaluation indicator, effectively supervise the company's energy conservation and emission reduction.

Second, in order to strengthen the comparability of GEVA data, it is necessary to further regulate the disclosure of industry environmental protection information. It is recommended that the calculation reference value be formulated in conjunction with the production standards that have been issued by the Ministry of Industry and Information Technology and the Ministry of Ecology and Environment, such as the total permitted amount of pollutants used in this article. Adequate and accurate corporate eco-efficiency information and environmental protection input information are the basis for calculating GEVA. The government must improve the confirmation, measurement, and disclosure systems of corporate eco-efficiency information and environmental protection input information.

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