Exporting and Innovative Enterprises—Retesting the "Learning Effect" Based on the Firm-Level Data of China

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ABSTRACT

As an important branch of heterogeneous enterprise theory literature, a large number of studies have been done in the area of "learning by exporting" effect. However, the conclusion is not uniform. Most of the research focus on the macro level, it need to be tested by micro-data further. This paper explores the relationship between export and R&D input, using a panel data of 45 listed companies in China's innovative enterprise. We found that the growth of export can promote the R&D input of innovative enterprises, and proved the effect of "Learning by exporting". Moreover, we find the profits will increase the R&D input of innovative enterprise, and they will be more inclined to R&D activities when grow older.

INTRODUCTION

With the deep development of economic globalization, China has become the world's largest exporter, and the data released by the world trade organization (WTO) show that China's export ranking was the world's largest in 2015, with exports of $2.27 trillion. The world's largest, exports of $2.27 trillion. However, this rapid export trade does not necessarily mean a corresponding improvement in export quality. In the vigorous development of foreign trade in China, there are many realistic problems, especially after China's accession to the WTO, more international, domestic market competition is increasingly fierce, make Chinese enterprises want to in high-end industry seems to be difficult to become bigger and stronger. At the same time, China's technological progress lacks historical accumulation, and its core technologies are subject to developed countries. If it is satisfied as a "world factory" and not based on independent innovation to develop the independent intellectual property rights and its own brand, will exist in OEM mode as the core of capital-intensive and labor-intensive enterprises are locked in low-end value chain link of risk, in the process of export trade in China's enterprises can't obtain technology upgrading and innovation [1]

To achieve China's leap from "manufacturing power" to "manufacturing power", it is necessary to attach great importance to the technological innovation in export trade, especially the "learning by exporting" effect. In the process of export, there are a lot of opportunities for technological upgrading, seize these opportunities, and need enterprises to have strong technological innovation capability. In the process of export, there are a lot of opportunities for technological upgrading, seize these opportunities,
and need enterprises to have strong technological innovation capability. Technology innovation ability from the internal research and development activities, also from the enterprise external knowledge learning and absorbing, between the two complement each other: higher technology research and development ability will improve the ability of enterprises in the export of technology absorption, which in turn will drive enterprise technology research and development ability of ascension. Existing literature research mainly focus on exports and the relationship between productivity [2-6], will affect export productivity as the main basis, less attention to the learning behavior of export enterprises, innovation investment reveal deficiencies caused by enterprises to export. Therefore, this article through 45 listed on China's stock market innovative companies of 2006-2015 panel data, the relationship between innovative companies export and development was investigated, in order to find whether developing countries participate in the global export market helps to the innovation investment and enhance innovation capability. Choose innovative companies as research samples, because the innovative companies represent the most competitive and the most dynamic part of the economic development, is also an important force in a country's innovation and export, the research has significant theoretical and practical significance.

LITERATURE REVIEW

Developing countries access to global economic network by means of foreign trade, and international trade is not simply the international exchange of goods or services, it also brings the innovation of technology and flow. So research on export trade and technological innovation is also increasing. Geng Jiang, Lv Daguo [7] use industrial enterprise data between 2004 and 2007, think that China's manufacturing enterprises in export will be more inclined to research and development activity, after and before Zhang Penghui use of 1998-2007 institute of industrial enterprise data by export enterprises is higher than the conclusion of the export enterprise productivity. Wang hua, Xu Helian, Yang Jingjing[8] with the method of system of generalized distance estimation, using data from 1997 to 2000, 1467 companies, research found that export enterprises in productivity be about twenty percent higher than that of the export enterprises to thirty; Li Ping and Tian Shuo[9] adopted the same method and studied the panel data of the manufacturing industry from 2001 to 2007. The study found that the horizontal spillover of the export trade had significantly promoted the technological innovation. Lai yongjian, he xiangmin based on the study of the panel data of China's manufacturing industry from 2005 to 2007, also thinks that the horizontal overflow of exports can produce positive effects on the innovation performance of enterprises. Similarly, Yao Xiangru, Ma Rong kang et al. [10], studied the sample of 5,928 manufacturing enterprises from 2004 to 2006, and the increase of export breadth could promote the improvement of enterprise innovation ability. Liang yun, Tang chengwei et al. [11], using the data of high-tech industries between 2000 and 2009, adopted Granger causality test to find out that the expansion of the export scale can improve the total factor productivity of enterprises. Li Zhengwei, Chi Renyong[12] based on data from 1111 high-tech industries in zhejiang province from 2003 to 2005, studied the impact of enterprise export on research and development, and concluded that the export of high-tech enterprises could promote research and development.
Of course, there are also studies that do not support the "export high school effect". Dong Youde and Meng Xing [13] use data from the provinces in China and found that the import and export trade has a negative impact on the innovation ability of Chinese enterprises. The same Wagner [14] examined the link between German export behavior and corporate productivity and failed to find empirical evidence of an "learning by exporting" effect.

Exports overall look, "the existing literature on learning effect" is to support, they believe that exports will total factor productivity of the enterprise or R&D have a positive impact, companies can get a certain technology to promote in the export trade. Nevertheless, it is of positive significance to further carry out empirical research on this issue in combination with the heterogeneity of enterprises.

THEORETICAL ANALYSIS AND ASSUMPTIONS

Export, innovation and productivity

A large number of empirical studies in recent years show that the productivity and innovation ability of export enterprises are higher than those of non-export enterprises [15-17]. There are two explanations for this phenomenon (as the Fig. 1 shows): “Learning by Exporting” effect and “self-selection” effect [18]. The "self-selection" effect means that the exporter chooses to export because it has high productivity and its ability can bear the export cost. In other words, enterprises with higher productivity have obvious competitiveness in the international market. Only Export activities can bring profits, the enterprises will be exported. Low-productivity enterprises cannot afford export costs. There is no competitiveness in the international market for these enterprises. If they enter the international market it also cannot be profitable. They will be eliminated eventually. So they do not export. The "export learning effect" is that after the enterprises begin to export, the highly competitive international market urges the enterprises to enhance their innovative ability to cope with the fierce international competition. Moreover, export enterprises can also enhance their own productivity by learning from and absorbing advanced foreign technologies [19]. The improvement of productivity occurs after exports.

![Fig. 1. Export theoretical framework, innovation and productivity.](image-url)
SELF-SELECTION EFFECT

Some of the existing empirical studies support the "self-selection" effect. The effect of self-selection refers to the fact that the high productivity of exporters already existed before their exports. And the main reason for the export enterprises begin to export is the export enterprises have high productivity already before exporting.

Clerides and Delgado [20-21] make the research that the export market is cruel, such as barriers to entry, transportation costs, tariffs, and more intense competition. The entry Barriers limited product entry. The transportation costs and tariffs have increased the cost of products, and fierce competition will reduce the unit profit. These are resistance to export behavior, and firms choose to export for profit, so only high productivity can reduce costs and enable the product to profit in the international market after a series of obstacles. This is the fundamental reason why enterprises choose to export. Therefore, only enterprises which have enough productivity to break through the resistance can participate in export trade.

LEARNING BY EXPORTING EFFECT

There are also some documents that support the "Learning by Exporting" effect, especially in the study of developing countries and regions. Biesbroeck, Blalock and Gertler[22-23] considered that customers in the international market will promptly and effectively return relevant information about the products to the exporters. And some customers will also provide corresponding technical training to the exporters so as to enhance the productivity of their exporting enterprises. For the export enterprises in the process of export trade will enable enterprises to increase their own innovation ability and productivity explained summed up the following three:

First of all is the scale of economies. Some scholars believe that the expansion of exports in order to obtain economies of scale, which will reduce the R & D risks and costs, lower marginal costs and risks that will encourage enterprises to carry out research and innovation activities. The study of Helpman [24] and Canto [25] also recognized the notion that exports are scaled economy and thus promote R&D investment.

The second one is the competitive effect. Some studies suggest that exports represent an increase in the intensity of competition and an increase in the sense of competition among enterprises. Obviously, the overall strength of exporting enterprises in China is weak. In the face of strong pressure from foreign strong groups, there will be greater pressure on exporting enterprises to force themselves to pass R&D and innovation to adapt to the fierce competitive environment in order to be able to get a place in such a competitive environment. Aw [26], Greenaway [27] and Xie Juanjuan [28-29] also think that the productivity of export enterprises will be higher than that of non-export enterprises, and the fiercer competitive environment will encourage enterprises to improve their products and processes.

The third is the information effect. This part of the study think that exports can help exporters understand the technical information in foreign markets or consumer demand information, which helps companies improve product design, quality or technology, a clear direction of research and development. Kang Zhiyong [16] think that the product quality, design and other aspects will firstly be reflected in the
requirements of consumers embodied in the process of export trade with consumers tend to get consumers in the product quality, design, and technical knowledge of the manufacturing process. What is more, the exporters will be more directly trained and technicalized by consumers in order to obtain the desired product quality, which will directly lead to the improvement of the exporter's technical level. Grossman [30] also argue that international trade allows a country's knowledge base to be fully exposed to its trading partners, and knowledge is accompanied by service and technology transfer, the flow of goods is being communicated, and exporters can buy from buyers Get a variety of useful information and technical support.

In some researches on the heterogeneity and R&D of export enterprises, the relationship between export and innovation capability has also been verified. Roberts [31] found that exporters would be more inclined to research and develop using data from different years of Taiwan's electronics industry. Li Qiang [32] used the Jiangsu Science and Technology Census data to find that the output contribution of R&D spending by exporters was higher than that of non-exporters.

**Research hypothesis**

Comprehensive above, it is easy to find that there is a “Learning by exporting” effects in the export trade of enterprises, in other words, export activities have a positive impact on the production efficiency and development ability. Export enterprises have a chance to gain extra information and more advanced technology, and in order to further promote R&D investment they have to improve themselves in their digestion absorbency. Meanwhile, competitive pressures in international markets and export scale expansion also motivate enterprises to innovate.

Most existing research just against the relationship between enterprises’ productivity and export, but the growth and decline of productivity is nothing but a result, so we have to attach importance to analyze the reason of productivity growth. The improvement of innovative ability is an obvious reason, and it is a main aspect of analysis. In terms of innovation ability, research can be done from two aspects: innovation input and innovation output. Innovative output is mainly reflected in the number of patents, technical secrets, new product output value, the difficulty of measuring output lies in the data is difficult to collect. In addition, the data gap between different industries is huge. In contrast, innovation investment is also an important reflection of the innovation capability of an enterprise or industry and the data are relatively easy to collect. Therefore, this article does not select the output of innovation but chooses the innovation to invest into the research.

The research object of this paper is innovation-oriented enterprises, which refer to those enterprises that have the intellectual property rights and core technologies, their own brands, have good innovative management and culture, and their technological level has advantages in the industry, competitive advantage and sustainable development. They have the characteristics of institutionalized research and development within the enterprise, research and development as the core functions of enterprises and through continuous innovation to gain revenue. Compared with non-innovative enterprises, innovative enterprises have a higher starting point, the technical foundation and innovative ability in terms of innovation, therefore, they have a stronger ability to learn through exports, in the process of international cooperation
and competition to learn and absorb and further enhance their innovative ability to form an innovative and self-reinforcing circular mechanism.

Based on the above analysis, this paper puts forward the following assumptions: The scale of export of innovative enterprises has a positive impact on their R&D investment.

EMPIRICAL ANALYSIS

Model setting

We need to establish a panel regression analysis model to analyze the relationship between export and R & D investment of innovative enterprises:

$$\ln R & D_{i,t} = \beta_0 + \beta_1 \ln EXP_{i,t-1} + \varepsilon_{i,t}$$

Among them, the investment in R & D of t enterprises during the t period represents the random error for the export period of i enterprises in the t-1 period. However, there are more factors that influence the R&D of enterprises than the export volume. According to the existing literature analysis, enterprise age, profit, scale, debt ratio and capital stock will have a certain impact on the R&D investment of enterprises, so it is necessary to improve the basic model that is to add explanatory variables. Referring to Yao Xiangru, Ma Rongkang and Liu Fengchao [20] variable selection and processing methods, after screening and sorting out the existing data, this paper adds the profit and enterprise age as explanatory variables into the model. Because the general production and management behavior in terms of the current will affect the development of the next phase of the investment so we put all the explanatory variables lagged one period, and in order to eliminate the heteroscedasticity that each sequence is more stable, so we will choose the variables in the model of logarithm, the final model set:

$$\ln R & D_{i,t} = \beta_0 + \beta_1 \ln EXP_{i,t-1} + \beta_2 \ln PRO_{i,t-1} + \beta_3 \ln AGE_{i,t-1} + \varepsilon_{i,t}$$

Among them, $\ln PRO_{i,t-1}$ represents the profits of i enterprises in t-1 period, and $\ln AGE_{i,t-1}$ represents the establishment time of enterprises in t-1 period.

Variable selection

In this article, the R&D input and the export amount are taken as the explanatory variables, and most of the existing literature is explained by R&D intensity (R&D investment / main business income) and personnel intensity (export income / main business income); In consideration of the availability of data, the absolute values of R&D investment and export income are used as explanatory variables and explanatory variables respectively in this article.

Research and development investment (R&D) is an important embodiment of the innovation ability of a country or region, in the enterprise level, R&D investment is also true, more or less, is an important indicator to measure an enterprise innovation ability, so we choose it as an explanatory variable.

In order to verify whether "Learning by exporting "effect can promote our own country innovation capability by export, and the export amount is the most direct
indicator of export change, so we choose export volume of enterprises as the most important explanatory variable in the model.

Generally speaking, the increase or decrease of enterprise's profit (operating income operating cost) will lead to the increase or decrease of R&D investment, so we regard enterprise profit as one of the explanatory variables.

Enterprise innovation resources accumulation with age (AGE) increased, general enterprises will set up a long than short time established enterprises tend to be more research and innovation activities from the objective angle, so the choice for one of the explanatory variables, the specific variables are shown in table 1:

**Descriptive statistics of data**

The data used in this article comes from the WIND database. This article does not choose the strength index, but the choice of absolute index. In order to eliminate the influence of price changes, to facilitate the comparison of the different historical period, so in the empirical analysis, this paper has 2006-2015 years all economic indicators are based on 1978=100 (China obtained from the National Bureau of Statistics website) the price index for the conversion of comparable value.

Because most of the innovative enterprises not listed unpublished data or difficult to find, taking into account the availability of data, the enterprises selected 99 innovative enterprises to find the target data, financial data, we need the enterprise to get through the query target enterprise 2006-2015 years of corporate annual reports, and according to the data we need, to filter out part of the target we need with missing values and specific value of the enterprise. Because the data processing needs of variables to logarithm of original data, so the variable cannot be negative, negative indicators of enterprises also screened, after screening we obtained 45 consecutive years from innovative enterprises 2006-2015 export data for a total of 450 objects.

| Table 1. Variable Definitions and Symbols. |
|--------------------------------------------|
| Variables | Definition | Symbol |
| Explained variables | Research and development investment | The amount of R&D invested by the enterprise in the current period | R&D |
| Export volume | Current export turnover of enterprises | EXP |
| Profit | The main business income of enterprises-cost | PRO |
| Enterprise age | Establishment time | AGE |

| Table 2. Descriptive Statistics of Data. |
|-----------------------------------------|
| Variable | Unit | Observation's | Mean | Standard deviation | Minimum | Maximum |
| Raw data | | | | | | |
| R&D | Million RMB | 450 | 390.4319 | 4392.92 | 0.002136 | 90491.68 |
| EXP | Million RMB | 450 | 9395.032 | 128402.6 | 0.035925 | 2531406 |
| PRO | Million RMB | 450 | 798.8181 | 6718.273 | 0.249949 | 137777.6 |
| AGE | year | 450 | 19.16667 | 13.29404 | 1.098612 | 4.158883 |
| Processed data | | | | | | |
| Lnr&d | Million RMB | 450 | 2.3092696 | 2.381194 | -6.14869 | 11.41301 |
| Inexp_lag | Million RMB | 450 | 3.78632 | 2.509577 | -3.32631 | 14.74429 |
| Inpro_lag | Million RMB | 450 | 4.171912 | 2.12931 | -1.3865 | 11.8334 |
| Inage_lag | year | 450 | 2.750412 | 0.561086 | 1.098612 | 4.158883 |

Data source: WIND database

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The value and standard deviation can be seen in Table 2, we can see the degree of dispersion indicators is higher, the stability of the data is rather poor, the number of variables before processing is larger. The standard deviation of R&D is greater than the mean, in which the maximum value is 90491.68 and the minimum is 0.002136. It said the development of different business investment will have a greater difference or the same enterprise in different periods of R&D investment may also have great differences, the same export volume (EXP) mean and standard difference, and the maximum and minimum deposit in the more obvious differences, it also shows that different enterprises or enterprises with exports different year changes greatly, and the existing literature data analysis results are consistent.

The average value of export enterprises' exports (EXP) can reach 93 million 950 thousand and 320 RMB from the mean value, which is enough to prove that China's export scale is huge. While the mean value of R & D investment (R&D) and profit (PRO) is small, it shows that the profits and R&D investment of Chinese export enterprises are relatively small. The average age (AGE) is as far as 19.16667 years, which also shows that China's innovative enterprises are generally younger.

The processed data can be seen, the logarithmic standard deviation is substantially reduced, between the standard deviation and average gap has narrowed, but the gap between the maximum and minimum values have narrowed a lot, so the degree of dispersion of data is greatly reduced, the data also tends to be more stable, more conducive to analysis step.

According to table 3, the Pearson coefficient in correlation analysis can be concluded that there is a strong correlation between the two explanatory variables and the explanatory variables, and it is positively correlated. Therefore, we can guess that exports and profits have a certain effect on R & D investment.

**Stability analysis**

In order to avoid pseudo regression, ensure the results of the regression is effective. We need to carry on the unit root test sequence, the test is not stable time series, stationary test results in PRO sequences of the profit we get is the original P=0.0898 fails to reject the unit root hypothesis, so we think that the non-stationary. In order to make the regression meaningful, we take the logarithm of the variables in the model.

After that, we use the two methods of LLC and IPS to test the stationarity of each sequence to ensure the stability of each sequence. (In the following empirical process, we use lnexp_lag, LN pro_lag and lnage_lag to represent lnEXP, lnPRO and lnAGE lag phase respectively).

From the results of Table 4 and table 5, we can see that all the P values of unit root tests of all sequences are less than 0.05, that is to say, all of them reject the original hypothesis of unit roots, and that is, we can assume that all sequences are stationary.

| TABLE 3. CORRELATION ANALYSIS RESULTS. |
|----------------------------------------|
| Independent variable | Dependent variable | Lnr&d |
|-----------------------|-------------------|-------|
| lnexp_lag             |                   | 0.6938* (0.0000) |
| lnpro_lag             |                   | 0.7534* (0.0000) |

Note: *, **, *** represent significant at 10%, 5%, 1% respectively
Regression test and result analysis

Panel regression model is mainly divided into mixed effects, fixed effects and random effects. Fixed effect model is used to analyze only some groups' samples we selected and we cannot promote the use of results of the analysis, but fix effect model analyzed these groups and we can promote the result we obtained to a larger range. Since we are going to analyze the entire cluster of innovative enterprises but not to analyze only 45 innovative enterprises we selected, from this point we should choose random effect model. Although the p-value of the Hausman test is 0 and the result of the test shows that the fixed effect is better than e random effect, choice of fixed effect model will make our research lost its relevance to reality, and in order to achieve this goal it's necessary for us to use random effect model.

According to Table 6 Panel regression results we can see the coefficient of Inexp lag is 0.129 and passes the 5% significance test, and this is consistent with previous research. That is to say, every 1% increase or decrease of export value will increase or decrease 0.129% of research and development investment. The result of this regression confirms our original assumption: the export of innovative enterprise has positive effect on research and development investment of company. That is to say, no matter it is because the export environment forces innovative enterprise to increase research and development investment to be competitive or because the increase in the size of the export of innovative enterprises reduces the marginal cost of R&D played a
role, we can think that enterprise will stimulate the investment of R&D during the process of export.

Similarly, we can also see that the coefficient of profit is 0.492 and passes the significance test of 1%, therefore we think the profit will also affect the enterprise's investment of research and development, for every 1% increase or decrease in profit, R&D investment in the enterprise will increase or decrease by 0.492 percentage points. This also validates what we said earlier that the increase or decrease of profits made by an enterprise will affect the increase or decrease of the enterprise R&D investment.

The coefficient of the establishment time of the enterprise was 0.373, which also passed the significance test of 5%, so again, businesses will increase their investment in research and development as they grow older, and thus validating what we said above. The positive effect of export on R&D investment may be the result of innovative enterprise's own choice for better competition in the harsh international markets or the scale-up resulting from export leads to reduction of R&D investment's marginal cost's choice, and which approach is more appropriate needs further exploration. However, we can confirm that the increase of export of innovative enterprises will lead to an increase of R&D investment and the increase or decrease of 1% of the mouth value will increase or decrease the R&D investment of enterprises by 0.129 percentage points.

We carry out significance test on the random effects model, P = 0, so it can be considered that the random effects model used in this paper is overall significant.

RESEARCH CONCLUSIONS AND PROSPECT

In this paper, a panel data of 45 innovative enterprises in China from 2006 to 2015 are used to study the relationship between innovation export and R&D investment by regression method, and through our study "learning by exporting" effect has been confirmed in this paper. The results show that every 1% increase or decrease in the export value of innovative enterprises will lead to an increase or decrease of 0.129 percentage points in R&D investment. The result of this regression confirms our initial assumption that the export of innovative enterprises has a positive impact on the R&D investment of enterprises. Similarly, we can see from the regression results that every unit change in profit also brings a 0.429% change in R&D investment. We think that profit will also have a positive impact on the R&D investment of enterprises. Based on the regression results, we can also think the establishment of enterprises will have an impact on R&D activities, the longer the time of establishment of enterprises, the more they inclined to engage in research and development activities.

Of course, the research in this paper is also flawed. For example, the number of sample companies used is too small, and the research does not control the industry characteristics of the enterprises, that might make statistical results biased. Another problem is that we didn't compare non-innovative enterprises in the study at the same time. Therefore, it cannot explain the difference between innovative and non-innovative enterprises in the "learning by exporting" effect. This will be the issue to be further explored in the future research.
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