Research on the Evaluation of the Developmental Potential in Guangdong's Listed High-Tech Enterprises under the Policy of Guangdong-Hong Kong-Macao Greater Bay Area

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Abstract. In order to make a scientific evaluation on the development potential of the listed high-tech enterprises of Guangdong-Hong Kong-Macao Greater Bay Area, providing useful advice for investors, enterprises and government, this paper put forward the significant concept of development potential evaluation system of the listed high-tech enterprise in Guangdong-Hong Kong-Macao Greater Bay Area. Combined with the analytic hierarchy process and the entropy method, we determined each indicator with weight, summarized the information of indicators and examined the status of developmental potential of the high-tech enterprises for each year.

1. Introduction

The Development Plan for Guangdong-Hong Kong-Macao Greater Bay Area (Greater Bay Area) officially announced by the Central Committee of the Communist Party of China and the State Council on February 18th, 2018 will guide the cooperation and development of the Greater Bay Area in the current and future period. The blueprint of the construction of Greater Bay Area is shifting from a vision to an action.

Creating a globally influential international science and technology innovation center is one of the core goal of the construction of Greater Bay Area. High-tech enterprises are the main driving force to achieve this goal. With the support of the government, the main economic indicators of high-tech enterprises in Greater Bay Area are increasing steadily, and the strength of innovation and scientific research are constantly improving. Status of high-tech enterprises in the national economy has been increasingly prominent. Although there is a sound management system for high-tech enterprises in China, their methods for evaluation are relatively few and not systematic. It requires a scientifically objective evaluation system to comprehensively reflect the level of their development potential, if high-tech enterprises have a desire for further development under the policy. The establishment of a development potential evaluation system for listed high-tech enterprises is of great significance to not
only the secondary market investors but also the financial environment and policy making in the entire Greater Bay Area.

2. The Situation of Greater Bay Area and Study on the Necessity of the Development Potential Evaluation System

2.1. The Implementation of the Policy in Greater Bay Area

The excellent geographical environment, economic developing situation with high-growth rate and powerful scientific research strength in the Pearl River Delta region have encourage Central Committee of the Communist Party of China to build and perfect this region further and form the concept of building Greater Bay Area. The strategic deployment of Greater Bay Area is a new policy planned and promoted by President Xi Jinping, which is a further implementation of the policy of reform and opening up. In addition to Guangzhou, Foshan, Shenzhen, Zhuhai, which are economically strong cities in the Pearl River Delta region, Greater Bay Area also includes Huizhou, Dongguan, Zhongshan, Jiangmen and Zhaoqing, and two special administrative regions, Hong Kong and Macao. The Nine cities of Guangzhou, Foshan, Shenzhen, Zhuhai, Huizhou, Dongguan, Zhongshan, Jiangmen and Zhaoqing is referred to as Nine City. The strategy of Greater Bay Area will take full advantage of the rich resources of Greater Bay Area from the aspects of industry, technology, finance and education, for the sake of the further development of economy, politics and people's livelihood.

2.2. Study on the Necessity of the Development Potential Evaluation System

According to China Torch Statistical Yearbook 2018, the total number of high-tech enterprises in Guangdong has reached more than 30,000, ranking first in the China. The main economic indicators are in the forefront of the country. As things stand, most of the high-tech enterprises in Guangdong belong to manufacturing industry, with output value accounting for more than 80% of the province’s. From the perspective of the distribution of technology field, only about 40% of enterprises belong to the field of electron and information technology, with more than 60% industrial output. High-tech enterprises in Guangdong are the core of science and technology innovation in Guangdong, playing an extremely important role in technological innovation.

In recent years, businessmen in Hong Kong have invested more in the Pearl River Delta region, but relatively fewer in other cities in Greater Bay Area. Therefore, for a brighter future of high-tech enterprises in Guangdong, it is necessary to form a scientific development potential evaluation system for listed high-tech enterprises, in order to provide more objective evaluation criteria. This evaluation standard helps enterprises to recognize their financing needs, financial level, innovation level, and their industry status. The listed high-development potential evaluation system designed in this paper will help institutional investors in Hong Kong and Macao to quickly screen enterprises with good development potential in the market, providing favorable conditions for constructing financial ecosystem in Greater Bay Area. Our evaluation criteria will also help the government finance department to rationally allocate financial subsidies and preferential tax resources, scientifically supporting high-tech enterprises at different development stages for the sake of maximizing the economic benefits of the Greater Bay Area policy.

3. Related Work

The theories, methods and technologies of evaluation systems for enterprise are increasingly sophisticated at home and abroad. Alexander Wole [1] first proposed the concept of credit ability, which is called Wall Method. This method is used for credit evaluation of enterprises, but fails to reasonably explain the reasons for the selection of each evaluation indicator and the basis of determining weight. Li Chun [2] proposed the concept of financial index of listed company in China, reflecting the financial status of listed companies in China, but the paper only study on 11 periods of financial indexes, which limits to research on the index further. Learning from the theories and methods of IMD international competitiveness evaluation combined with actual situation of Chinese enterprise development, Pang
Jingan [3] built Innovative Development Diamond Evaluation Model with three dimensions of innovation foundation, innovation capability, and innovation activity and innovation performance.

With the rise of subject integration, theories and methods of statistics are widely used in the field of enterprise evaluation. Li Wenbo [4] proposed a comprehensive evaluation index system for capability of technological innovation based on BP network. Wang Yudong [5] put forward the evaluation index system of capital operation performance of high-tech enterprises based on radial basis function neural network. However, both of the methods pay too much attention to the method innovation of the index establishment, some indicators are even selected to be result-oriented and lack of theoretical logic.

Kaplan and Norton's first book [6] on balanced scorecard marked the advent of a balanced scorecard for evaluating organizational performance. Since then, more and more enterprises have used the balanced scorecard. For example, unlike the traditional KPI management, Bright Dairy [7] has successfully improved corporate performance by establishing performance evaluation system which is agree well with its strategic objectives through a balanced scorecard. At present, domestic and international research generally applies balanced scorecard to personnel performance appraisal and enterprise performance evaluation. Balanced scorecard has a profound theoretical foundation. The construction of the development potential evaluation system of listed high-tech enterprises in this paper should also follow the balance between indicators based on balanced scorecard.

4. Study on the Model of the Development Potential Evaluation System of Listed High-Tech Enterprises in Greater Bay Area

4.1. Theoretical Study on the Model of the Development Potential Evaluation System of Listed High-Tech Enterprises in Greater Bay Area

First of all, this paper defines the development potential evaluation system of listed high-tech enterprises in Greater Bay Area (DPELH) as a system which evaluate the development potential and the future growth rate of the listed high-tech enterprises in Nine Cities comprehensively, based on the scientific scoring method. In this regard, this paper rationally selects the indicators which reflect the development potential of listed high-tech enterprises in Nine Cities, scientifically determine weight for each dimension and indicator, comprehensively refines the evaluation information of the development potential of enterprises, and finally presents the synthesis score in a dynamic form, comprehensively reflecting the development trend of listed high-tech enterprises in Nine Cities. According to the development characteristics of high-tech enterprises, we summarizes four dimension for the evaluation system: operational financial dimension, innovation and growth dimension, financing needs dimension and industry status dimension.

4.1.1. Operational Financial Dimension is an Important Dimension for the Development of Listed High-Tech Enterprises. From the perspective of enterprise value, the main driving force for the development of high-tech enterprises is its financial status and profitability. We mainly considers the business level of high-tech enterprises and evaluates it from the financial aspect. Financial data can intuitively reflect the production and operation status of an enterprise. Financial data of enterprises is the basic information for enterprise managers, secondary market investors and the government to understand the development status of enterprises. Therefore, operational financial data is an important reference information for evaluating the development potential of listed high-tech enterprises in Greater Bay Area.

4.1.2. Innovation and growth is the Core Topics for the Listed High-Tech Enterprises in Greater Bay Area. For all the industries involving high technology, its sales volume or business volume are both driven by technology. While technology products can attract market's attention, enterprises also need continuous strong scientific research and technical inputs. The strength of scientific and technological innovation often indicates the status of an enterprise in its industry, so the ability to innovate and growth is the main core competitiveness for high-tech enterprises.
4.1.3. **Financing Needs Drives Development of Listed High-Tech Enterprises in Greater Bay Area.** All kinds of enterprises have Financing Needs in each development stage, and their financing has different characteristics. As the scale of an enterprise getting larger and larger, the enterprise enters the growth period. Its management team is increasingly mature, and the scale of production and operation needs to be expanded. In the case of insufficient internal financing, if a high-tech enterprise wants to further expand the production line or invest in research projects, external fund support is absolutely necessary, whether it is equity financing or bond financing. The level of financing needs reflects the level of growth space of an enterprise. On the other hand, Greater Bay Area policy can provide financial assistance for high-tech enterprises with financing needs. With good financial support, the greater the financing needs of enterprises, the more financial support they can get from financial institutions and the better development quality. Therefore, the financing needs of enterprises are an important aspect to evaluate the development potential of enterprises.

4.1.4. **Industry Status of Listed High-Tech Enterprises in Greater Bay Area.** The position of an enterprise in the industry reflects the external influence factors on the development of enterprises. The industry status of an enterprise represents the its competitiveness, reflecting whether the company has a competitive advantage in the industry. In order to seek benefits and achieve long-term development, enterprises should not only consider their self-factors, but also their industry status.

4.1.5. **Idea of Model Construction.** In addition to considering the current operating conditions and innovative capabilities of an enterprise, the DPELH also focuses on financing needs and industry status. Driven by the technological innovation and financial support in Greater Bay Area, high-tech enterprises possess broad development space, so that our evaluation system should focus on the future performance of an enterprise. As a result, our evaluation system includes operational financial dimension, innovation and growth dimension, financing needs dimension and industry status dimension.

4.2. **Model Design of the Development Potential Evaluation System of Listed High-Tech Enterprises in Greater Bay Area Based on Balanced Score Card**

Different from the application of balanced scorecard to the traditional performance indicator system, following the principle of balance between the indicators and combining the characteristics of high-tech enterprises in Greater Bay Area, we establishes DPELH, which can be seen as Table 1.

**Table 1. Development Potential Evaluation System of Listed High-Tech Enterprises in Greater Bay Area**

| Dimension                  | Indicator                                      |
|----------------------------|-----------------------------------------------|
| Operational Financial dimension | Total Assets Turnover<br>Return on Equity<br>Gross Profit Margin<br>Operating Cash Flow/Gross Sales<br>Year-on-Year Growth in Gross Sales<br>Comprehensive Tax Rate (Tax Payments/ Gross Sales) |
| innovation and growth dimension | The Number of Patent<br>R&D/Gross Sales<br>Intangible Assets/Total Assets |
| financing needs dimension | Current Assets/Total Assets<br>Fixed Asset /Total Assets<br>Debt to Asset Ratio<br>Financing Constraints |
| industry status dimension | Gross Sales/Industry Average Gross Sales<br>Total Profits/Industry Average Total Profits<br>Product Market Share |
For indicators in the operational financial dimension, year-on-year growth in gross sales is a long-term indicator, while other indicators are all short-term indicators, which in line with the principle of “long-term indicators and short-term indicators balance” in balanced scorecard. Financing constraints and the number of patent are non-financial indicators, while others are financial indicators, according with the principle of “financial and non-financial indicators balance”. Indicators in industry status dimension are external indices, whereas indicators in other three dimensions are internal indicators, conforming to the principle of “internal and external indicators balance”. Indicators in innovation and growth dimension belong to driven indicators, meanwhile indicators in other three dimensions are consequential indicators, in accordance with the principle of “driven and consequential indicators balance”. Consideration of our evaluation system has been given to four principles of balanced scorecard. Therefore, our evaluation system is rational and scientific.

4.3. Research Design

4.3.1. Sources of Data. The research objects of this paper is the listed high-tech enterprises in Nine Cities from 2010 to 2018. Excluding ST enterprises and enterprises with a large number of missing indicator data, we selected 333 listed high-tech enterprises as research samples. The annual reports of enterprises come from CNINF, and the rest of the data mainly comes from Wind and Choice. Based on the actual situation, the missing indicator data is completed by annual industry average or 0.

4.3.2. Construction of Indicator of Financing Constraints. Currently, there are no unified metrics and methods for measuring the value of financing constraints. Referring to Hoherg’s [8] and Jiang Fuxiu’s [9] papers, we selected ten industries and four boards of the main board of Shanghai Stock Exchange, the main board of Shenzhen Stock Exchange, Growth Enterprises Market Board and Small and Medium Sized Enterprises Board. Excluding annual reports of ST enterprises, we finally got 20227 annual reports of 3060 enterprises from 2010 to 2018 for constructing the indicator of Financing Constraints through text analysis.

Firstly, we extracted the content of Management Discussion and Analysis (MD&A) from each annual reports, and respectively classified them by year, by industry annual and by board annual. According to the description of enterprises’ funding status in MD&As, we designed a set of regular expression to extract the information of financing constraints implied in MD&As. And include MD&As with information of financing constraints in the corresponding annual text set of financing constraints (FC set). Then, take all the unique words in all the MD&As as entire corpus, construct word frequency vector for every MD&A and normalize each word frequency vector. The normalized word frequency vector of enterprise i in year t is denoted as Vect_{i,t}.

ConstrainedScore_{i,t} = Vect_{i,t} \times ConstrainedVect_t

ConstrainedScore_{i,t} is the similarity between MD&A of enterprise i in year t and FC set in year t. Next, we normalized respectively the mean of normalized word frequency vectors of MD&As, belonging to FC set of year t (t=2010, 2011,…, 2018), and got ConstrainedVect_t. We make

ConstrainedScore_{i,t} = Vect_{i,t} \times ConstrainedVect_t

BoilerplateScore_{i,t} = Vect_{i,t} \times BoardVect_{b,t}

BoilerplateScore_{i,t} represents the similarity caused by common information. Similarly, we can get IndustryScore_{i,t} which is the similarity caused by industry characteristics. Finally, we got the value of financing constraints through multiple regression.
\[ \text{ConstrainedScore}_{i,t} = \beta_0 + \beta_1 \text{BoilerplateScore}_{i,t} + \beta_2 \text{IndustryScore}_{i,t} + e_{i,t} \]  

(3)

Residual \( e_{i,t} \) is the value of Financing Constraints we want.

4.3.3. Determining Weight. This paper combines objective weight with subjective weight to determine weight. The specific ideas are as follows.

(1) Based on Table 3.1, we designed Development Potential Evaluation System of Listed High-Tech Enterprises in Guangdong-Hong Kong-Macao Greater Bay Area Construction Questionnaire in order to get importance score of each indicator. The questionnaire indicates the importance of the indicator by 1-5 points. The higher the score, the more important the indicator is in the system.

(2) We choose the average of weight of each dimension in the questionnaire as the weight of each dimension. The weights of the four dimensions of operational financial dimension, innovation and growth dimension, financing needs dimension and industry status dimension are 0.2637, 0.3637, 0.1799, 0.1927.

(3) We use Analytic Hierarchy Process to calculate subjective weight. Hierarchical model is as Figure 1.

We used the mode of score in questionnaires as indicator score. Combined with the result of the questionnaires, based on Analytic Hierarchy Process with Three Scale Standard, we applied optimization transferring matrix to transfer scale matrix under each dimension to optimal transfer matrix, and calculated subjective weight of each indicator under their dimension.

(4) Using Entropy Evaluation Method to calculate objective weight

(5) Using the linear weighting method to combine the subjective weights with and objective weights, the final weight of each indicator \( w_k \) is

\[ w_k = \varphi p_k + (1 - \varphi) q_k \]  

(4)

0 ≤ \( \varphi \) ≤ 1 is an undetermined coefficient, \( p_k \), \( q_k \) represent subjective and objective weights respectively. We choose \( \varphi = 0.5 \). The final weight of each indicator is as Table 2.
Table 2. The Final Weight of Each Indicator under DPELH

| Dimensions                  | Indicators                              | Names        | Weights | Name                          | Weights under Dimensions | Indicator Weights |
|-----------------------------|-----------------------------------------|--------------|---------|-------------------------------|--------------------------|-------------------|
| Operational Financial       |                                         | Financial    | 0.2637  | Total Assets Turnover         | 0.2230                   | 0.0588            |
| innovation and growth       |                                         | Return on Equity |        |                                | 0.1871                   | 0.0493            |
| financing needs             |                                         | Gross Profit Margin |     |                                | 0.2910                   | 0.0767            |
| industry status             |                                         | Operating Cash Flow/Gross Sales |     |                                | 0.1151                   | 0.0304            |
|                            |                                         | Year-on-Year Growth in Gross Sales |     |                                | 0.0895                   | 0.0236            |
|                            |                                         | Comprehensive Tax Rate(Tax Payments/ Gross Sales) |     |                                | 0.0943                   | 0.0249            |
|                            |                                         | The Number of Patent |        |                                | 0.2182                   | 0.0794            |
|                            |                                         | R&D/ Gross Sales |        |                                | 0.4577                   | 0.1664            |
|                            |                                         | Intangible Assets/Total Assets |     |                                | 0.3241                   | 0.1179            |
|                            |                                         | Current Assets/Total Assets |     |                                | 0.3479                   | 0.0626            |
|                            |                                         | Fixed Asset /Total Assets |     |                                | 0.2153                   | 0.0387            |
|                            |                                         | Debt to Asset Ratio |     |                                | 0.3102                   | 0.0558            |
|                            |                                         | Financing Constraints |     |                                | 0.1266                   | 0.0228            |
|                            |                                         | Gross Sales/Industry Average Gross Sales |     |                                | 0.3836                   | 0.0740            |
|                            |                                         | Total Profits/Industry Average Total Profits |     |                                | 0.1652                   | 0.0318            |
|                            |                                         | Product Market Share |     |                                | 0.4512                   | 0.0869            |

4.3.4. Synthesizing Information of Development Potential Evaluation System of Listed High-Tech Enterprises in Greater Bay Area. After nondimensionalizing indicator data, we uses linear weighted method to synthesize multi-indicator information to form a synthesis score of the development potential of enterprises.

\[
y_{ij} = \sum_{k=1}^{n} w_k x_{ijk}
\]  

\(y_{ij}\) is the synthesis score of development potential of enterprise j in year i, \(w_k\) is the weight of the indicator k, \(x_{ijk}\) is the value of indicator k of enterprise j in year i.

5. Synthesis Score of Development Potential of Listed High-Tech Enterprises in Guangdong-Hong Kong-Macao Greater Bay Area and Analysis

For the convenience of analysis, the sample enterprises are divided into nine groups, Donguan, Foshan, Guangzhou, Huizhou, Jiangmen, Shenzhen, Zhaqing, Zhongshan and Zhuhai, according to the cities they belong to. Except for research on synthesis score of development potential of enterprises, we also analyze synthesis score under four dimension. Because of limited space, we mainly analyze on five relatively important cities of Guangzhou, Shenzhen, Foshan, Dongguan and Jiangmen.

In general, synthesis score of development potential of enterprises in the five cities all present a falling tendency. Different regions have different synthesis score of development potential. Synthesis score of development potential of listed high-tech enterprises in the five cities is in a slowdown. Through vertical analysis of four dimensions, it is easy to find that the operating financial level of enterprises in the five cities are all declining. In the past nine years, synthesis score under operating financial dimension decrease between 1% and 11%. After deeper study, we find that the values of gross profit margin of all the enterprises in the five cities are dropping. The manufacturing industry which dominates
in the A-share market, is facing stress of the increasing production costs which mainly come from the rising trade tariffs and labor costs through the development process. It is noteworthy that industry status of enterprises in Shenzhen and Guangzhou always stayed ahead in the past, while Dongguan gradually takes their position in the industry in recent two years. Besides, the drop of synthesis score under financing needs dimension of the five cities is around 5% to 19%. The data says that debt of our sample enterprises are going down, while the assets got a high score in liquidity. There is no need for an enterprise to refinance so far. On the other hand, the increase in financing constraints will make it hard for the managers of the firms to get further financing, stopping the enterprise from expanding its scale further. Finally, we pay our attention to the innovation and growth dimension in the five cities. For the past nine years, the average increase synthesis score under innovation and growth dimension has reached between 6.6% and 63%. Technical patents have gradually become an important influence factor for the profitability of an enterprise, especially for Shenzhen.

Synthesis Score of Development Potential of Listed High-Tech Enterprises in Greater Bay Area can been seen as Figure 2 and Figure 3.

![Figure 2. Line Chart for Synthesis Score.](image-url)
6. Conclusion and Advice

From the result of our paper, synthesis scores of development potential of listed high-tech enterprises in Greater Bay Area have declined and grown slowly these year. Such slow growth can be explained as follow. The majority of listed high-tech enterprises in Great Bay Area belongs manufacturing industry. Due to the trade disputes between China and the United States, listed manufacturing enterprises in Guangdong, a big trading province, have suffered a lot in recent years. In 2017 and 2018, new orders of manufacturing industry in Guangdong has dropped dramatically. Purchasing Managers' Index (PMI) has even fallen to 50.6%, which indicates depression when lower than 50%. Financial performance of most of the listed enterprises is reducing. As a result, listed high-tech enterprises are supposed to seek for a source of future growth.

Under the circumstances that the overall growth rate of the A-share market in Guangdong has slowed down, the implementation of Greater Bay Area policy will be of great help for stimulating the development of listed high-tech enterprises. The improving capability of independent innovation of listed high-tech enterprises in Greater Bay Area will help economic restructuring and up gradation effectively. The effectiveness of the implement of Greater Bay Area policy is predictable. In addition, the financing needs of listed high-tech enterprise is still in a downward trend. After Greater Bay Area policy opens the door to investors from Macao and Hong Kong financial institutions, the lower financing needs or higher financing constraints of inland listed high-tech enterprises will lower businessmen’s desire for investment, especially equity investment. Therefore, in order to integrate the capital market and improve the financing environment in Greater Bay Area further, we suggest that economic department of government should raise the requirements of information disclosure of the A-share market to reduce the financing constraints caused by the information asymmetry. Meanwhile, we also advice

Figure 3. Line Chart for Synthesis Score under each Dimension.
that the banks should offer more generous terms on loans and reduce the cost of loans for enterprises with high credit level in order to reasonably improve enterprise leverage on the premise of meeting the deleveraging policy.

The government should pay more attention to talent cultivation and intellectual property safeguards, and also encourage high-tech enterprises to promote independent research and cooperation with universities through preferential policy, such as government subsidies, tax preferences, and relaxing conditions of IPO review fundraising project, so that the innovation and growth capabilities of high-tech enterprises can be further improve and enterprises can attract the investment of institutional investors to expand their scale. Besides, the government can adopt areas with high-tech enterprises of high growth rate such as Zhuhai, Shenzhen and Guangzhou as economic test fields in the Greater Bay Area and put forward relevant policies to obtain the sensitive value of economic measures for the development speed of high-tech enterprises in order to gain experience for promoting the development of Greater Bay Area.

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