"Sustainable growth" or "growth with pollution"——research on economic growth patterns of industrial enterprise based on industry attributes

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Abstract. In recent years, protecting the ecological environment while developing the economy has become a widespread demand, but there is still a big controversy about the mode of industrial economic growth in China. This paper analyzes the growth pattern of China's industrial enterprises by using the micro data of enterprises from 2011 to 2018. On the one hand, industrial enterprises without pollution fees show higher sales growth rate, and this phenomenon is more obvious in high pollution industries such as mining industry and smelting industry, which proves the existence of "sustainable growth" pattern; on the other hand, among the industrial enterprises that are levied pollution fees, those with more pollution fees have higher sales growth rates, which shows that there is still a phenomenon of "growth with Pollution " in some polluting enterprises. These enterprises evade the responsibility of protecting the environment by paying the pollution fees, and in exchange for the growth of the company’s sales at the expense of the environment. This paper provides a reference for further promotion of energy saving, and selection of sales growth pattern for highly pollution industries such as mining industry and smelting industry.

1. Introduction
With the rapid economic growth in China, the Chinese government has also paid more and more attention to the protection and governance of the resource, environment and ecological environment, and has successively issued a series of environmental control policies. On July 1, 2003, the State Council formally implemented the "Administrative Measures on Collection Standards for Sewage Discharge Fees", and officially implemented the environmental protection tax in 2018. According to regulations, companies that directly discharge pollutants into the natural environment need to pay fees according. Therefore, whether or not the pollution fee is levied and the amount of the pollution fee reflects the degree of environmental pollution of the enterprise to a certain extent.

However, in the analysis of the number and proportion of companies that are levied their pollution fees, 6315 samples have been levied pollution fees from 24,386 samples. Although the absolute amount of pollution fees collected by these enterprises is relatively large, its proportion in the business income of these enterprises is still very small, and the average ratio is only 0.0027. Wang Jing[1] also found that most companies believe that pollution fees account for a small proportion of operating income, giving enterprises an incentive to implement a “growth with pollution" strategy.

The possible contributions of this article are as follows: First, most of the previous studies have not reflected the overall status of Chinese industrial enterprises from a macro perspective or through
questionnaire surveys and case analysis, and there is insufficient discussion on the micro-mechanism of economic growth patterns. Second, the study provides internal motivation and theoretical support for the "sustainable growth" pattern to reduce environmental pollution.

2. Theoretical analysis and research hypotheses

2.1 Analysis of environmental pollution and the growth pattern of enterprise

In general, there are two economic growth patterns, "sustainable growth" and "growth with pollution". Byrne[2] believes that economic growth often needs to come at the expense of environmental pollution, which leads to "growth with pollution". Smulder[3] believes that a good ecological environment is a necessary condition for the long-term sustainable development of the economy. In the long run, the sales growth pattern of micro-industrial enterprises largely determines the development mode of the entire macro-economy. Consumers generally prefer companies that adopt cleaner production technologies. In addition, while updating production equipment to reduce environmental pollution, companies may turn pollutants into treasure and increase their income[4]. This process has well-coordinated the relationship between sales growth and environmental protection, consistent with the "sustainable growth" pattern. But previous studies have found that the environmental pollution level of an enterprise is mainly determined by its production process and production technology[5]. This pattern is often at the expense of the environment and is consistent with the macroeconomic development pattern of " growth with pollution ".

Based on the above analysis, this paper proposes the following opposite hypotheses H1a and H1b.

H1a: Pollution fees will promote "sustainable growth" pattern.
H1b: Pollution fees will promote "growth with pollution " pattern.

2.2 Industry Attributes and Enterprise Sales Growth Pattern

The industry environment plays an important role in deciding the strategic decision of an enterprise, and the behavior of the enterprise will inevitably be affected by the industry characteristics. The possibility of environmental problems caused by heavy pollution industries and the degree of environmental damage are higher than those of low pollution industries, the impact of pollution fees on them is also more significant than that of low pollution industries. Therefore, this paper proposes the hypothesis H2.

H2: In high-pollution industries, the environmental pollution level of industrial enterprises has a more significant impact on their sales growth rate.

3. Research design

3.1 Samples and data

The article uses China's A-share listed industrial enterprises from 2011 to 2018 as a sample. The data on the company's pollution fees come from the corporate social responsibility report and environmental report, which are collected manually. The corporate financial indicators and annual report data are all from the CSMAR database. In order to ensure the reliability of the subsequent empirical evidence, the original data is screened: (1) ST, ST* and enterprises with missing values are excluded; (2) The tailing of 1% up and down is performed on important continuous variables. Finally, the annual observation value of 24,386 enterprises in the total sample is obtained.

3.2 Variable definition and description

3.2.1 Sales growth rate (SGR)

The environmental pollution level of an enterprise is largely determined by its production technology and production process, and it is difficult for industrial enterprises to completely update their production technology within two to three years. It can be assumed that the environmental pollution level of industrial enterprises will basically be within the next two years, so the article uses the average sales
growth rate for the next two years to calculate the sales growth rate.

3.2.2 Environmental pollution level (EPL)
We use pollution fees to measure their environmental pollution levels. Different companies often use different production technologies, which results in different pollutants. Enterprises that are levied pollution fees (EPLB) are counted as 1, and those that are not levied are counted as 0; among the enterprises that are levied pollution fees, the greater the pollution fees accounts for the total operating income (EPLP), the greater the impact on the enterprise.

3.2.3 Industry attributes (INDS)
Since the situation of the company's pollution fees can reflect its environmental pollution level to a certain extent, the article uses three indicators to compare the environmental pollution levels of various industries, “the proportion of enterprises charged with pollution fees in the industry”, “the average amount of pollution fees collected by enterprises”, and “the pollution fees accounted for the average business revenue proportion”. We use the principal component analysis method to construct a comprehensive indicator that can reflect the industry's overall pollution level.1

The principal components constructed here can explain the variance of 0.5349, which has a strong representativeness and can be used to analyze the overall environmental pollution level of the industry. Based on the above factor loads, the main component indicators of environmental pollution levels in various industrial sectors were calculated separately. The industry division is based on the two-digit industry code in the "National Economic Industry Classification" (GB/T4754-2017). "High pollution industries" include coal mining and washing industry (B06), ferrous metal mining industry (B08), non-ferrous metal mining industry (B09), non-metallic mining industry (B10), alcohol Beverage and refined tea manufacturing (C15), paper and paper products (C22), petroleum coal and other fuel processing industries (C25), chemical raw materials and chemical products manufacturing (C26). Among all 24,386 sample industrial enterprises, "high pollution industry" corresponds to 7,306 enterprises.

3.2.4 Control variable
In order to control the influence of other factors of the enterprise on the empirical results, the following control variables are set. We use the natural logarithm of the company's listed year to measure AGE; the enterprise’s solvency (LEV) is calculated by the asset-liability ratio, which is a measure of the company’s leverage; the larger the size of a listed company (SIZE), the more economies of scale, and the logarithm of the company’s total assets represents the size of the listed company; the nature of the company’s equity (SOE), when the listed company is a state-owned enterprise, the SOE value is 1; net asset income Rate (ROE) is a financial indicator that analyzes the efficiency of capital use.

3.3 Research pattern
We build model (1) (2). In the model (1), the dependent variable SGR represents the sales growth rate, the independent variable EPLB represents whether the company is levied pollution fees, and EPLP represents the proportion of pollution fees in the operating income. The model tests Hypothesis 1.

\[
\text{SGR}_{it} = \alpha_0 + \alpha_1 \text{EPLB}_{it} + \alpha_2 \text{AGE}_{it} + \alpha_3 \text{LEV}_{it} + \alpha_4 \text{SIZE}_{it} + \alpha_5 \text{SOE}_{it} + \alpha_6 \text{ROE}_{it} + \epsilon_{it}
\]

\[
\text{SGR}_{it} = \gamma_0 + \gamma_1 \text{EPLP}_{it} + \gamma_2 \text{AGE}_{it} + \gamma_3 \text{LEV}_{it} + \gamma_4 \text{SIZE}_{it} + \gamma_5 \text{SOE}_{it} + \gamma_6 \text{ROE}_{it} + \epsilon_{it}
\]

4. Empirical analysis

4.1 Descriptive statistics and Correlation analysis
The average value of SGR is 0.284; the average value of EPLB is 0.373, which means 37.3% of the

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1 In order to save the length of the article, the regression results of principal components are omitted. Interested readers can contact for detailed analysis results
enterprises are levied the pollution fees; the average value of $EPLP$ is 0.0027, and the proportion of pollution fees of the sample enterprises is very small. Among the control variables, the average value of $AGE$ and $LEV$ are 2.844 and 0.440; the average of $SIZE$ is 22.14; the average value of $SOE$ is 0.345, it shows that there are more private listed companies than state-owned enterprises in this sample.

4.2 Correlation analysis

The correlation analysis test results show that the correlation coefficients of $SGR$ to $EPLB$ and $EPLP$ are 0.028 and 0.067, both of which are significant at the 1% level. The absolute values of the coefficients are relatively small, and the model does not have obvious multicollinearity problems.

4.3 Regression analysis

4.3.1 $EPLB$ as the independent variable

Based on model (1), multiple regression tests the relationship between $EPLB$ and $SGR$, as shown in column 1 of Table 1. The regression coefficient is -0.183, which is significant at the level of 1%, indicating that the sales growth rate of polluting enterprises is relatively low. The market prefers environmentally-friendly production companies that adopt the "sustainable growth" pattern.

The second column in Table 1 reports the regression results when $EPLB$ is used as the independent variable in the "high pollution industry". The regression coefficient of $EPLB$ is -0.206, which is statistically significant at the level of 1%. The absolute value of the regression coefficient is greater than the absolute value of the coefficient in the full sample regression, indicating that the environmental pollution level of industrial enterprises in high-pollution industries has a stronger impact on its sales growth rate.

In order to examine this effect more precisely, we further constructs the regression of the cross-terms of the variables $EPLB$ and $INDU$. The third column of Table 1 reports the corresponding regression results. At this time, the full sample is used for regression. The regression coefficient of $EPLB$ is -0.181, which is significant at the 1% level. This result further corroborates that the environmental pollution level of companies in "high pollution industries" has a stronger influence on their sales growth rate.

| Table 1 Multiple linear regression |
|-----------------------------------|
|                                | (1)          | (2)          | (3)          | (4)          | (5)          | (6)          |
|                                | SGR          | High pollution industry sample | Full sample | SGR          | High pollution industry sample | Full sample |
| $EPLB$                  | -0.183***    | -0.206***    | -0.181**     | 6.108***     | 6.184**      | 5.34**      |
| $EPLB*INDU$              | -0.730***    | -0.196***    | -0.729***    | -0.114**     | -0.0650      | -1.159      |
| $EPLP$                   | 0.0576       | 0.0690***    | 0.0574       | 0.142***     | 0.434***     | -6.468***   |
| $EPLP*INDU$              | 0.249***     | 0.101***     | 0.249***     | 0.0227       | 0.0253       | 1.266*      |
| $AGE$                    | 0.188*       | 0.960***     | 0.188*       | 0.456***     | 1.228***     | -1.044      |
| $LEV$                    | 0.0682       | -0.0252      | 0.0672       | -0.0290      | 0.0282       | 0.257       |
| $SOE$                    | -0.0101*     | -0.00229*    | -0.0101*     | -0.00332     | 0.00761      | -0.0942     |
| $ROA$                    | 24386        | 7306         | 24386        | 6315         | 3211         | 6315        |
| $F$                      | 27.25***     | 19.37***     | 22.68***     | 30.55***     | 24.63***     | 21.84***    |
| Adjusted-$R^2$           | 0.1613       | 0.0866       | 0.0843       | 0.1005       | 0.0915       | 0.1582      |

4.3.2 $EPLP$ as the independent variable

The second independent variable used in this paper is $EPLP$. This variable is only measured for 6315 industrial enterprises. The fourth column of Table 1 reports the regression results when using $EPLP$ as the independent variable. The regression coefficient is 6.108, which is significant at the level of 1%. The regression results indicate that the more polluted the companies are, the higher the future sales growth
rate will be.

The fifth column in Table 1 uses a sample of "high pollution industry" to verify the proposition. The regression coefficient of EPLP is 6.184, which is statistically significant at the 5% level. This regression coefficient is higher than the regression coefficient in the entire sample. We also attempts to use the cross-term of EPLP and IND at regression, but the regression coefficient of the cross-term is not significant. This may be due to the fact that industrial companies need to pay high pollution fees while discharging pollutants.

Comprehensively considering the results, it can be found that the phenomenon of "sustainable growth" and "growth with pollution " coexist in the sales growth process of Chinese industrial enterprises. Overall, the market favors environmentally friendly industrial companies that use cleaner production technology. At the same time, some polluting enterprises did not reduce pollution by adopting clean and environmentally friendly production technology, but by paying fees to achieve legal sewage discharge. This phenomenon of achieving enterprise growth at the expense of the environment deserves special attention.

5. Conclusion
The article analyzes the impact of the company's environmental pollution level on its sales growth rate, analyzes the sales growth pattern of Chinese industrial enterprises, and studies the impact of pollution fees on mining and other highly polluting industries. The study found that environmental protection industrial companies that have not been levied pollution fees have achieved higher sales growth rates, which shows that China currently has an external market environment to achieve "sustainable growth", and this effect is more significant in high-pollution industries; For enterprises that are levied pollution fees, the higher the amount of pollution fees, the higher the future sales growth rate, which shows that in some polluting industrial enterprises, the phenomenon of "growth with growth" still exists.

Both "sustainable growth" and "growth with pollution" coexist, which shows that there are some obstacles and difficulties in the process of industrial enterprises' transition from "growth with pollution" to "sustainable growth" pattern. In order to achieve for the long-term sustainable development of China's economy, it is necessary for the government to take measures to encourage energy conservation and environmental protection, and urge enterprises to change the "growth with pollution" pattern.

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