A GRAVITY ANALYSIS OF CHINA'S EXPORT GROWTH

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ABSTRACT

In the past decade, China experienced rapid growth in its export trade. This paper explores the major factors affecting China's exports. This paper conducts a gravity analysis based on the export of goods from China to 30 OECD countries between 1999 and 2005. The empirical results indicate that the traditional explanatory variables, GDP per capita and population have strong and significant effects on China's export trade, while physical distance and remoteness have negative effects as expected. Moreover, the empirical results also demonstrate that trade cooperation applies significantly positive effects on the export trade. Two other explanatory variables, regional economic organization APEC (Asian Pacific Economic Cooperation) and the exchange rate, do not significantly affect China's exports.

Keywords: China; Export; Gravity Model

Subject Terms: China; Export; Gravity Analysis

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1. Introduction

In the past two decades, the world has seen the Chinese economy's amazingly fast growth. China's great economic success not only raised the country's reputation in the world, but also improved the life quality of Chinese people. Since 1978 when China's communist government launched economic reform and applied the openness policy, the economy of China has increased tenfold in 27 years. From 2003, China's annual economic growth remained at 10% for three consecutive years. In 2005, China's gross domestic product (GDP) reached a record high 2234.3 billion USD. The contribution of China's GDP in world GDP grew up from 1.8% in 1978 to 5% in 2005. China also became the fourth largest economy in the world, next to the United States, Japan and Germany. According to data from the World Bank, between 2000 and 2004, economic growth in China contributed, on average, 15% of the growth of the world economy. Undoubtedly, China has become a powerful engine driving the global economy.

In the success of China's economy, China's export trade played an important role. Since the mid 1980s, the hot spot of China's economic growth started to move from domestic trade to international trade. Vast numbers of products labeled "Made in China" filled the shelves at supermarkets all over the world. With rich labor resources, extremely low labor cost and a strong manufacturing industry, China quickly revealed a comparative advantage in the world market and started to emerge as a leading export country. After being granted membership in the WTO (World Trade Organization) in 2001, China further integrated its international trade with the world economy by adjusting

its import/export policies and improved its investment environment. Thanks to the more flexible trade policy and the massive inflow of foreign direct investment, China had even greater success in its export trade. From 2002 to 2006, Chinese total exports expanded about 3 times, from 326 billion USD to 969 billion USD. The annual growth of exports was between 22% and 40%.

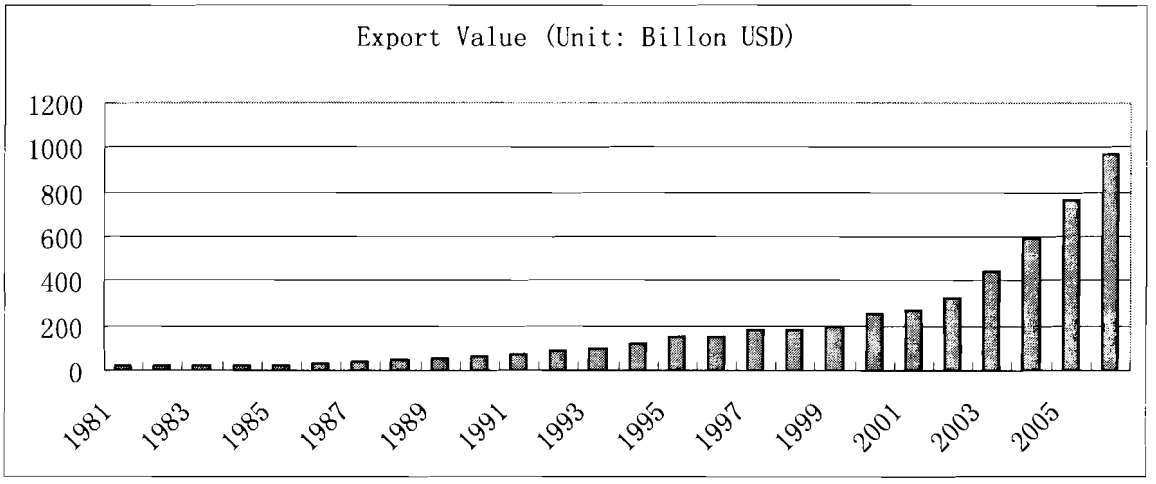

Figure 1: China's exports from 1981 to 2006[1]

As a large country with both rapid GDP growth and rapid export growth, understanding the factors behind China's success is not only helpful for other developing countries, but also for the sustainable development of China's exports. This paper addresses this issue.

The outline of this paper is as follows. In section 2, I provide some basic statistics about China's export growth and highlight a few export trade patterns. In section 3, following the introduction of the standard gravity model, an extended gravity model with more explanatory variables is proposed. Section 4 discusses the data sources and data

[1] The data come from China Customs official website. http://english.customs.gov.cn/

related issues. In section 5, a regression based on the extended gravity model is performed. The empirical results are reported and interpreted. Section 6 lists several concluding remarks derived from the empirical results. Section 7 ends the paper by describing a few known issues and possible future work.

2. Evaluation of China's exports

The most outstanding characteristic of China's exports is its fast growth. In 2001, the total amount of China's exports in goods was 266 billion USD. China was ranked as the 6th biggest export country. By 2005, China's export values in goods reached 761 billion. That means that China's exports in goods grew by almost threefold in 4 years. In the club of the biggest export countries, China became the third leading export country by surpassing England, France, and Japan. Meanwhile, the first two leading exporters were Germany and United States. In 2006, China recorded another 27% growth in its exports. The total exports in goods reached 969.08 billion USD. Especially, in the second part of 2006, China overtook the United States as the second-largest exporter in the world. OECD (Organization for Economic Co-operation and Development) (2005) even published an article to predict that "China could become world's largest exporter by 2010."

The rapid growth of China's exports can also be demonstrated by a comparison of export value with other countries or regions. Figure 2 shows the export statistics of 12 leading export countries or regions. As the two biggest exporters, Germany and United States form group 1, Japan is group 2, and the other 9 countries can be considered group 3. From 1999 to 2002, China was still in group 3 with France, Italy and Russia. From 2003 to 2005, China quickly departed from group 3, overtook group 2, and became a member of group 1.

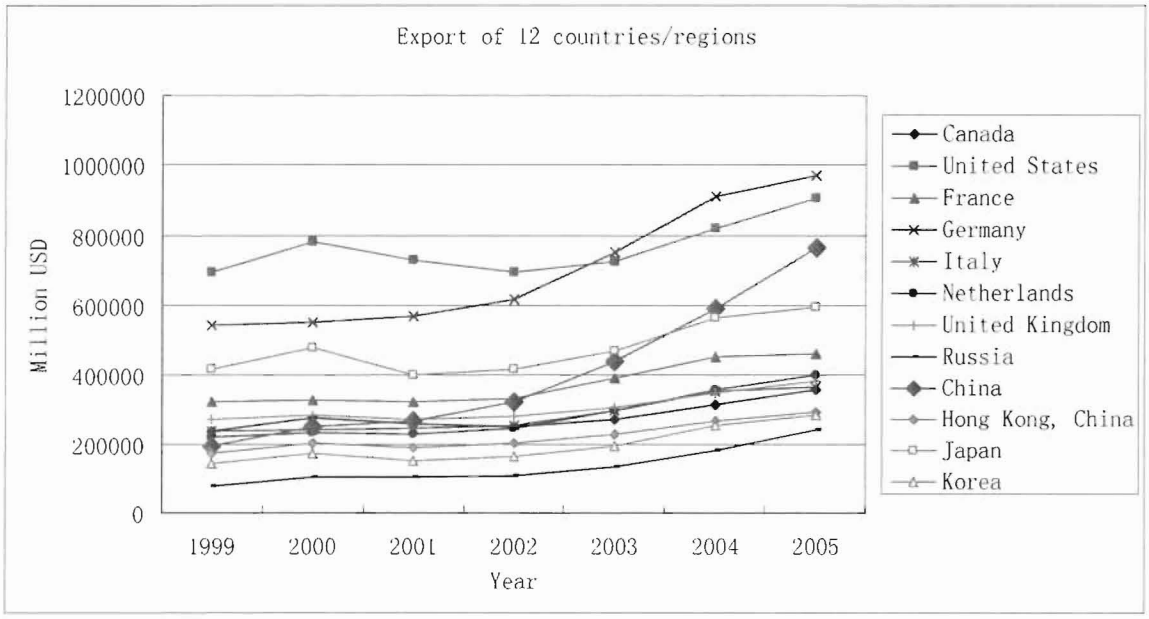

Figure 2: The export of 12 leading countries from 1999 to 2005[2]

Along with its rapid export growth, China achieved a bigger and bigger share in its major trading partners' import market. In 2005, China's top 10 export destinations were: the United States, Hong Kong, Japan, Korea, Germany, Netherlands, United Kingdom, Singapore, Taiwan and Russia. If considering the European Union countries as a whole, the European Union was the biggest export destination for China. According to the statistics provided by WTO, in 2000, China's shares in the import market of the European Union, United States and Japan were 2.7%, 8.6%, and 14.5% respectively. In 2005, China almost doubled its shares in the above three regions/countries to 4.7%, 15%, and 21.1% respectively.

[2] The data are from WTO's international trade statistics 2006.
http://www.wto.org/english/res_e/statis_e/its2006_e/appendix_e/a06.xls

Figure 3: the share of China's export destinations

In summary, China has achieved great success in its export trade. The success can be noticed not only from the speed of the export growth, but also by China's important share in the international export market. Exploring the factors driving the rapid growth of China's exports will be valuable for China to continue its advance and for other countries to repeat the success. As the most popular model in analyzing bilateral/multilateral trade, the Gravity Model is employed in this paper.

3. Gravity Analysis

This section begins by introducing the basic Gravity Model, and extends the model by adding more explanatory variables.

3.1 The Standard Gravity Model

The gravity model is an empirical model widely used in the research of international trade. The model was inspired by Newton's "Law of Universal Gravitation.", which explains the attractive force between two objects. Similarly, the gravity model tries to explain the attractive force between countries: the international trade flows between countries. In 1962, Jan Tinbergen, the Dutch economist who won the first Nobel prize in economics, first introduced the gravity model. Tinbergen (1962) believed that the trade flow between two countries is determined by the economies of scale and the distance between these two countries. The trade flow should be positively related to the economy of scales, which can be measured by the GDP or GDP per capita. Also, it is negatively related to the distance between the two countries. The basic model can be represented with the following log equation:

$$Log(T_{ij}) = \alpha Log(Y_i) + \beta Log(Y_j) - \gamma Log(D_{ij}) + \varepsilon$$

T_{ij} is the total trade amount flowing from country i to country j.

Y_i is the GDP of country i

D_{ij} is the distance between country i and country j

α, β, γ are coefficients for different components.

ε is the error term.

Although this model has been an empirical success, the theoretical justification for the model always raises disputes among scholars. Most scholars who object to this model believe that a law used in physics has no special validity when directly applied to

the economic domain. The model itself has a strong relationship with a geographic view of trade. It may ignore other important factors that can heavily affect trade flows.

To respond to the academic doubts, the economists who support the gravity model have actively looked for a theoretical foundation of the gravity model. Anderson (1979) made the first attempt. He derived a gravity model by using the properties of expenditure systems where the preference structure is similar and assuming a hypothesis of identical homothetic preferences across regions. Bergstrand (1985) derived the gravity model from a general equilibrium world trade model and illustrated that "the gravity model is a reduced form of a partial equilibrium subsystem of a general equilibrium model with nationally differentiated products." Deardorff (1995) demonstrated that the gravity model can be derived from the Heckscher-Ohlin Model with Cobb-Douglas preferences and with CES preferences.

While providing a solid theoretical foundation for the gravity model, economists also continued to enhance the gravity model and extended its flexibility. Linnemann (1967) changed the basic form of the gravity model and added a dummy variable for a reciprocity treaty. Years later, Helpman (1981) introduced product differentiation into the gravity model. Frankel (1995) argued that the physical advantages between trade partners, such as the common border, played an import role. After that, other economists, such as Garman (1998), added more independent variables, such as common language and regional trade integration, to make the gravity model more comprehensive.

3.2 The Extended Gravity Model

One major limitation of the standard gravity model is that the equation over-emphasizes the impact of geographic locations and ignores possible factors from other perspectives. Many scholars have made improvements by introducing more explanatory variables into the traditional gravity model. In this paper, I propose the following extended gravity model, which includes the remoteness, the relative exchange rate, the APEC dummy variable and a trade cooperation dummy variable.

$$\begin{aligned}\log(E_{ijt}) = \alpha &+ \beta_1 \bullet \log(pgdp_{it}) + \beta_2 \bullet \log(pop_{it}) + \beta_3 \bullet \log(pgdp_{jt}) \\ &+ \beta_4 \bullet \log(pop_{jt}) + \beta_5 \bullet \log(dist_{ij}) + \beta_6 \bullet \log(Exchange_{ijt}) \\ &+ \beta_7 \bullet \log(\mathrm{Re}moteness_{it}) + \beta_8 \bullet \log(\mathrm{Re}moteness_{jt}) \\ &+ \beta_9 \bullet APEC_j + \beta_{10} \bullet TC_{ij} + \varepsilon\end{aligned}$$

E_{ijt} represents the total exports from country i to country j in year t.

$pgdp_{it}$ is the GDP per capita of country i in year t. GDP per capita is used to measure the technical or education level of a country and the average income level. The higher the GDP per capita is, the higher the technical level and the average income are. Meanwhile, the higher technical level and the average income can mean that the country can export and import more in general.

pop_{it} is the population of country i in year t. The population of a country basically determines its consumer market and the labor market.

$dist_{ij}$ is the physical distance between country i and country j. It is measured by the distance between the two capitals. The distance between two countries can directly affect the transportation cost between two countries. The higher transportation cost causes the comparatively lower trade possibility.

$Exchange_{ijt}$ represents the relative currency exchange rate between country i and country j in year t. The definition of the relative exchange rate is explained in the section about data.

$\mathrm{Re}moteness_{it}$ represents the remoteness of country i in year t. Different from the physical distance between two countries, the remoteness of country i measures the relative distance between country i and all other countries in the world. For example, the physical distance between Australia and New Zealand is short. However, because Australia is relatively far from other countries in the world, the remoteness of Australia is high. The remoteness can partially indicate the connection of one country to the rest of the world.

$APEC_j$ is a dummy variable to indicate whether the country j is a member of APEC organization.

TC_{ij} is a dummy variable to indicate whether country i has a strong trade cooperation relationship with country j. Trade cooperation means that the two countries

have signed a free trade treaty, have accessed the same regional trade agreement or are negotiating potential trade agreements. Trade cooperation might lower the import cost from one country to another. It also grants a country unique trading benefits compared to other countries that do not have a trade cooperation relationship. As a result, the trade between the two countries could be improved.

α is the constant; ε is the error term.

Traditionally, country GDP is used in the gravity model to represent the economy size of a country. In my extended model, GDP per capita and population are used instead. From the mathematic perspective, this change does not make any difference because $\log(gdp_i) = \log(pgdp_i \bullet pop_i) = \log(pgdp_j) + \log(pop_i)$. From the statistical perspective, the regression result might be slightly different. The intention is to explore the impact of PGDP and population, not the impact of GDP as a whole.

Other than the classic gravity model explanatory variables, some other repressors are introduced in the extended model. Some governments, especially United States, believed that the undervalued exchange rate of China's currency RMB strongly stimulated the exports of China and urged the appreciation of RMB. Therefore, the exchange rate is included in this model to evaluate its significance on the export growth.

In the current world, trade barriers between countries are the major factor handicapping bilateral trade. Economic cooperation organizations offer opportunities to mitigate this barrier. This is why many countries are enthusiastic about building regional economic groups or joining existing trade organizations. WTO, NAFTA (North America

Free Trade Agreement), and ASEAN (Association of Southeast Asian Nations) are the best examples of such economic organizations. Because China is a major member country of APEC, it might be helpful to evaluate the effect of APEC on China's exports. Although China is also a member country of WTO, we did not add a dummy variable for WTO because all sample countries in the data set are also WTO members.

In a few recent studies, remoteness was included as a component of their augmented gravity models. As an index to measure the GDP weighted average distance of a country to the rest of the world, remoteness is normally calculated based on the sum of the ratio of the physical distance to GDP. Different from the physical distance that predicts the transport cost of goods, the remoteness can be used to evaluate the accessibility of a country to other export sources. The lower the remoteness of a country is, the easier this country can access the export sources. Therefore, the country may have the potential to import more goods.

Other explanatory variables, such as border, common language, colonial history, are not included in the extended model because they are not applicable to China.

3.3 Data

The data set for this analysis has 210 observations, over a period of 7 years (1999-2005). The countries included in this data set are members of the OECD: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden,

Switzerland, Turkey, United Kingdom, and United States. The data set is used because on one hand, the data offered by OECD are more available and accessible; on the other hand, the trade of OECD members contributes the major part of the world trade. According to the OECD's 2006 annual report, the OECD share of the world trade was 75%. The statistical data retrieved from the OECD official website include GDP, GDP per capita, Population and Export in goods. The descriptive statistics of the data set is shown in the Appendix section.

The currency exchange rate data come from the internet data source http://www.chartflow.com/ozforex/averageRate.asp. Because the currency units between China and other countries are quite different, it is not fair to directly use the value of the exchange rate. Instead, the relative exchange rate is calculated by dividing the exchange rate of one year (1999 to 2005) by the exchange rate of 1998. The relative exchange rate is employed in the extended model to represent the moving trend of the currency exchange rate.

The distance between two countries is measured by the distance between their capitals. The distance data between capitals are retrieved from http://www.geobytes.com/CityDistanceTool.htm.

The remoteness of a country is calculated based on the equation $R_i = 1/(\sum_j (GDP_j / Dist_{ij}))$. R_i is the remoteness of country i. GDP_j is the GDP of country j. $Dist_{ij}$ is the distance between country i and country j. This equation is suggested by Head (2003). Its form is slightly different from the previous ones for calculating remoteness. As per Head, the new form can mitigate the impact of economy

size of the very distant countries. According to this equation, the higher the remoteness is, the relatively distant the country is. It is not necessary to collect GDP data and distance for all countries in the world. In this paper, the remoteness is calculated based on a group that only includes 30 OECD countries and China. Table 1 shows the remoteness of 30 OECD countries and China in year 2005. As expected, Australia and New Zealand have the highest remoteness values. The remoteness values of European countries are relatively low.

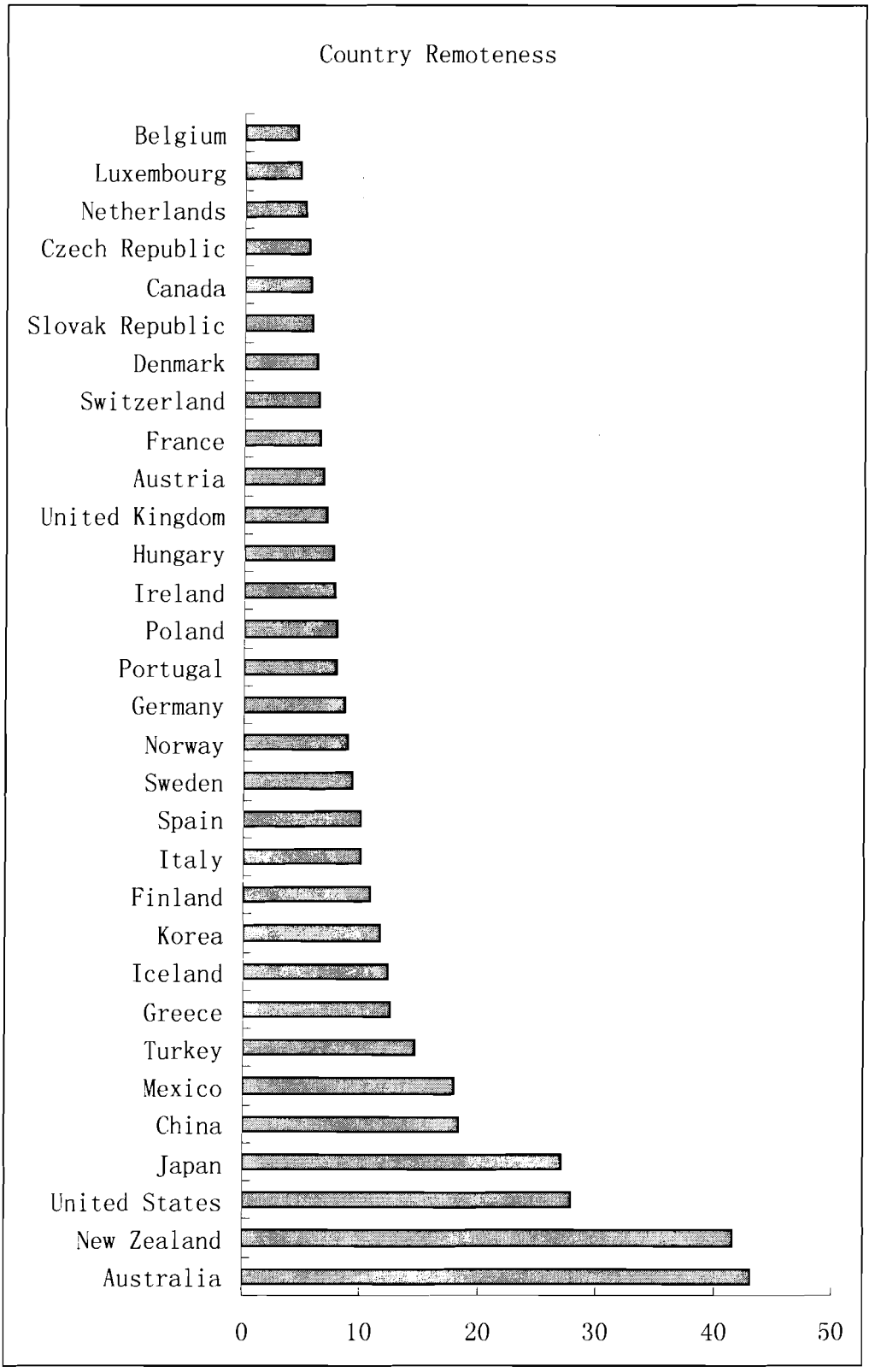

Figure 4: remoteness of selected countries in 2005

Among the 30 OECD countries, Japan, Korea, United States, Canada, Australia and New Zealand are the APEC membership countries[3]. In the data set, the APEC dummy variable of these countries is set to 1.

The information about China's trade agreements is extracted from the official website of Ministry of Commerce of the People's Republic of China and Antkiewicz's working paper (2004). In 2001, China became a member country of the Bangkok agreement organization that includes Korea. Therefore, China indirectly set up a regional trade agreement with Korea. China signed regional trade agreements with Hong Kong, Macao, ASEAN, Chile, Pakistan, Australia, and New Zealand. Trade agreements are either in negotiation or under discussion with South Africa, India, Iceland and the Gulf Cooperation Council. Therefore, in the data set, the TC dummy variable for the 4 countries, Korea, Iceland, New Zealand, and Australia, is set to 1.

3.4 Regression Results

Table 1 presents the ordinary least square (OLS) estimates of the extended gravity model estimated with EViews.

[3] The data about APEC membership are collected from Wikipedia. http://en.wikipedia.org/wiki/APEC

Dependent Variable: LOG(EXPORT_VALUE)

Method: Least Squares

Sample: 1 210

Included observations: 210

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	918.76	893.51	1.03	0.30
LOG(CHINA_PGDP)	6.37	4.05	1.57	0.12
LOG(CHINA_POPULATION)	-45.16	42.66	-1.06	0.29
LOG(COUNTRY_PGDP)	0.80	0.06	13.25	0.00
LOG(COUNTRY_POPULATION)	1.14	0.04	28.60	0.00
LOG(DISTANCE)	-0.16	0.10	-1.62	0.11
LOG(EXCHANGE_RATE_CHANGE)	0.30	0.37	0.81	0.42
LOG(REMOTENESS_CHINA)	1.22	6.95	0.18	0.86
LOG(REMOTENESS_COUNTRY)	-0.32	0.11	-2.84	0.01
APEC	0.09	0.16	0.55	0.58
TC	0.92	0.20	4.64	0.00

R-squared	0.90	Mean dependent var	21.82
Adjusted R-squared	0.89	S.D. dependent var	1.80
S.E. of regression	0.59	Akaike info criterion	1.83
Sum squared resid	69.26	Schwarz criterion	2.01
Log likelihood	-181.50	F-statistic	174.30
Durbin-Watson stat	1.93	Prob(F-statistic)	0.00

Table 1: OLS Regression Result for the extended model

The adjusted R-squared value is 0.90, which means that the extended gravity model has strong predictive power. The regression results suggest that the export destination country's GDP per capita and population have positive effects on the China's export trade. The coefficients for the destination country's GDP per capita and population are 0.80 and 1.14 respectively. These two coefficients are also statistically significant because their t-statistic values are 13.25 and 28.59. Especially, another

interesting fact is that the destination country's population may have bigger influence than its GDP per capita. It means that the increase of population in a destination country may cause more requirements for importing goods than the increase of income or education level in the same country.

The parameter estimates on China's GDP per capita and population are 6.37 and -45.16. It seems that China's population has a strongly negative impact on its exports. However, this result may not be true because the estimate is not statistically significant (t-statistic = -1.06). The t-statistic of China's GDP per capita is 1.57, which is significant at about 0.9 confidence level. It indicates that the improvement of education and technical level may benefit China's exports.

As expected, distance between China and the destination country negatively impacts its exports. The estimated coefficient for distance is -0.16 and the t-statistic value is -1.62, which is relatively significant. The absolute value of the coefficient is not high. It means that with the fast progress of transportation technique, distance may not have the strongly negative impact on its exports.

The coefficient estimated on the relative exchange rate is 0.30. Although the sign of this coefficient is positive, this parameter estimate does not have strong explanatory power on China's exports because of its low t-statistic value 0.81. That means that based on the regression in this paper, the lower exchange rate does not necessarily have an effect on China's exports.

The parameter estimate on China's remoteness is positive, but not statistically significant. So, the impact of China's remoteness can be ignored. The estimate on the

destination country's remoteness is negative and statistically significant. This result suggests that the relative distance of the destination country may hamper its import trade with China.

Because of the low t-statistic value (0.55), the dummy variable APEC does not have statistical significance in explaining China's exports. That indicates that China does not get significant benefit on its exports from its membership in APEC although the coefficient sign is positive.

As expected, the parameter estimate for the trade cooperation has a high positive value (0.92) with statistical significance (t-statistic value = 4.63). This regression result suggests that trade cooperation can effectively facilitate export trade between China and other countries.

Some estimated coefficients imply that part of independent variables may be correlated. The Appendix section contains a table demonstrating the correlation between regressors. As a result, some of the regressors are ignorable. Meanwhile, given the fact that some repressors are not statistically significant in the previous model, it is worthwhile to check the regression result by removing these regressors. The reduced gravity model is as follows.

$$\log(E_{ijt}) = \alpha + \beta_1 \bullet \log(pgdp_{it}) + \beta_2 \bullet \log(pgdp_{jt}) + \beta_3 \bullet \log(pop_{jt}) + \beta_4 \bullet \log(dist_{ij}) + \beta_5 \bullet \log(\mathrm{Re}moteness_{jt}) + \beta_6 \bullet TC_{ij} + \varepsilon$$

Where

$pgdp_{jt}$ is the GDP per capita of country j in year t.

pop_{jt} is the population of country j in year t.

$dist_{ij}$ is the physical distance between country i (China) and country j.

$\mathrm{Re}moteness_{jt}$ is the remoteness of the country j in year t.

TC_{ij} is the dummy variable of trade cooperation between country i and country j.

Dependent Variable: LOG(EXPORT_VALUE)
Method: Least Squares
Sample: 1 210
Included observations: 210

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-28.86	3.45	-8.37	0.00
LOG(CHINA_PGDP)	2.60	0.25	10.51	0.00
LOG(COUNTRY_PGDP)	0.83	0.06	14.63	0.00
LOG(COUNTRY_POPULATION)	1.15	0.04	31.83	0.00
LOG(DISTANCE)	-0.18	0.10	-1.90	0.06
LOG(REMOTENESS_COUNTRY)	-0.30	0.10	-3.00	0.00
TC	0.97	0.19	5.21	0.00

R-squared	0.90	Mean dependent var	21.82
Adjusted R-squared	0.90	S.D. dependent var	1.80
S.E. of regression	0.59	Akaike info criterion	1.82
Sum squared resid	70.75	Schwarz criterion	1.93
Log likelihood	-183.74	F-statistic	289.38
Durbin-Watson stat	1.90	Prob(F-statistic)	0.00

Table 2: OLS Regression Result for the reduced model

The regression results on the reduced model are similar to that of the previous model. The adjusted R-squared value is still high (about 0.90). It means that the

regression based on the reduced model matches the data set well and has good capability to predict too. The regression results suggest that all independent variables, China's GDP per capita, the other country's GDP per capita, the other country's population, the distance, the remoteness of the other country and the trade cooperation, has strong explanatory power on China's exports. Meanwhile, their signs match the results estimated from the previous model too.

4. Conclusion

4.1 Concluding remarks

To explore the reasons behind China's fast export growth, this paper proposes an extended gravity model and performs an OLS regression on a data set involving 30 OECD countries. The empirical results not only prove that the gravity model is applicable to China's exports, but also provide a number of insightful facts.

The GDP per capita and population of the importing country have strong positive effect on China's exports. Higher GDP per capita indicates that the consumers in the importing country has higher income and are able to consume more commodities. Larger population always represents a larger consumer base. China should adjust its industrial structure and export strategy for countries of high GDP per capita and large population, such as United States and Japan. That way, China can further explore the import potential of these countries.

As an indicator of transportation cost, physical distance plays an important role in impacting China's exports. Distance causes higher transportation costs that to some degree hampers the opportunity for its export trade. Meanwhile, the relative distance or remoteness of the destination country has a significant effect on China's exports. This fact suggests that China may have better opportunities to export goods to countries in the same physical region or countries with a lower remoteness.

Trade cooperation has been an effective tool to remove or mitigate trade barriers between countries. The empirical results demonstrate the significant power of trade cooperation on China's exports. The trade cooperation relationship can directly cause an increase in the export value to the destination country. China government should actively promote trade negotiations with other countries to sign a free trade agreement or develop deeper economic cooperation.

The empirical results fail to reveal evidence of a significant effect from exchange rate variation and membership in APEC. A low value of the exchange rate might be one reason promoting China's exports. However, the impact of exchange rate variation is limited and different from country to country. Technically, APEC is a regional economic forum, not a formal economic organization like EU or ASEAN. Plus given its shorter history, the effect of APEC has not started to emerge on China's current export trade.

4.2 Known issues and future research

For regression analysis, the data set is very important. In my data set, I included the data for 30 OECD countries from 1998 to 2005. However, other big trading partners are omitted, including Russia and some ASEAN countries. The data for 2006 are not included in the data set either. To make the regression more comprehensive and accurate, the data set should be enriched in the future research.

Tariff, reimbursement, foreign investment and economic freedom are also major factors impacting export trade. The importing country can easily use tariff to adjust the amount of specific imported goods. The country can even apply antidumping acts to

restrict the import. Reimbursement is often used by the Chinese government to promote the export of commodities and manipulate the export structure. Because of the lower cost and higher return, many foreign companies extend their business in China by opening new factories and transporting manufactures directly to European and North America market. FDI (Foreign direct investment) is emerging as a powerful engine to drive China's export growth. Economic freedom is a measure to evaluate how one can perform economic activity without interference. A country with a high degree of economic freedom often offers a more open market and allows more freedom of trade. Because of the extensibility of the gravity model, it is possible to include all of these factors as new explanatory variables in the gravity analysis.

The analysis performed in this paper concentrated on the overall export trade from China to other countries. From 1990 to 2006, China had made huge effort in reforming the infrastructure of its exports. High tech products are replacing the leading position of textile and machinery in China's exports. Therefore, it will be interesting to explore the export infrastructure and use the gravity model to analyze the change of China's export infrastructure.

Appendices

Appendix A: The correlation table of regressors

	LOG(EXPORT_VALUE)	C	LOG(CHINA_PGDP)	LOG(CHINA_POPULATION)	LOG(COUNTRY_PGDP)	LOG(COUNTRY_POPULATION)
LOG(EXPORT_VALUE)	1.000000	NA	0.275829	0.271771	0.152563	0.830089
C	NA	NA	NA	NA	NA	NA
LOG(CHINA_PGDP)	0.275829	NA	1.000000	0.996490	0.056383	0.007929
_POPULATION)	0.271771	NA	0.996490	1.000000	0.056398	0.007914
TRY_PGDP)	0.152563	NA	0.056383	0.056398	1.000000	-0.221808
TRY_POPULATION)	0.830089	NA	0.007929	0.007914	-0.221808	1.000000
LOG(DISTANCE)	-0.235490	NA	-1.01E-17	-1.78E-28	-0.011188	-0.144662
E_CHANGE)	0.223630	NA	0.427996	0.393012	0.287817	-0.053248
LOG(REMOTENESS_C)	-0.272359	NA	-0.990518	-0.987541	-0.056888	-0.007859
LOG(REMOTENESS_R)	0.265980	NA	-0.076497	-0.076851	-0.033203	0.299473
APEC	0.444843	NA	-4.70E-17	3.26E-17	0.052687	0.399517
TC	-0.089018	NA	3.74E-17	-6.45E-18	0.044558	-0.251999

TC	APEC	LOG(REMOTENESS_R)	LOG(REMOTENESS_C)	LOG(EXCHANGE_RATE_CHANGE)	LOG(DISTANCE)
-0.089018	0.444843	0.265980	-0.272359	0.223630	-0.235490
NA	NA	NA	NA	NA	NA
3.74E-17	-4.70E-17	-0.076497	-0.990518	0.427996	-1.01E-17
-6.45E-18	3.26E-17	-0.076851	-0.987541	0.393012	-1.78E-28
0.044558	0.052687	-0.033203	-0.056888	0.287817	-0.011188
-0.251999	0.399517	0.299473	-0.007859	-0.053248	-0.144662
-0.274857	-0.218483	-0.079049	7.91E-19	-0.235000	1.000000
0.141117	0.166123	-0.039374	-0.398735	1.000000	-0.235000
-2.87E-17	1.42E-17	0.077643	1.000000	-0.398735	7.91E-19
0.553543	0.705189	1.000000	0.077643	-0.039374	-0.079049
0.479140	1.000000	0.705189	1.42E-17	0.166123	-0.218483
1.000000	0.479140	0.553543	-2.87E-17	0.141117	-0.274857

Appendix B: The statistic summary of the data set

Variables	Mean	Median	Standard Deviation
CHINA_PGDP	1134.062	1105.958	190.1460
CHINA_POPULATION	1.28E+09	1.28E+09	16895706
COUNTRY_PGDP	21155.49	23177.81	11586.27
COUNTRY_POPULATION	38125124	10716225	56570596
EXCHANGE_RATE_CHANGE	0.995737	1.000000	0.147608
DISTANCE	7812.667	7860.000	2186.076
REMOTENESS_CHINA	19.7	19.7	0.8
REMOTENESS_COUNTRY	13	8.8	10.9
EXPORT_VALUE	1.31E+10	2.77E+09	3.17E+10

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