Analysis on the influencing factors of the environmental management of Liaoning Industrial Enterprises

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Abstract

Environmental management has become a global strategy, widely used in the world. As high energy consumption high pollution industry, industrial enterprises need environmental management as part of the daily operation .This paper selects five explanatory variables to construct the multiple linear regression model .At significance level a = 0.05,the model were tested by a series of parameter estimation, heteroscedasticity, autocorrelation and multicollinearity. The results showed that the four indexes of total profit, R&D funds, industrial solid waste comprehensive utilization rate, the efficiency of the energy processing and conversion with environmental pollution total investment accounted for the proportion of GDP are related, total profit, industrial solid waste comprehensive utilization rate, efficiency of energy conversion and environmental management is positively correlated, however, R&D funds have negative correlation with the environmental management .Finally, this paper put forward the corresponding suggestions to promote the enterprise sustainable development .

Keywords

Industrial Enterprises, Environmental Management, Influencing Factors, Multiple Regression .

1. Introduction

Environmental management is a new concept on how to understand and solve the relationship between environmental problems and business activities. According to the theory of transaction cost, when the external transaction cost of environment is greater than the internal transaction costs, it needs to internalize the environmental cost and environmental cost is controlled in environmental self purification capacity, we call environmental management the environmental management activities [1]. Some scholars believe that environmental management is regarded as the new element of enterprise management strategy, the environmental protection activities are important aspects of the business activities and operations management. Procurement, development, design, manufacturing, waste disposal, etc, make corresponding environmental problems strategy gradually concrete to reduce investment in the water, energy, raw materials, chemical substances caused by management activity and tries to make the minimization of environmental load [2].

The concept of environmental management was first put forward by the Japanese scholar when the Japanese economic achieved rapid growth , but many enterprises one-sided pursuit profit to

accumulate capital and contempt for waste disposal and protection of resources and environment, not conducive to sustainable economic development[3] . Now the Japanese through environmental management idea, course of action and environmental management practices established a relatively perfect environmental management system to achieve a win-win between economic and environmental benefits, worthy of reflection and draw lessons [4]. In recent years, with the improvement of people improve natural environment calls for , sustainable development has become generally accepted by the world governments and commercial organizations. Environmental protection, and actively carry out social responsibility, efforts to achieve the harmony of "economic, environmental and social" has become a basic requirement of the enterprise management, and promoting environmental management is widely used throughout the world .And our country's current industrial enterprises as an important pillar of the national economy is also high pollution, high energy consumption of the industry, has a great impact on the environment. Now under the constraints of high environmental standards, industrial enterprises urgently need to change the way of development and learn from the Japanese ,which avoid the occurrence of major environmental disaster. In this paper, the author finds out the factors restricting the development of industrial enterprises through the multiple linear regression and further promotes the sustainable development of industrial enterprises.

2.　Literatures Review

About environmental management, many scholars studied its relationship with corporate performance, corporate value, such as Japanese scholars Tian Daolong which studied the relationship between the enterprise value and the implementation of environmental management in 2002. About the relationship between environmental management measures and the enterprise value, they put forward a theory hypothesis. Japan Chiba University of Commerce Itou Yasu (2001)believed that if the enterprises was due to some reasons which did not fully master necessary information to increase the profit ,with the introduction of environmental regulation or improved as an opportunity ,then it made it possible to explore the development of the technological innovation of cost management[5] . Kisaki Yangyi(2015) believes that lower the cost of economic results can be achieved by environment harmonious enterprises' positive measures for environmental problems[6]. World Council for sustainable development used empirical research and statistical methods to test the correlation between environmental management and enterprise value. Ricoh Group according to the 2003 ~ 2008 report on the environmental management in the enterprise environment accounting information, from business environment cost and the economic benefits, environmental benefits and environmental load project comparison of the environmental accounting and environmental indicators income ratio, environment effect rate, environment load profit rate and social cost profit rate of 4 index change demonstrates the Ricoh Group environmental management effectiveness .

Chinese scholars Zongwei Lv (2015) from the perspective of corporate culture , constructed the corporate culture and business environment value system,though it could alleviate environmental pressure in som links as procurement, development, design,etc,the concept of environmental management deeply root in the hearts of the people both increasimg the enterprise profit and promoting environmental protection[7] .

In view of the necessary input of environmental management, different scholars have put forward to different views in terms of cost management, Bingru Zhang, Niu Wei (2015) by "Internet plus"strategic platform, the use of the Internet information and big data technology, the various economic activities in enterprises for collection, storage, processing, transmission etc. which diversified of measurement and analysised, better playing the role of environmental management accounting[8]. Qiang Guo Qing (2015) proposed to enhance the competitiveness of enterprises by modifing the use of raw materials, improving environmental liability insurance system and external audit of the science to achieve cost control of the business environment [9].

About influencing factors for the business environment, the Japanese scholars Kono Hironori(2005) put forward to the "new business environment", that is so-called "new environmental management" refers to the behavior of environmental management is not only to improve environmental performance, but through considering the business environment to improve enterprise value. In this sense, the new environmental management is definitely not a special transaction, but should have been added to the business of enterprise management[10].Only in the "new environmental management" can be included in the ability to break (innovation) the potential of the enterprise itself . Fujitsu group in April 2009 began its unique environmental management consulting services. "Environmental management framework"used "①based on the environmental management, ② environmental assessment and response, ③environmental protection activities, ④information and communication, ⑤the monitoring, ⑥corresponds to IT "as the main field of about 100 evaluation standards, and conducted a comprehensive diagnostic reference to the goal enterprise environment operating conditions on this basis, besides, it provided opinions and suggestions for the target enterprise based on the diagnosis results . Our country scholar Aidong Liu (2013)used enterprise of Changzhutan city group as the research object, by sampling from the actual effective questionnaire data as a sample, using structural equation model to test and correct[11]. The result showed that the media pressure on the government does not directly drive the enterprise environment management behavior; corporate environmental management behavior need is driven by the market and the efficiency.

3. Model Building

3.1 Variable Selection and Hypothesis

In the current information disclosure system, environment information belongs to voluntary disclosure of information, in addition to a small number of enterprises sustainable development report or environmental reports, the majority of enterprises environmental information for text representation, it is difficult to find quantitative data. Therefore, the total investment of environmental pollution control in this paper accounts for the proportion of gross domestic product (%) to respond to the environmental management of the industry, expressed in Y. The flow of investment represents a strategic development direction of an enterprise, the more investment in environmental management, the more emphasis on environmental management, the better and the environment. In addition, through the analysis of the important factors influencing the enterprise environment , the author selects the total profit, R&D funds, industrial solid waste comprehensive utilization rate, the efficiency of the energy processing and conversion, the total investment of industrial pollution control, five indicators as independent variables to explain dependent variables , respectively expressed by X1, X2, X3, X4, X5 .

Through the literature, the author puts forward the following research hypothesis based on the research results of the majority of scholars at home and abroad, combined with the actual situation of China's industrial enterprises:

H1: Total profit and environmental pollution control investment accounted for the proportion of GDP was positively correlated.

Enterprise's goal is making a profit, if they have more profits, there will be more idle funds and enough ability to control pollution, which realize the enterprise's sustainable development. It is the an important indicator of environmental management.

H2:R&D funds and environmental pollution control investment accounted for the proportion of GDP was positively correlated.

R&D activities are the core elements of enterprise survival and development is an important factor affecting the economic development of enterprises and the upgrading of the level of technology. R&D are regarded as the life in international famous enterprises, all invested heavily in R&D. Therefore,

the increase in the funding of R&D will improve the level of corporate governance and governance capacity, the effect of environmental management will be better.

H3: The comprehensive utilization rate of industrial solid waste and environmental pollution control investment accounted for the proportion of GDP was positively correlated.

Industrial solid waste comprehensive utilization rate represents a circular economy highly developed. Higher comprehensive utilization rate , more possibility can realize good environmental condition, so it is positively related with environmental pollution total investment accounted for the proportion of GDP.

H4: The efficiency of the energy processing and conversion and environmental pollution control investment accounted for the proportion of total GDP was positively correlated.

The higher the efficiency of energy conversion is representing the higher energy use,which have an important impact for resource conservation and sustainable development, so it is positively related with environmental pollution total investment accounted for the proportion of GDP .

H5: The total investment of industrial pollution control and environmental pollution control investment accounted for the proportion of GDP was positively correlated.

Industrial pollution control investment is a necessary test conditions for environmental management, if industrial pollution control investment is better, more environmental problems will get governance and attention, and the environmental pollution total investment accounted for the proportion of GDP will be more.

3.2 Data Sources and Processing

Liaoning Province, as the eldest son of the Republic, the heavy industry base, is the typical representative of industrial enterprises. Taking into account availability of indicators and the reliability of regression analysis, this paper chooses the Liaoning Province all above scale industrial enterprises from 2003-2012 of 10 years of data. In order to ensure the objectivity of the data, all the data are derived from the statistical yearbook of Liaoning Province, the specific data see table 1. Data collection and input using EXCEL2007, regression analysis using Eviews7.2.

Table 1 Influence factors of the industrial enterprise environment management

Year	Environmental pollution control investment accounted for the proportion of total GDP (%)	Total profit (billion yuan）	R&D funds (million yuan）	The comprehensive utilization rate of industrial solid waste (%)	The efficiency of the energy processing and conversion (%)	The total investment of industrial pollution control(million yuan）
	Y	X1	X2	X3	X4	X5
2003	1.198	235.95	647622.00	39.94	73.3	2218281.00
2004	1.195	430.78	1085174.00	41.61	72.40	3081060.00
2005	1.291	355.98	1207888.00	38.1	74.70	4581909.00
2006	1.186	449.75	1621326.00	38.10	74.10	4839485.00
2007	1.274	852.67	2198162.00	39.01	75.40	5523909.00
2008	1.572	658.19	3013223.00	46.83	75.9	5426404.00
2009	1.542	1381.95	3054462.00	47.19	75.60	4426207.00
2010	1.896	2371.35	4021200.00	47.68	77.39	3969768.00

| *2011* | 1.504 | 2511.21 | 5126475.00 | 37.89 | 76.86 | 4443610.00 |
| *2012* | 1.589 | 2435.69 | 6278473.00 | 43.37 | 78.64 | 5004573.00 |

4. Empirical Analysis

4.1 Parameter Estimation

In view of the data is not obvious regularity, the author first use Eviews7.2 to carry on a simple graph analysis, according to the scatter plot rule, the author establishes the multiple linear regression model:

$$Y = \beta 0 + \beta 1 * X1 + \beta 2 * X2 + \beta 3 * X3 + \beta 4 * X4 + \beta 5 * X5$$

（β0,β1,β2,β3,β4,β5 as the regression coefficients）

Data has been established are substituted into regression model to fit, first through the test statistics exceeds (more or less) than the specific sample observations probability Prob value to determine the fitting results. If the Prob value is less than the given significance level (α =0.05), it is assumed that the original hypothesis may be established; if the Prob value is greater than the given standard, there is no sufficient evidence to support the original hypothesis.Eviews7.2 fitting results as shown below, known by the fig.1 Prob>0.05, apparently the results did not fit through the test, so the model must be modified. As explained Prob variable X5 maximum value, and then the variable Y respectively with the explanatory variables were fitted that be explained variable Y and explanatory variables X5 fitting degree minimum, Prob value reached 6.4915% .Thus industrial pollution control investment of the explanatory variables that influence is very small. Therefore, it is necessary to eliminate the factor X5. After the elimination of the explanatory variable X5 to remodify the fitting results as shown in Fig.2, we can see that Prob are<0.05 in 0.05 of the significant level through the regression coefficient estimates of the significant T test.

Secondly, the estimation of the regression equation about the goodness of fit of a sample observation value is tested, the test statistic is determinated by coefficient R^2 .If the value of R^2 is close to 1, Y is explained more by estimated from the regression equations , estimates of the regression equation of sample view of values is the better fitting; on the contrary, the value of R^2 closer to 0, Y is explained the less part by estimated from the regression equations , the estimates of the regression equation is fit to the worse with observation sample value known from Fig.2.Equation fitting degree is also high estimate that reached the 98.7559% and real values of the variables, quasi fitted and residual values are shown in Fig.3, the estimated equation is:

$$Y = -1.9024 + (2.41E - 11) * X1\hat{\,}3 - (1.32E - 14) * X2\hat{\,}2 + 0.0305 * X3 + (4.83E - 0.6) * X4\hat{\,}3$$

（-5.9374）（6. 1807）   （-5. 1140）   （9. 2052）   （5. 5100）   T

$$R^2 = 98.7559\% \quad DW=2.8572 \quad F=99.2248$$

Fig. 1 Estimation results of the model

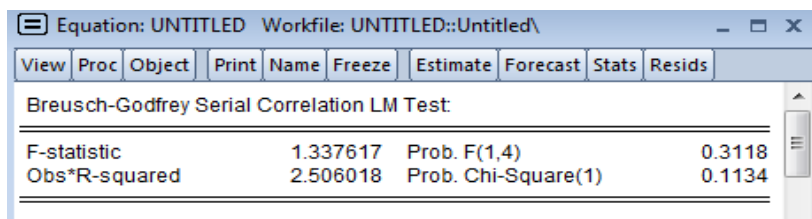Fig. 2 Estimation results of the modified model

Fig. 3 The real variables and fitted values and residuals chart

4.2 Model Checking

Model using the least square estimation method, there is a possible error about heteroscedasticity, self correlation or multiple universals under the assumption, so it is a necessary corresponding test to rule out the possibility of error. Tests for heteroscedasticity have graphic method, Goldfeld-Quandt test, white test, H.Glejser test, Spearman rank correlation coefficient test. The white test can use Eviews scientific operation to test heteroscedasticity. If the test Prob value > 0.05 are not heteroscedasticity, if Prob value < 0.05 are modified by using the weighted least squares method . There is no difference in the Prob=0.2387>0.05 of Fig.5. The self related test methods are illustrated by graphic method, Durbin-Watson test, LM test and regression test. And LM statistics can be used to establish a stronger applicability of the autocorrelation test method, which can not only test the first order autocorrelation, but also can be used to test the high order autocorrelation. It is proposed by Breusch-Godfrey, also known as B-G test. From Fig.5 we can see its Prob=0.1134>0.05, therefore, there is no correlation between the variables. The law of Klein test respectively linear regression with the other explanatory variables , and calculate the fitting goodness of R_1^2, R_2^2, R_k^2, where the fitting goodness and close to 1, indicating the linear relationship between the corresponding explanatory variables and all other explanatory variables significantly.It can be seen from Fig. 6 that the correlation coefficient is less than the goodness of fit, so there is no multicolinearity.
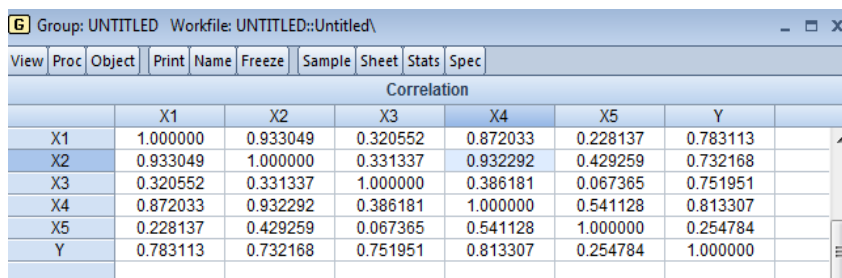

Fig. 4 White test

Fig. 5 LM test

Fig. 6 Multicolinearity test

5. Conclusion and Suggestions

5.1 Conclusion

By the final model fitting results show that the first four assumptions were established in the case of a significant level of α =0.05. Means total profit, R&D funds, the comprehensive utilization rate of the industrial solid wastes , the efficiency of the energy processing and conversion ,these four indexes and the total investment of the environmental pollution accounted for the proportion of GDP are related, and the total profit, the comprehensive utilization rate of the industrial solid wastes , the efficiency rate of the energy processing and conversion and has the positive relation with the environmental management, but R&D funds has the negative relation with the environmental management. On the Contrary to the initial hypothesis of the R&D funds , on the one hand dues to the long period of the research and development and the low rate of the technology transforming utilization ,and influence the effect of the environment management.On the other hand ,the lack of the high-quality scientific research person in our country now and the funds have not been reasonable used, causing it was not fully at work. Therefore, the enterprises should improve the economic benefit , improve the comprehensive utilization rate of the industrial solid wastes and the efficiency rate of the energy processing and conversion and keep or properly reduce the R&D investment fund.

5.2 Suggestions

According to the results of the empirical analysis, we conclude some influencing elements related to environmental management, so the author also give the enterprise some helpful suggestions to improve the level of the environmental management:

First: Improving the profitability of enterprises is the guarantee of the environmental management

Enterprises are with the goal of profiting maximum, enterprises in an industry, the higher the average level of profitability is, the stronger competitiveness of enterprises are, then the enterprise are in higher leading and exemplary role in the industry, accordingly enterprises will also be more willing to take on more social responsibility. Industrial enterprises as the mainstay of the national economy, maintaining sustained profitability can have the ability to improve equipment, clean the production, so the enterprise must take economic responsibility in an important position.

Second: Maintaining or reducing R&D funding in the existing resources

While raising the level of technology is helpful to improve the production efficiency, saving production cost and reduce the possibility of environmental pollution,the blind investment does not

improve the environmental management level of industrial enterprises. So the industrial enterprises should improve the level of environmental management, enhancing the environmental awareness of workers, attracting more innovative talents, establishing and improving the incentive mechanism,with the existing resources and technology and playing a higher level.

Third: Vigorously develop the circular economy

Wastes are misplaced resources, industrial enterprises as high resource consumption and high energy consuming enterprises, in resources and environment worsening today, should make the greatest possible extracting or transforming resources and energy which can be used .Do the harmless comprehensive utilization to them, reduce resource waste and production costs, to achieve the circular economy.

Fourth: The implementation of energy-saving measures

Energy saving is an important aspect of environmental management practice. Many enterprises emphasize on the combination of environmental protection and energy saving in the process of production and operation [12]. Energy saving measures of the enterprise, not only to assume the environmental accountability of the product, but also using the ability of technological innovation reflects the value of the interests of the customers, It makes either a good thing or a good virtuous cycle of business comes true, improving energy processing and conversion efficiency is exactly one of the beneficial approaches to save energy [13].

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