The Survival Analysis and Empirical Study of Innovation, Exposure and the Performance of Listed Companies in China

Author Details

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Abstract: In the context of a right economic situation, consumers prefer the appearance and new features of their products. Therefore, companies that develop new features and products with new appearances will perform better. As China's GDP has grown for 27 years (1980-2017), with an average growth rate of 9.57, the number of enterprises in the same industry has increased, and the competitiveness has also increased. During the 12th five-year plan period (2010-2015), the number of enterprises in the country increased by 92.3%, and the annual growth rate of high-tech manufacturing enterprises was 7.1%. In this context, consumers are increasingly inclined to purchase stylish and innovative products. Also, because of the increase in the number of companies with similar products and the increased competition, companies with high positive exposure, which companies actively promote through various media, have performed better. This article takes Shenwan Industrial Group's listed domestic appliance companies as the research object. To exclude the impact of scale on the research sample, only companies with average total assets of less than RMB 3 billion from 2014 to 2016 are selected. The COX model was used to test whether the level of innovation and exposure had a significant positive impact on the company's survival performance, to encourage companies to invest more resources in the company's innovation and advertising marketing.

Keywords: Innovation, Exposure, COX Model, Survival Analysis, Household Appliance Industry

1. Introduction:

With the continuous growth of the world economy (the average annual growth rate of world GDP for 2011-2015 is 2.62%), as shown in Table 1, China's economy shows a stronger upward trend (the average annual growth rate of China's GDP in 1980-2017 is 9.57%). According to Undata, the average of world GDP growth annually from 2010 to 2015 is 2.9%. With the growing GDP in the world, the competition in all industries become increasing. Consumers prefer to purchase new function and beautiful design. The abundance of commodities and the upward trend in the economy make consumers tend to buy stylish products with novel functions. Enterprises that can better meet this demand are more likely to survive. At the same time, companies with higher exposure have higher operating income and are more likely to survive.

![World GDP annual growth rate](image)

Figure 1

2. Relevant literature review

The resource-based view (RBV) states that organizations which own special resources or capabilities would gain competitive advantages (Peteraf, 1993). Recent years, a growing number of empirical studies test this theory. The approach used to test this theory is to develop measures of firms' resources or capabilities. The
organizations which gain competitive advantages would live longer.

3. Hypothesis:

**Hypothesis 1.** Enterprises with higher exposure are more likely to survive if the economy continues to strengthen and market competition becomes more intense.

**Hypothesis 2.** In an environment where the economy continues to be strong, consumers prefer the appearance of products and innovative functions. Enterprises that satisfy consumers' preferences are better performing and are more likely to survive.

4. Research Methods:

4.1 Research Design:
The research data of this thesis comes from the annual reports of listed companies. However, the company's annual report does not list the advertisements and channel construction costs of the enterprises, and most of the company's annual reports do not list development expenditures for the development and transfer of intangible assets. Because the appearance and new functions are reflected in the R&D investment, resulting in the appearance of the application and the results of utility model patents, while the advertising costs and investment in channel construction are reflected in the sales expenses, this study will operationalize the concepts of appearance and product new functions. The ratio of R&D input to business revenue in the company's annual report is used as the operating variable of this concept. The ratio of sales expenses to the operating revenue of the company is used as the variable of the exposure, i.e., the company that believes that the ratio of R&D investment is high is even higher. It may apply for more appearance and utility model patents; enterprises with higher sales costs will have higher exposure. Taking the business profit in the company's annual report negative as an event of the company's survival analysis, the COX risk model was used for multi-factor survival analysis.

4.2 Data:
Because household appliances have a longer life cycle and longer replacement cycle, the selection of such products at the time of purchase more reflects the consumer's preference for product appearance and innovative functions and is more susceptible to the positive exposure of the company. The research object was selected as a listed company in Shenzhen and Shanghai, according to Shenwan industry's household appliances industry. Considering that smaller listed companies are more affected by dependent variables, only companies with average total assets of 3 billion Yuan or less for three years (2014-2016) are selected, and 30 companies are randomly selected as samples to survive. The analysis time is 2014-2016. The data comes from the annual reports of these samples, and the business profit in the annual report is negative as the event of survival analysis. That is, if the operating profit is negative, the sample is deemed as "dead."

5. Results:

5.1 Survival table analysis:

5.1.1 Kaplan-Meier analysis based on sales expenses as a percentage of operating revenue

In the 30 samples, the ratio of sales expenses to operating revenue is from high to low, the highest 10 samples are grouped as a group of high sales expenses, and the lowest 10 samples are taken as a proportion of low sales expenses. Kaplan-Meier analysis, the results of the analysis are as follows.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Mean&lt;sup&gt;a&lt;/sup&gt; Estimate</th>
<th>Std. Error</th>
<th>95% Confidence Interval Lower</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low sales revenue ratio group</td>
<td>2.100</td>
<td>.327</td>
<td>1.459</td>
<td>2.741</td>
</tr>
<tr>
<td>High sales revenue ratio group</td>
<td>2.900</td>
<td>.095</td>
<td>2.714</td>
<td>3.086</td>
</tr>
<tr>
<td>Overall</td>
<td>2.500</td>
<td>.195</td>
<td>2.118</td>
<td>2.882</td>
</tr>
</tbody>
</table>
Table 1

Overall Comparisons

<table>
<thead>
<tr>
<th></th>
<th>Chi-Square</th>
<th>df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log Rank</td>
<td>5.545</td>
<td>1</td>
<td>.019</td>
</tr>
<tr>
<td>(Mantel-Cox)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test of equality of survival distributions for the different levels of Classification.

Table 2

In the overall comparison table, it can be seen that the significant P value is 0.019, which is less than 0.05, which shows that the proportion of sales expenses as a grouping factor has significant differences in the survival of enterprises at different levels. According to Table 1, during the three years of observation, the average survival time of the low sales expense ratio group was 2.1 years, while the average survival time of the high sales expense ratio group was 2.9 years; and it can also be seen from the survival function graph. The proportion of high sales expenses to the group survival time is significantly higher than the proportion of low sales expenses. Kaplan-Meier analysis confirmed that Hypothesis 1 was supported.

5.1.2 Kaplan-Meier analysis based on the ratio of R&D input to operating revenue

Similarly, for the ratio of R&D input to operating revenue, the highest percentage of 10 samples is divided into high R&D input ratio groups, and the lowest percentage of 10 samples is divided into low R&D input proportion groups. Kaplan-Meier analysis was performed, and the results of the analysis are as follows.

![Survival Functions Figure](image)

Table 3
Overall Comparisons

<table>
<thead>
<tr>
<th></th>
<th>Chi-Square</th>
<th>df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log Rank</td>
<td>6.574</td>
<td>1</td>
<td>.010</td>
</tr>
</tbody>
</table>

Test of equality of survival distributions for the different levels of Classification.

Table 4

Figure 3

In Table 4, it can be seen that the significant P value is 0.01, and the value is less than 0.05, indicating that the ratio of R&D investment is used as a grouping factor. At different levels, there is a significant difference in the enterprise's survival. Table 3 shows that in the observation period of three years, the survival time of the low R&D investment group is 2 years, and the survival time of the high R&D investment group is 2.7 years; and it can also be seen from the survival function chart. The survival time of the R&D input ratio group was significantly higher than that of the low R&D investment share group. Therefore, Kaplan-Meier analysis confirmed the establishment of Hypothesis 2.

5.2 COX model analysis:
The COX risk proportion model was analyzed by taking the 30 sample lifetimes, the proportion of sales expenses, and the proportion of R&D input. The regression method used the Enter method. The analysis results are as follows.

Variables in the Equation

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>SE</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>Exp(B)</th>
<th>95.0% CI for Exp(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>Sale revenue ratio</td>
<td>-.533</td>
<td>.271</td>
<td>3.874</td>
<td>1</td>
<td>.049</td>
<td>.587</td>
<td>.345</td>
</tr>
<tr>
<td>R&amp;D investment ratio</td>
<td>-.353</td>
<td>.172</td>
<td>4.214</td>
<td>1</td>
<td>.040</td>
<td>.703</td>
<td>.502</td>
</tr>
</tbody>
</table>
Table 5

<table>
<thead>
<tr>
<th>Covariate Means</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sale revenue ratio</td>
<td>5.155</td>
</tr>
<tr>
<td>R&amp;D investment ratio</td>
<td>5.433</td>
</tr>
</tbody>
</table>

Table 6

As can be seen in Table 5, the P values of the two variables of the proportion of sales expenses and R&D input are 0.049 and 0.040, respectively, which are less than 0.05, showing that these two variables have a significant impact on the survival of the company. According to the table, the HR value of the sales expenses ratio is 0.587, and the HR value of R&D investment is 0.703, both less than 1, indicating that the proportion of sales expenses and R&D investment are the protective factors for the survival of the company. In other words, the higher the ratio of sales expenses to R&D investment, the lower the risk of an event - the “death” of the company (profit is negative). The proportion of the average sales expense to operating income and R&D input to operating income of the selected 30 samples were 5.155% and 5.433%, respectively. Through the analysis of the Cox, risk proportion model, the establishment of hypotheses 1 and 2 is also confirmed.

6. Conclusions:

Based on the survival analysis of the selected sample in this paper, the following conclusions can be drawn:

(1) The proportion of corporate sales expenses to operating income has a significant impact on the survival (operating profits is negative) of listed household appliances companies. The higher the proportion of sales expenses in operating income, the higher the company's survival rate and the significant difference in the proportion of different sales expenses.

(2) The ratio of corporate R&D investment to operating revenue also has a significant impact on the survival of listed home appliance companies. The company's survival rate is higher with higher R&D investment.

(3) Through the analysis of COX risk proportion model, the ratio of sales expenses to operating revenue and the ratio of R&D investment to operating income have a significant impact on the survival of the company, and the proportion of sales expenses and R&D investment are the protection factors for corporate survival.

Conflict of interests
The author has not declared any conflict of interests.

References


