The Study of China’s Manufacture Goods Export Duration Based on the Kaplan-Meier Method

LU Xin, SUN Lin, ZHANG Jing
School of Management and Economics, Zhejiang University of Technology, P.R.China, 310023

Abstract: This paper is based on the CEPII database’s the 6 – digit HS code exported trade data in 2003-2010, and using the survival analysis method to analyze the duration of the China exported industrial manufactured goods’ relations, the results of the study has found that the duration of our countries’ exported industrial manufactured products trade relations is relatively short, mostly trade relations are only 2 to 3 years. On this basis, this paper has put forward that our countries’ policy should establish the early warning system, stabilize and deepen the existing trade relations to maintain the steady development of the exported trade.

Keywords: Duration of exports, Survival analysis method

1 Introduction

With the rapid development of China’s economy, the trade volume of China has increased in an astonishing speed. In the act of China participating in the global economy, China has its own unique pattern and main characteristic of this pattern is explosive growth in export (Dean at al, 2007). In the condition of the rapid growth of China trade volume, Wu Fuxiang and Liu Zhibiao (2009) has described in their research that under the circumstances of the increasing number of trade friction and the constant increase of the appreciation of RMB, the sustainable and rapid growth of China's trade volume is drawing the world’s attention, and this is regarded as the growth of China's trade volume puzzle. But with the explosive growth of exported trade, what lies behind of China’s the rapid growing trade are some new problems of exported trade. When we observe from our countries’ bilateral exports, it could be found that there are a lot of trade zero values. This zero values reflect that the products vanish in the market frequently. Many studies have also found and proved that the existing of zero values which are in the bilateral exports of the countries. For example, Baldwin and Harrigan (2007) has used the 10-digits HS highly subdivided trade data, running statistics on the United States 8880 kinds of product exports’ net export which exported to 100 destination countries or regions’ trade market, and it got the result that the zero values in the bilateral trade volume was as high as 70%. Besedeš and Prusa (2008) has expand the research object to 46 countries for researching the duration of export trade, they used the data of 4-digit SITC to find the median value of all export regions (The article divided 46 countries to six regions: east Asia, the Caribbean region, central America, South America and Mexico) duration ware only about 1-2 years, and there were significant differences between regions, it had more high survival rates of the product’s export if the trade is in the developed countries and successful developing countries, but even the trade was made from "success” exporter, the duration of trade relations only have 1/4 relations which are more than 5 years. Besedeš and Blyde (2010) analyzed the data which was based on SITC-4 digits data of Latin America area, they also has found that the duration of the products export in this area is also relatively short, and the export survival rate is lower than the United States, European Union and East Asia, it is respectively 11%, 5% and 6%. At the enterprise level, the trade duration refers to the duration of the enterprises export to the specific destination. Esteve-Pérez et al. (2010) used Spain enterprise level data from 1997 to 2006 and research the duration of export trade. The result has showed that the duration of enterprises exporting is still quite short, the median duration is only 2 years, and 47% durations of export trade were over in the first year. The research of Görg et al (2008) combined the enterprise and product. This research used Hungary customs statistical data from 1992 to 2003, and analyzed the export duration of the multi-product enterprises. The research has pointed out that 15% durations was not complete, and there were three forth durations which was about 4 years until 2003.
As far as we know, there are many domestic researches for the duration of China trade relations, but it is lack of researches for China industrial manufactured goods exported trade duration. What is more, even if they used survival analysis, but that was confined to the partial factors, it didn’t make a comprehensive analysis on it, that is lead we know little about the survival dynamic of China industrial manufactured exports, so it is a pity. In view of this, this article will focus on China manufactured goods exports, discuss the length of the duration of trade relations by survival analysis model.

2 Model and Data Description

2.1 The survival analysis model
In survival analysis, it often uses the survivor function or hazard function to describe the distribution characteristics of survival duration, and the method of survival analysis can effectively deal with the Censored Data problems which are existing in the data. In this paper, we have built the survival function of the durations of China’s export trade relationship, and use the result to confirm the distribution features of the duration of the China exports industrial manufactured goods trade relations. Let T denote the one export destination countries’ the trade relation’s real survival time of one product, because the time in this paper is discrete variable, so we assume that T is a random discrete time variable, and it takes on values ti, i = 1, 2, ..., n, with a probability density function p(ti)= Pr(T= ti), i = 1, 2, .... n, where t1 < t2 < ... < tn. If a duration period is complete, it records as Ci = 1, the right censoring records as Ci = 0. The relevant survivor function describes the probability of a duration of the trade relationship which is over ‘t’ years. The survival function is given by:

\[ S(t) = Pr(T > t) = \prod_{t_i > t} p(t_i) \]  

Hazard function means that if a duration has not failed under the circumstance of the ‘t–1’ time period, the failed probability in the ‘t’ time period. The hazard function is given by:

\[ h(t) = \frac{Pr(t - 1 < T_i \leq t | T_i > t - 1) \cdot p(t - 1 < T_i \leq t)}{Pr(T_i > t - 1)} \]  

In this article, we use Kaplan Meier product limit estimator. In order to estimate the survival function and hazard functions, this article will assume that we have ‘n’ independent observations denoted (ti, ci), where ‘ti’ is the duration of the trade relationship, ‘Ci’ is a censoring indicator variable about censored, where its value of 0 indicates that the observation is censored, its value of 1 otherwise. Let ‘m’ to denote to indicate the moment of the end of trade relations, because the time in this paper is discrete, so the value of ‘m’ taking on an integer from 1 to 7. In general, because of the censored data (the end time of censored data can be not observed, thus ‘m’ is not reflecting the censored data), and it is possible that some observation duration which were the same (tied events), so ‘m’ is less than ‘n’. Let ‘tm’ denote the duration which was until to the moment ‘m’ (‘m’ is the end of trade relations ), let this survival ti times are sorted from small to large as the length of duration, it will get t (1) < t (2) < ... < t (m), if the subjects’ number at risk of failing at ‘t(i)’ is ‘ni’, (including censored data, although we don’t know when the censored data ends, but we can know how long censored data survived at least.), the observed failures’ number is ‘di’. (Not excluding censored data, because the end time of censored data cannot be observed.) The survivor function which is by the Kaplan-Meier product limit estimator is (non-parametric estimation of the survivor function):

\[ \hat{S}(t) = \prod_{t_i > t} \frac{ni - di}{ni} \]  

In this function, if t < t(1), S^(t) = 1. The hazard function which is by The Kaplan-Meier product limit estimator is (non-parametric estimation of the hazard function):

\[ \hat{h}(t) = \frac{di}{ni} \]  

2.2 Data description
For researching the duration of the trade relationship of Chinese manufactured goods exports, we use the
data from CEPII - BACI database (A World Database of international Trade at the Product level), it is the China export 6-digit HS quintile bilateral Trade data in 2003-2010. We selected 2207 observations of the product. Due to the limitation of research conditions, this article selects the chemical products and corresponding industrial products which have the typical characteristics of Chinese manufactured goods, through this kind of manufactured goods to analyze and estimate the duration’s characteristics of China industrial manufactured export trade. This article uses the data which the unit is year from disposal and screening, due to that it can reflect the trade relationship better. We define that the unit of duration is year, it is that the duration of one produce which is from China exporting this product in one importing country to stop exporting in this country (there is no time interval in the middle). When China stops exporting this product to the importing country, we call this duration ‘failures’.

In this paper we have selected five export destination countries which import products from china, and got the durations of the every trade relations which are selected between China and five export destination countries. In recent years, the increasing speed of European Union, Japan and other regions importing industrial manufactured exported goods from China is very significant. Main exported market of industrial manufactured goods is mainly in Asia, Europe and North America, Japan, Canada, Malaysia, etc. From the aspects of geography, Japan and Malaysia are all close to China, the cultural differences and the distance are smaller. At the same time, Britain is one of the big economic power countries in the European Union countries. In addition, Canada and Australia is also the representative importing countries of China. Combined with all the reasons, the research objects of this paper choose these countries which have the large trade volume of China industrial manufactured goods, it is Canada, Japan, Britain, Australia, Malaysia respective. In the end, we have selected 671 kinds of products, and a total of 2534 durations of trade relations from the main five importing countries.

3 Data Treatment and the Empirical Results

Table 1 intuitively shows relevant data of the Kaplan-Meier survival data. Calculation of the survival rate uses the probability multiplication theorem which mentioned before. Take one year as a unit time interval, divide the time span of the entire sample into seven intervals, add up non-censored data (number of deaths) and censored data (censored number) in each interval respectively, and separately calculated how many relationships did each country have on each kind of durations (Table 1). Then, calculate the index values of various non-parametric estimation which according to previously described formulas.

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>CANADA</td>
<td>214</td>
<td>100</td>
<td>56</td>
<td>13</td>
<td>10</td>
<td>26</td>
<td>419</td>
</tr>
<tr>
<td>AUSTRALIA</td>
<td>181</td>
<td>102</td>
<td>63</td>
<td>11</td>
<td>14</td>
<td>29</td>
<td>400</td>
</tr>
<tr>
<td>JAPAN</td>
<td>153</td>
<td>105</td>
<td>72</td>
<td>11</td>
<td>5</td>
<td>31</td>
<td>377</td>
</tr>
<tr>
<td>MALAYSIA</td>
<td>190</td>
<td>120</td>
<td>44</td>
<td>24</td>
<td>22</td>
<td>34</td>
<td>434</td>
</tr>
<tr>
<td>UK</td>
<td>206</td>
<td>112</td>
<td>56</td>
<td>15</td>
<td>10</td>
<td>22</td>
<td>421</td>
</tr>
<tr>
<td>TOTAL</td>
<td>944</td>
<td>539</td>
<td>291</td>
<td>74</td>
<td>61</td>
<td>142</td>
<td>2051</td>
</tr>
</tbody>
</table>

We can see from the Table 1, in the industrial manufactured goods exported trades between China and five countries, most of trade relations will fail in 1-2 years, and most relations are just lasting about 1 year.
Table 2 The statistical description of China manufactured goods export trade’s survival rate (2003-2010)

<table>
<thead>
<tr>
<th>Trade partner</th>
<th>1 year</th>
<th>Survival rate (more than 1 year)</th>
<th>More than 3 year</th>
<th>Survival rate (more than 3 year)</th>
<th>More than 5 year</th>
<th>Survival rate (more than 5 year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CANADA</td>
<td>174</td>
<td>33.40%</td>
<td>11</td>
<td>2.11%</td>
<td>4</td>
<td>0.76%</td>
</tr>
<tr>
<td>JAPAN</td>
<td>114</td>
<td>24.62%</td>
<td>6</td>
<td>1.30%</td>
<td>1</td>
<td>0.21%</td>
</tr>
<tr>
<td>UK</td>
<td>219</td>
<td>41.56%</td>
<td>15</td>
<td>2.85%</td>
<td>4</td>
<td>0.76%</td>
</tr>
<tr>
<td>AUSTRALIA</td>
<td>174</td>
<td>35.73%</td>
<td>9</td>
<td>1.85%</td>
<td>4</td>
<td>0.82%</td>
</tr>
<tr>
<td>MALAYSIA</td>
<td>176</td>
<td>33.15%</td>
<td>17</td>
<td>3.2%</td>
<td>6</td>
<td>1.13%</td>
</tr>
<tr>
<td>TOTAL (FIVE COUNTRIES)</td>
<td>906</td>
<td>63.47%</td>
<td>62</td>
<td>4.19%</td>
<td>7</td>
<td>0.77%</td>
</tr>
</tbody>
</table>

Source of data: Calculating and screening on the basis of CEPII database data from 2003 to 2010.

In the Table 2, in 1 year, UK has the most trade relations, it has 219. But when the year more than four, the trade relations rapidly fall to 15. The trade relations of Malaysia is 176 in the first year, but in the fourth year it is also decreased, the number which duration more than 6 years is just 6. The other countries are very similar, with the year increasing, the trade relations are decreasing rapidly. The total survival rate of 1 year is 63.47%. The trade relations which more than 4 years are obvious reduced than the relations which in 1 year, and the total survival rate is 4.19%. And comparing with the trade relations which more than 6 years, it is much less, the survival rate is just about 1%. So we can see from the table, the survival rate is obvious reduced with the increasing of time.

Chart 1 is that the survival curve which got from Kaplan-Meier Method is the exported trades between China manufactured goods and five countries, this chart got from 95% confidence level. On one hand, this survival curve obviously shows that the survival rate is decreasing with the increasing duration, and the total exported trade duration of five countries main is short-term. The trade relations are concentrated at first two years, and the duration’s proportion of six years is very small. On the other hand, in the chart, with the duration continuous extending, the downtrend of survival curve is gradually slowing, the survival rate is tend to steady.

Chart 1 Survival curve of exported duration

It is showed that the possibility of trade interrupt is gradually reduced. Once a trade relation has established, and it is lasting at many years, then the probability of trade existing longer will larger. This is the ‘trade threshold effect’ (Pakes and Ericson, 1998). Our result is the same with the conclusion of Pakes and Ericson (1998) which researched retail trade. At the same time, our result proves the principle of the negative duration dependence.
### Table 3 The statistical description of China manufactured goods export trade’s hazard rate (2003-2010)

<table>
<thead>
<tr>
<th>Hazard rate</th>
<th>CANADA</th>
<th>AUSTRALIA</th>
<th>JAPAN</th>
<th>MALAYSIA</th>
<th>UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>n=3</td>
<td>48.78%</td>
<td>46.58%</td>
<td>46.88%</td>
<td>49.19%</td>
<td>66.67%</td>
</tr>
<tr>
<td>n=4</td>
<td>33.3%</td>
<td>33.85%</td>
<td>30.51%</td>
<td>35.48%</td>
<td>54.37%</td>
</tr>
<tr>
<td>n=5</td>
<td>26.53%</td>
<td>20.37%</td>
<td>23.41%</td>
<td>30.00%</td>
<td>31.92%</td>
</tr>
<tr>
<td>n=6</td>
<td>22.22%</td>
<td>27.44%</td>
<td>13.88%</td>
<td>39.28%</td>
<td>31.25%</td>
</tr>
</tbody>
</table>

The hazard rate in Table 3 is the trend of falling, and the trade relations tend towards steady with the duration extending. On the whole, this shows that the hazard rate is very high at first years, but it reduces with the time increasing. So the failure rate of trade relations is the highest at the beginning of the trade, and then it will decrease, the hazard rate has the obvious characteristics of negative duration dependence. So this curve result also proves the negative duration dependence.

In addition, the existing of negative duration dependence makes us question the viewpoint which is the important of implementing diversification market strategy. It should be that, exported market diversification is really the selectable strategy of improving export, but due to the hazard rate of trade failure is the highest at the beginning of the trade, so improving the exported market diversification simply may be cannot completely guarantee the steady development of export trade. By contrast, it should consider the duration of trade relations. As Chen Yongbing, etc. (2011) showed that, between 2000 and 2005, the new market entry enterprises’ contribution of export value is much less than the continued exported enterprises. It means that the exported ability of new entered enterprises is much less than continued existing enterprises in the exported market. So the rapid increasing of China exporting still mainly needs to realize by the continued existing enterprises’ trade volume expansion.

### 4 Conclusions and Policy Recommendations

This paper uses CEPII-BACI database’s 6-digit HS data from 2003 to 2010 to analyze the duration of China exported industrial manufactured goods. We find that the duration of China exported industrial manufactured goods is short, its survival time mostly is about 1-2 years, and the total average value of trade relations’ duration is 2.36 years. What is more, trade relations will face high risk in the early years, and fall rapidly later. The exported durations obviously shows the negative duration dependence. A longer trade duration is the important factor to realize the stable growth of trade (Besedes and Prusa, 2008; Fugazza and Molina, 2011). So the research for the duration of China exported manufactured goods give the new thought to the China export’s stable development.

We base on the above research and from the view of improving the exported duration, we put forward the corresponding policy recommendations:

Firstly, Due to the export destination countries’ related information have very important influence for exported trade. So we should be let national economic and investment management unit as the core, and establishing exported risk pre-warning mechanism. The pre-warning mechanism is mainly for international political risk, market risk, as well as the exchange rate risk and so on. This can help the exported enterprises as soon as possible to deal with possible risks.

Secondly, the negative duration dependence shows that, enterprises will face higher risk at the early exported year. So compared with establishing new trade relations, keeping and deepening the existing trade relations are more important.

Lastly, if the trade policy which is simply and blindly in order to promote export and ignore the duration of the relations in the exported market, its implementation effect is likely to be reduced. What is more, if enterprises enter and exit the exported market soon, it will inevitably cause the waste of resources. So this exported promotion policy is flawed. Therefore, how to formulate the appropriate trade policy is especially valuable for the government thinking.
Acknowledgement:
This research work is supported by the Key projects of Zhejiang Philosophy and Social Science Planning (11JCYJ02Z) and National Natural Science Foundation (71303216).

References