

Correlation between Economic Factors and High-Technology Export in Asia-Pacific Nations

Jiyan Hu¹

Abstract:

This paper investigates the correlation between high-tech exports in Asian-Pacific nations and the economic effects in term of economic growth. Some economic factors will be highlighted in this paper, such as foreign direct investment inflow, R&D expenditure, country openness as well as gross saving. The model will explain some economic factors are the key to determinant the volume of the high-tech export in Asian-Pacific nations. In order to understand the model and interpretation of each factor, high-tech export per worker will be targeted as a dependent variable. This paper will include data from 1997 to 2007 and it will be confirmed into econometric framework and explanation will be given in this paper.

JEL classification: F10, F21, O10, O30.

Key Words: High-Tech Export, Research & development, Trade

¹ Applied Economics major, Business Administration minor. Bryant University, 1150 Douglas Pike, Smithfield, RI 02917. Phone: (610)888 6808 Email:jhu@bryant.edu

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1.0 Introduction

International trade has become the most important components in terms of globalization. Many countries from Asia-pacific gain benefits from international trade, particularly high-technology exports. Global exports volume of high-tech products have been increased rapidly in the past decade. Some Asia countries such as China, Hong Kong, India, Indonesia, Japan, South Korea, Malaysia, and Singapore Australia, and Vietnam have comparative advantages in terms of high-tech exports. First, high-tech is the most advanced technology that human can achieve. Mostly, high-tech products are referenced to micro-electronics. It is hard to classify which products are considered high-tech goods because the definition of high-tech products is shifted over time. Overall, the following sectors approach classifies industries according to their technology intensity, Aerospace, Artificial Intelligence, Biotechnology, Software, Electrical Engineering, Photonics, Nontechnology, Nuclear Physics, Robotics, Telecommunications and such. Srholec (2007) claimed that a majority of countries maintain a below-average share of high-tech products in exports. Most low-income countries report negligible high-tech exports, although specialization in high-tech exports is by no means a privilege of the most advanced countries. However, this was not always the case. Some Asia nations share high-income and low-income while they both have advantage in high-tech exports. As a result, it is very important to understand which economic factors drive Asia nations to success in terms of the share of high-tech export among all nations in the world.

In order to drive economic growth and improve the term of trade in the United States, investigate some Asia-Pacific nations are necessary. Some important factors will be included in

the discussion, such as Research and Development Expenditure, Foreign Direct Investment, Country Size, Savings, and Education Level. Using fixed-effects of the regression and panel data, we can estimate which variables are statistically significant in terms of high-tech exports. Furthermore, interpretation of each variable will be given.

Meanwhile, my study is different from previous studies because this investigation has cross-sectional and time series across different counties while others are only focusing on specific nation. Second, in order to fully interpret each variable, dependent variable will be defined as high-tech exports per worker instead of high-tech export. Third, data is concentrating on the influence of the Asian financial crisis that was beginning in 1997. The raised fears of a worldwide economic meltdown, and the impacted to High-Tech export among Asian Pacific nations will be discussed in this study.

2.0 Trend in the High-Tech Export

The most current trend from figure 1 below shows that China, Japan and Asia-8 (India, Indonesia, Malaysia, Philippines, Singapore, South Korea, Taiwan, Thailand) are more likely to have upon slopes compare to United States and EU in terms of trade balance in high-technology goods. Although, Japan has decreased rate of trading high-tech goods due to the recession, but Asian countries have increased rate over all in the past decade. The trends indicate that increasing R&D investments in Asian countries are the major factors to encourage for trading high-tech goods. In other words, we expect R&D expenditures will have positive relationship with high-tech exports per work based on the trends we observed.

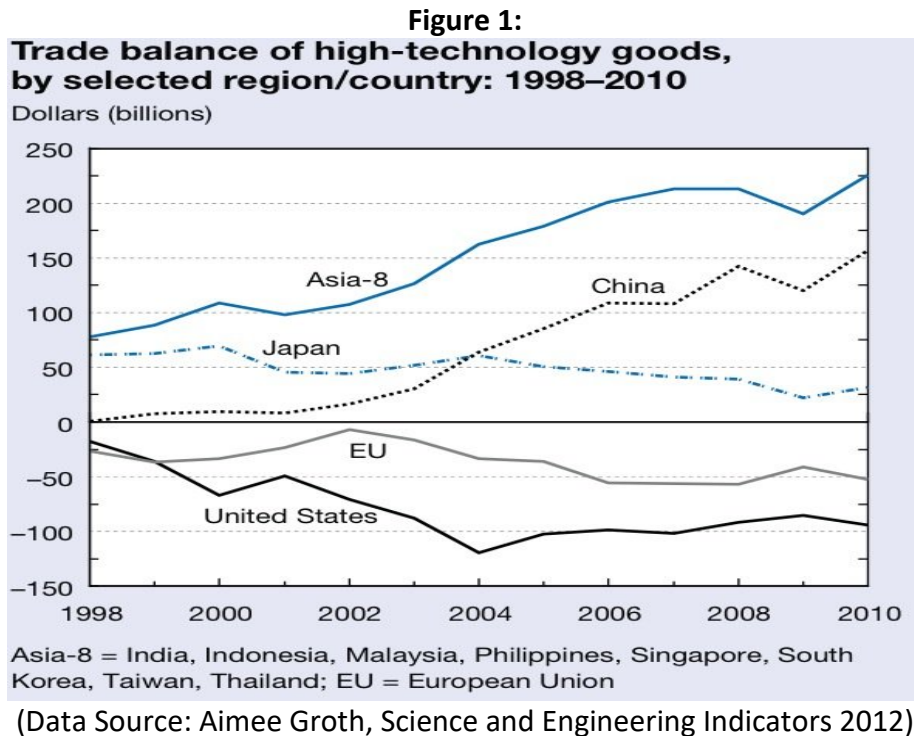
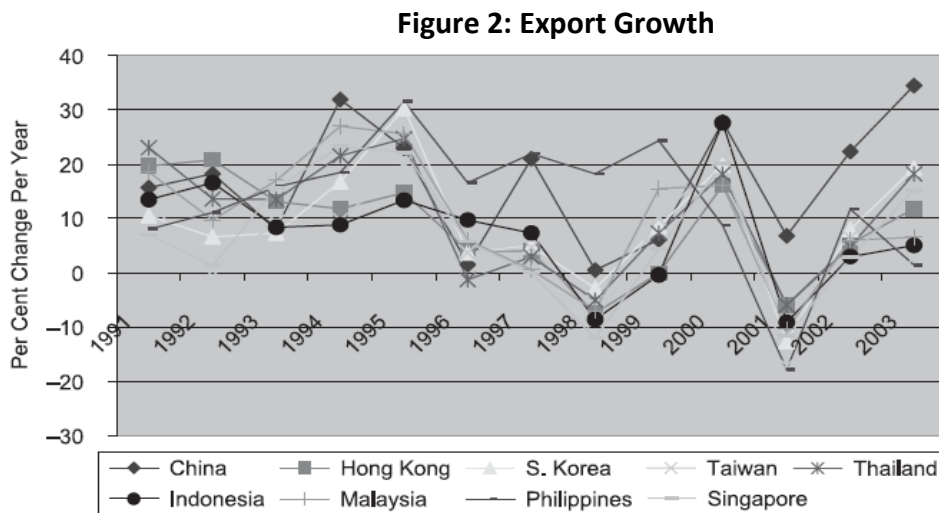


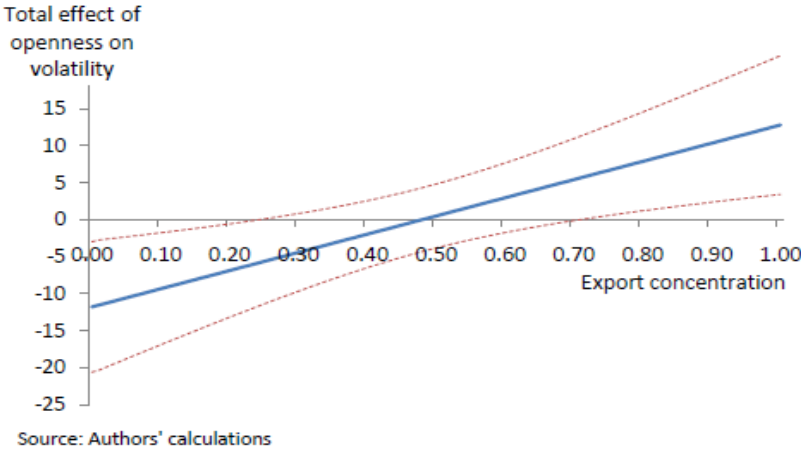
Figure 2 below displays Asian nations' export have expanded very rapidly since 1990. Meanwhile, the rate of growth from Asian nations, particularly in China, has more than twice the rate of growth of world trade. Other East Asian countries also show rapidly in terms of export growth. Asian nations are very success in the international markets. However, United States shows substantial declines in market share in world export market



(Data Source: Journal Compilation at Blackwell Publishing Ltd, 2006)

High-tech exports can be effected by varies reasons. Country that has higher openness levels is expected to have higher export levels in terms of high-tech goods. The following trends from figure 3 explain a higher degree of openness only associate with large number of exports but also interconnect with economic growth. As a result, we can indicate that countries openness should have positive impact of high-tech exports per worker.

Figure 3: Openness and Export



(Data Source: Trade Openness Reduces Growth Volatility When Countries Are Well Diversified. Policy Research Working Paper 5222.)

3.0 Literature Review

This study has investigated the correlation between high-tech exports and all possible economic factors. The regression models are supported by many people and their studies. Some papers that are reviewed will be used in the model. Gerard et al, (2006) in East Asia, China's competitiveness is being seen as responsible for shifts in production and foreign investment that have impeded growth in other countries in the region. Increasing strongly in the manufactured mass production products and finally turning to high-tech and capital goods as the economy's productive power matures. We can see that East Asian countries, such as China have very high productivities functions in terms of High-Tech products. The advantages that China has in terms of High-Tech exports were built upon foreign direct investments and labor intensive. A country which has a large labor force tends to have abilities to reduce the price of production in terms of High-Tech products.

Gerard et al (2006) indicated that China has such a labor resource endowment for generations and we must seek another explanation for China's current export competitiveness. Labor resources become one the key economic factors that has significant impact of High-Tech exports per labor.

Liu & Buck, (2007) concluded that domestic innovation performance in an industry is positively associated with the local Research and Development activities of multinational enterprises (MNEs) in that industry. Domestic innovation performance in an industry is positively associated with levels of imports of advanced technology in that industry. Foreign direct investments from those multinational enterprises are highly associated with R&D in terms of

High-Tech exports. Because of this hypothesis, R&D and FDI inflow from other countries have positive relationships of High-Tech exports. In other words, higher level of Research and Development can lead to higher innovation.

Haddad et al, (2010) indicated that the link between openness and growth volatility is indeed by the extent to which a country has openness and growth volatility diversified its export base. In other words, country's openness can impact its economy. High-tech export products are one of the major goods components in term of export base. As a result, Openness can effect High-tech export as well as others sector. Haddad et al, (2010) also claimed that using a cross-country panel, show that the growth effect of openness may indeed depend on a variety of structural characteristics, while consider how trade liberalization interacts with human capital policies as well as the quality of existing institution to determine actual growth outcomes. Finally, trade openness is one of the factors that can reduce and increase high-tech export in Asia-Pacific nations.

Furthermore, Xing (2011) concluded that China's openness to FDI and its rich endowment in labor constantly attract MNEs to relocate their product capacities, outsource labor intensive components to China and integrate China into their global production networks, thus boosting the production of high-tech goods. On the other hand, the production technology, distribution networks and brand names of MNEs function as vehicles for made-in-China products to access the global market. The case of China is given a good example for this study to investigate the correlation of foreign direct investment and openness as well as the relationship between these variables and high-tech exports.

Nevertheless, Srhlec (2007) said that increasing exports of high-tech products from the low-cost location, where the manufacturing segments relocate, whereas the most skill-intensive activities, such as research and development, might remain clustered in developed countries. This statement argued that country has the advantage of high-tech exports is not necessary to have research and development. The flip side is that research and development should not have any influences to high-tech export in the long run because Asia-Pacific nations are included developing and developed countries. As a result, R&D will be tested in the regression model, and conclusion will be given after the test.

The overall research and study will attempt to explain the correlation between Economic Factors and High-Technology Export in Asia-Pacific Nations. The regression analysis will provide necessary information to explain the relationship between high-tech export and others variable. All variables and conclusions in the literatures will be used to provide evidences to support this study.

4.0 DATA AND EMPIRICAL METHODOLOGY

4.1 Data

The study used annual data from 1997 to 2007, and data were obtained from World Bank Group.

Available data were included ten countries and were selected from Asia-Pacific nations. Summary

Statistics for the data are provided in Table 1 below.

Table 1 Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max	
htexport	110	4.32E+10	5.76E+10	6.63E+07	3.37E+11	
sperl	110	8495.903	8400.6	149.16	36953.6	
fdiin	109	4.902752	6.843849	-5.12	36.62	
openness	110	1.311626	1.235312	0.1896889	4.389016	
pa	105	53697.7	111166.7	25	384201	
rd	96	1.449167	0.9654142	0.05	3.44	
set	85	37.00271	27.75039	5.53	101.8	
gdpperl	110	26244.99	25044.85	731.99	77341.58	

4.2 Empirical Model

The model could be written as follow:

$$LNHTXPERL_{i,t} = \alpha_i + \beta_1 LNSPERL_{i,t} + \beta_2 FDIIN_{i,t} + \beta_3 OPENNESS_{i,t} + \beta_4 LNPA_{i,t} + \beta_5 R\&D + \beta_6 SET + U_i$$

Dependent Variable

LNHTXPERL- Log High-Technology Exports per worker (current US\$)

Independent Variable

LNSPERL- Log Gross Domestic Savings per worker (current US\$)

FDIIN- Foreign Direct Investment, net inflows (% of GDP)

OPENNESS- Country Openness

LNPA- Log Patent Applications, residents

R&D- Research and Development Expenditure (% of GDP)

SET- School Enrollment, tertiary (% gross)

$LNHTXPERL_{i,t}$ is the log of High-Tech export per worker from ten Asia-Pacific nations to country i at year t . In other words, ten countries from Asia-Pacific nations will be selected from 1997 to 2007. This study took place after Asian financial crisis in 1997. We want to capture which economic factors affected high tech export the most in that decade since 1997. Furthermore, Independent variable can indicate the economic growth among Asia-Pacific by increasing exports share of GDP. The investigation can explain the correlation between some independent variables and high-tech exports. The data of high-tech exports are difficult to interpret. Instead, the study created a new variable which was high-tech export per labor. The new variable can improve the interpretation of the model.

Six independent variables are selected to explain the relationship of high-tech exports. LNSPERL represents gross domestic savings per worker. Country that has higher saving rate will expect to have a higher export rate in general. FDIIN is foreign direct investment, net inflows measures the percentage of GDP inflows from other nations in terms of investing. OPENNESS is country openness, which is calculated by export plus import and divided by total GDP. Lower degree of openness will expect lower high-tech exports. LNPA is log patent applications for residents. It represents the number of applications in term of high-tech goods. R&D is research and development expenditure which reflect among of money that spend on research and development for new technology. Finally, SET is school enrollment, tertiary. It indicates the level of education for labor force.

5.0 EMPIRICAL RESULTS

Table 2: Regression results for the High-Tech exports

	OLS LNHTXPERL	Fixed Effects LNHTXPERL	Random Effects LNHTXPERL
LNSPERL	1.176*** [6.48]	0.255* [1.69]	0.419*** [3.01]
FDIIN	-0.289*** [-8.91]	-0.0266** [-2.14]	-0.0354*** [-2.84]
OPENNESS	2.062*** [8.92]	0.858*** [2.87]	1.143*** [4.66]
LNPA	0.608*** [6.29]	0.619*** [5.76]	0.469*** [5.28]
R&D	-1.349*** [-3.49]	0.133 [0.81]	0.0778 [0.45]
SET	0.0130* [1.88]	0.00684 [1.43]	0.00872 [1.76]
CONSTANT	-8.729*** [-6.32]	-2.938*** [-4.22]	-3.159*** [-4.09]
<i>N</i>	69	69	69

Note: ***, **, and * denotes significance at the 1%, 5%, and 10% respectively.

Standard errors in parentheses

The purpose of this study was to determine which independent variable has significant effect of high-tech exports. For this reason, the analysis is based on 69 observations for each independent variable. The data collected ten years period which from 1997 to 2007. Two independent variables are log form so that the interpretations are much accurate. The regression models are based on panel data. It means that fixed effect and random effect models would be considered in this study. The assumption of fixed effect models said that

there are unique attributed of individuals that are not the result of random variation. In other words, it does not vary across time. On the other hand, the assumption that random effect model was made only when there is no correlation between individual repressors and high-tech export in this case. In order to compare and contrast the data, OLS, Fixed Effect, and Random Effects models are provided above table 2. After running three models, this investigation was using Hausman test to determine which models are the best model among the three. The R – square within ten years data is 0.89, between Asian countries is 0.52, and overall is 0.43. The result of the probability is 0.4286 which is grater that 0.05. As a result, the model failed to reject the null hypothesis which is difference in coefficients not systematic. In other words, Hausman test suggested that fixed model should be used in this particular penal data.

Six variables had been tested, and the result of these regressions from fixed model show that only four out of six variables were statistically significant. Saving per labor is significance at 10% level. It indicant that high-tech export can be expected to increase for 0.25%, if saving per labor increase by 1%, holding all other variables constant. Even though the impact of saving had only little effect on high-tech exports per labor, yet the variable is still significant.

The second variable, foreign direct investment is also statistically significant at 5% level. This can be explained by the fact that more investment from other counties can lead to higher export products are being produced. The fixed effects model suggest that if foreign direct investment increased by 1 %, high-tech export per labor increased by 2.67%.

The third statistically significant variable is country openness. The result could indicate that high percentage of country openness will increase high-tech exports per labor at a very

high significant level. The expectation is made lot of sense based on the correlation between high-tech exports and all exports goods in general.

Finally, a patent application for resident is also indicated statistically significant at 1% level. In other words, 1% increased for patent application, high-tech export per worker increased by 0.619%. However, it is interesting to find out that research and development expenditure and school enrollment, tertiary are not statistically significant. Based on this result, the study suggested that research and development expenditure and high education had no impact to high-tech exports.

6.0 Conclusion

Country with large labor force tends to have abilities to reduce the price of production in term of High-Tech products. Labor resources become one the key economic factors that has significant impact on High-Tech exports in term of per labor. Domestic innovation performance in an industry is positively associated with levels of imports of advanced technology in that industry. Foreign direct investments from those multinational enterprises are highly associating with R&D in term of High-Tech exports. Because of this hypothesis, R&D and FDI inflow from others countries have positive relationship with High-Tech exports. In other words, higher level of Research and Development can lead to higher innovation. Nevertheless, the regression mode only showed that foreign direct investment is significant but not research and development expenditure. It is possible that country spent money on research and development but not necessary associated with high-tech products. As a result, the analysis should drop the research and development from the model.

Furthermore, saving per labor, trade openness, and patent applications are considered high quality of variables in this model, and they all have positive high-tech export per labor in Asia-Pacific nations. Although this study indicated that there is a correlation between four variables and high-tech exports per labor, but this study had limitation of data. Also, other factors that may include in this model were not analyzed in this study. Stronger data and evidence can able to improve and support this investigation.

Appendix A: Variables Description and Data Source

Acronym	Description	Data source
HTXPERL	High-Technology Exports per worker (current US\$)	United Nations, Comtrade database.
SPERL	Gross Domestic Savings per worker (current US\$)	World Bank national accounts data, and OECD National Accounts data files.
FDIIN	Foreign Direct Investment, net inflows (% of GDP)	International Monetary Fund, International Financial Statistics and Balance of Payments databases, World Bank, Global Development Finance, and World Bank and OECD GDP estimates
OPENNESS	Country Openness	World Bank, Doing Business project (http://www.doingbusiness.org/).
PA	Patent Applications, residents	World Intellectual Property Organization (WIPO)
R&D	Research and Development Expenditure (% of GDP)	United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics.
SET	School Enrollment, tertiary (% gross)	United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics.

Appendix B- Variables and Expected Signs

Acronym	Variables Description	What it captures	Expected sign
SPERL	Savings divide labor	Savings motive expenditure in term of high-tech export products	+
FDIIN	Foreign direct investment	Investment motive high-tech export	+/-
OPENNESS	Level of openness	Level of openness motive high-tech export	-/+
PA	Number of innovation in term of number of High-tech products	Number of patent application encourage innovation in term of high-tech export	+
R&D	Money spends on research and development in term of number of High-Tech products	Research and development motive high-tech export	+
SET	Education with tertiary	Education motive high-tech export	+

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Standard errors in parentheses

Table 3: List of Countries Analyzed

Country
China
Hong Kong SAR China
India
Indonesia
Japan
Korea Rep
Malaysia
Singapore
Australia
Vietnam

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