**China’s Intra-Industry Trade and Country Specific Determinants.**

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***Abstract:*** A lot of studies have been made concerning intra-industry trade for developed or industrialized countries and not so much for transitional economies like China. The purpose of this thesis is to analyze the trend of Chinese intra-industry trade with 20 partner countries and to empirically test six country specific determinants during a time period of 22 years (1990-2011). Intra-industry trade (IIT) will be calculated using the Grubel and Lloyd index, which is the most readily used index to calculate IIT. Trade will be divided into seven sectors (machinery, metal, chemical, food, textile, transport, electrical) and each sector will have its own regression analysis to test the country specific determinants. The regressions yielded some surprising results. Three determinants revealed themselves to be quite significant. Population and GDP in terms of purchasing power parity (GDP\_PPP) define how similar two markets are and the results show that the more similar two markets are, the more likely trade will take place. However, trade imbalance (BOP) was significant in 5 sectors as well.

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# 1 Introduction

## 1.1 Motivation

 The theory of intra-industry trade, the simultaneous import and export of a set of commodities in the same product group, has been used by scholars to analyze trade flow. IIT is important because it is part of international trade. International trade is not just inter-industry trade, because countries often import and export products within the same industry. Variety of preferences within an industry creates IIT, implying that comparative advantage is no longer the only way to analyze international trade. The Heckscher-Ohlin-Samuelson model was the model that economists used for a long time to describe trade patterns and it is based on comparative advantages. The model states that a country will export the commodity that uses the relatively abundant factor and import the commodity that requires use of its relative scarce factor. Differences in factor endowments creates differences in factor and product prices. The bigger the differences in factor endowments between two countries, the bigger the trade is expected to be. However, Greenaway and Milner (1986) revealed that IIT is common between countries with little differences in factor endowments or factor prices.

Most of the studies concerning IIT, both empirical and theoretical, have focused more on western countries or developed economies. Trade analysis in developing economies, such as China, are now attracting more attention because of their high economic growth rates and rapid integration into the world economy. Due to the increase of overall trade , their economies are restructuring. Institutional reforms, as is the case with China, have changed the position of these emerging countries/economies in the world economy. China’s economic liberation, led to China’s trade success with very impressive growth rates. This process of economic reform started in 1978 and lead to them joining the WTO in 2001.

 The motivation of this thesis is to analyze the pattern of IIT between China and twenty partner countries. The statistical data focuses on seven sectors which are machinery, metal, food, electrical, textile, transport, and chemicals. This will be done from 1990 to 2011 in order to get a clear view of how China’s opening up policy affects the IIT. The second purpose of this thesis is to test the country specific determinants of IIT to see how they have influenced China’s economic growth in this transition period. A regression model will be created for each sector from which the impact of the various determinants can be deduced.

## 1.2 Historical Antecedents

During the 1960’s, economists like Pieter Verdoorn (1960) and Bela Balassa (1963, 1966) first studied the increase in trade flows among European countries. The study of IIT really took off with the publication of Herbert Grubel’s and Peter Lloyd’s book in 1975. They provided the empirical evidence of the importance of IIT and how to measure the magnitude of IIT. Further developing theoretical explanations concerning IIT were developed by Paul Krugman (1979). The examination of the empirical determinants of IIT was accredited to David Greenaway (1994). Grubel and Lloyds formula to calculate the magnitude of IIT has been the one that is most commonly used.

 In the case of China, not many case studies have been performed. In fact, there are limited case studies concerning transition economies and empirical evidence of China’s IIT is quite scarce. Hellvin (1996), Hu and Ma (1999) and Zhang, Witteloostuijn and Zhou (2005) studied IIT in China and have gone to classify IIT into horizontal and vertical intra-industry trade. Horizontal intra-industry trade (HIIT) is trade in similar products with different varieties. Vertical intra-industry trade (VIIT) is trade in differentiated products that are distinguished by price and quality like China importing high quality clothes from France and exporting low quality goods to France. However, I will not elaborate on horizontal or vertical IIT and focus more on total intra-industry trade in the seven sectors.

## 1.3 Outline of Thesis

 This thesis is divided into two parts. The first part of this thesis will analyze the IIT trend of China with twenty partner countries covering a period of 1990 up to 2011. IIT will be analyzed as total IIT and it will be divided among seven sectors; chemical sector, electrical sector, food sector, machinery sector, metal sector, textile sector and the transport sector.

The second part will tests the country specific determinants of IIT, which are GDP(PC), GDP(PPP), FDI, BOP (balance of payments), Distance and Population. Each sector will have its own regression for which the determinants will be tested.

The theoretical part of the thesis will explain the changes in Chinese economic policies and the Grubel and Lloyd index in detail. Chapter 2 will focus on Chinese economic policies that have been implanted since 1978. The focus will lie on the changes the Chinese have made such as the open door policy. Chapter 3 will explain intra-industry trade. This chapter is divided into two parts. The first part will explain the theory of intra-industry trade eventually leading to the Grubel and Lloyd index. The second part will explain the determinants of IIT. Chapter 4 is the second or empirical part of the thesis. The methodology will be explained and it contains the statistical data calculated used for the Grubel and Lloyd index. Chapter 5 will show and explain the regression results. The conclusions will be the final chapter.

# 2 Chinese Economic Policies

## 2.1 History of Chinese Economic Policies

 China lived in isolation with many trade barriers to keep total control until the late 1970’s. The reform of China’s economic policy started on December 22, 1978 when the partly leaders concluded that the Maoist version of the centrally planned economy had failed to produce economic growth. It was decided that a gradual and fundamental reform of economic policies must be introduced. The purpose of the reform was to gradually introduce market mechanisms into the system in order to reduce government planning and direct control. These market mechanisms are normally present in free markets and not in controlled markets such as communist China. However, the Chinese introduced these mechanisms in a few small areas and if they proved successful, they would be introduced into the rest of China. In the period of readjustment of 1978-1984, the first and successful introduction was the Household Responsibility System. (http://www.chinaculture.org) This system allowed individual farm families to produce food on a piece of land for profit and in return the families would send a set amount of the food to the government at a set price. Almost immediately the production costs went down and the total produce increased. China had hundreds of millions of farmers whose living standards improved. Reforms were also introduced in urban industry to see if production could be increased there as well. A dual price system was introduced and commodities were sold at both planned and market prices. This was followed by the first introduction of private businesses since the communistic takeover, which increased the total output of industries even more. The service sector then needed boosting so price flexibility was introduced. China was ready for foreign investment and this was first allowed in the Kuomintang area. A series of special economic zones were created where bureaucratic regulations and other interventions where almost not present. These regions are like small economies on their own in the sense that these areas were completely enclosed and shut off from the rest of China. These ‘economies’ were much more liberal and salaries in these areas were much higher compared to salaries outside the special economic zones. This was done to see the effects on a small scale before gradually expanding these zones. These zones ended up being the driving force behind China’s economic growth.

After this initial period of reform, came a second period that lasted from 1984 until 1992. Initial economic policy reforms were increased. Government intervention decreased as did the control of private business. The first state-owned-enterprises were privatized. This notable development of decentralization of state control gave local provincial leaders the possibility to experiment ways in which they could increase their own economic growth and privatize the state sector. Private and village enterprises began to gain market share decreasing the share of the state sector, which eventually led to the re-opening of the Shanghai Stock Exchange in 1992.

Further reforms were to be implanted to start a new period of reform. The average import tariffs were reduced from 43.2 percent in the early 1990’s to 15.3 percent in 2001! (P. Drysdale and L. Song, 2000) In line with this development Chinese trade expanded impressively. This left the opposition powerless. In 1997 and 1998 large scale privatization occurred leaving just a small large monopolies and the rest were sold off to private investors. The last step the Chinese took was joining the World Trade Organization in 2001. This meant that further reforms had to be made or else they could not join the WTO. The lowering of tariffs on imports, the permission for foreign companies to sell directly on the Chinese domestic market, and the opening up of the finance and telecommunication sectors to foreign competition where just some of the reforms that were implemented.

The GDP in China since these reforms has grown tremendously and it has been the highest of the world over the last three decades. Ever since the beginning of the reforms in 1978, China accomplished a steady and exceptionally high growth. Even the impact of the Asian Financial Crisis in 1997 could not deter the overall economic growth.

**2.2 China’s Trading Partners**

To further explain how China’s IIT has grown, an analysis is made using twenty partner countries. These twenty countries include developed economies such as Japan, and USA but, also developing or transitional economies like Brazil and Malaysia. Some surrounding Asian countries like South Korea, Malaysia and Singapore are used since they are big trading partners of China. Countries like South Africa and Brazil were included to see if Distance is a significant determinant in IIT.

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# 3 Intra-Industry Trade

## **3.1 Theoretical background of IIT**

Intra-industry trade is unrelated to the market structure or the production function with respect to returns to scale. The magnitude of IIT will vary depending on the market structure of a given industry. The magnitude of IIT will likely be bigger in an open market with many differentiated products, as opposed to a monopolistic market. The consumer is more likely to find his preferred product in an open market with more choices available, as opposed to monopolistic market, since there are more suppliers in an open market.

 Economies of scale and products differentiation are important for the trade pattern of IIT. Increasing returns to scale plays an important role in IIT. Economies of scale in production, makes each firm produce a specific set of varieties of products within a product group. Countries will now gain from having a large market through trading. If there is a situation with constant returns to scale, then the production is determined by comparative advantages. Therefore, economies of scale are very important for IIT.

In order for IIT to take place, product differentiation is crucial. Consumers want the biggest amount of product variety possible since their utility increases as the variety increases. This in return implies that the bigger the variety, the more IIT will take place and both countries will gain from IIT. Consumers want to have the option to have as many varieties of a certain product from all over the world. Consumer preference is basically the driving force behind IIT.

There are two types of product differentiation, namely vertical and horizontal product differentiation. Products that are produced within a particular industry but, have a different quality is known as vertical product differentiation. Prices within this industry vary depending on the quality because the higher the quality, the higher the price will be. In horizontal product differentiation prices are not relevant. If two products have the same price, then it is likely that a consumer will buy the product that is preferred while another consumer will prefer the other variety.

## 3.2 Literature Review of Trade Theories

 Before the introduction of the Grubel and Lloyd index economists used the Heckscher-Ohlin-Samuelson (HOS) model to measure international trade. The HOS model was built on the theory of comparative advantage from David Ricardo. The HOS proposes *“that in a neoclassical framework with two final goods, two factors of production, and two countries which have identical homothetic tastes, a country will export the good which intensively uses the relatively abundant factor of production.”* (Marrewijk, 2002) The HOS uses the assumption that the production of manufactures is capital intensive, which can lead to two outcomes. The first one is that if a country has abundant capital, then it will export the capital intensive good. The second outcome would be if a country is abundant in labor, then it will export labor abundant goods. The problem with this model is that this model assumes that the only differences between countries are either in relative abundance of capital and labor. This 2x2x2 model allows for the comparison of two countries, two commodities, and two factors of production. The problem therefore with this model was its poor predicting power. Factor endowments can’t predict or give an adequate explanation for international trade patterns. Especially when this model assumes that the production functions are identical for all countries. This is not realistic since countries have clear differences in their levels of technology or production.

## 3.3 Indices of Intra-Industry Trade

 There are several alternative ways to estimate the degree of IIT. The most widely preferred and used index to measure the extent of IIT is the Grubel-Lloyd (G-L) index. Other indices are the Balassa index, the Aquino index and the Bergstrand index. These indices had critique on the G-L index since their initial index did not take a country’s trade imbalance into account. Grubel and Lloyd proposed a new formula that did take a country’s trade imbalance into account, known as the adjusted G-L index.

**The Balassa Index**

 Although Liesner (1958) was the first to use an revealed comparative advantage (RCA) index, the most common one is the Balassa index after he refined it in 1965 and in 1989. The Balassa index measures export shares of a particular country’s industry with respect to the exports of a group of reference countries in that same industry.

 (1)

where is country *a*’s export value of industry *j* and is the export value of industry j for the group of reference countries. and represent the total export value of country A and the total export value of the group of reference countries respectively. If , then country *a* has a comparative advantage in industry *j* because this industry is more important to country a than it is for the exports of the group of reference countries.

**The Grubel-Lloyd Index**

In 1975 Grubel and Lloyd introduced their index to measure IIT. It measures intra- industry trade as a percentage of a country’s total trade under the assumption that trade was balanced, implying that exports and imports are equal. So for an individual product group or industry *i,* the index is as follows;

 (2)

Where and represent the values of country *j*’s export and imports respectively for commodity *i*. Basically, if all trade was balanced, then the GL index would equal 1. While on the other hand, if all trade was one way, then the GL index would equal 0. This implies that the closer the index is to 1, that more of the trade in this industry is intra industry trade. The GL index therefore takes values ranging from 0 to 1.

Grubel and Lloyd (GL) then changed their equation in order to get an overall measure of IIT across industries. GL proposed calculating a weighted mean by using the relative size of exports and imports of a particular product group as weights. This led to the following formula;

 (3)

Where refers to all the ’s weighted by total trade of that particular industry.

*J* stands for the *j*th country and *i* stands for the *i*th of *n* industries. This formula was then simplified to;

 (4)

or

 (5)

for *n* set of industries.

Now the index measures average IIT as a percentage of the export and import trade. The GL index is a weighted mean since the share of some products is higher than others within total exports and imports. A simple average of all ‘s would give misleading results.

The indices from equations (2) to (5) do not allow for any imbalance in the total trade of a country. This is not acceptable according to Grubel and Lloyd because if there is an imbalance, then the index will be biased and as a result, the share of IIT will likely be underestimated. GL corrected this deficiency and proposed the adjusted GL index by incorporating trade imbalance into their fourth (4) equation.

 (6)

where is the adjusted GL index.

The denominator in equation (4) has been reduced by the amount of country *j*’s overall trade imbalance when compared to equation (6). This implies that when a country’s trade imbalance increases, then the difference between and should also increase. This adjusted measure of the GL index incorporates the total trade imbalance implying that it is measured with respect to total balanced trade. However, recent studies have shown that this may induce rather than adjust a measurement bias. Therefore the trade imbalance will be incorporated as a determinant into the model.

**The Aquino Index**

 The Aquino index was introduced in 1978 as a critique on the unadjusted GL index, which failed to correct for a trade imbalance in the overall trade of a country and therefore underestimated the true extent of intra-industry specialization. According to Aquino, the GL index needs to be adjusted for this trade imbalance instead of just calculating the weighted average of the GL index. Aquino proposed adjusting the GL index, whenever the total trade of a country is unbalanced, to then estimate the overall average for the country using the adjusted GL ratios. This led Aquino to the following formula;

 (7)

Where represents the adjusted (adj.) exports of industry *i* between countries *k* and *j*.

The adjusted imports of industry *i* between countries *k* and *j* is represented by:

**The Bergstrand Index**

J.H. Bergstrand stated in 1983, that intra industry trade needs to be measured as a proportion of a country’s trade with each of its trading partners. He proposed a bilateral intra industry index which had to be adjusted for each country’s multilateral trade imbalance. This proposition resulted in the following formula;

 (8)

where

and

In this formula represents the value of bilateral exports from country *j* to country *k* in industry *i*. The other component , indicates the value of bilateral exports from country *k* to country *j* in industry *i*.

## 3.4 Determinants of Intra-Industry Trade

 In intra-industry trade there are two classifications in which the determinants can be divided; industry specific and country specific. This thesis focuses on the country specific determinants. Table 1 shows all the determinants used in this thesis that influence IIT and their effect on IIT.

**Table 1**

|  |  |  |
| --- | --- | --- |
|  | **Country Specific** | **Effect**  |
| Determinant 1***Similarity*** | GDP per capita | - |
| Determinant 2***Economic Size*** | GDP ppp (purchasing power parity) | - |
| Determinant 3***Economic Size*** | Population | - |
| Determinant 4***Trade Imbalance*** | Balance of Payments | - |
| Determinant 5***Distance*** | Distance (km) | + |
| Determinant 6***FDI*** | FDI (Inward flow) | + |

Zhang, Witteloostuijn, and Zhou (2005) used five factors, similarity, distance, size, stage, and FDI. Each factor had different variables to test the factors. Similarity had seven variables; culture, GDP per capita, Gini index, energy consumption and three types of education. I used their 5 factors, but I did not use so many variables. I used the method of Hu and Ma (1999) and Khun and Xing (2007), and choose one variable per factor to test their influence on IIT. Except for economic size, which has two variables because of its importance to IIT. The variables used in all these studies are more or less the same. All of them test GDP (GDP average, GDP pc and/or GDP ppp), FDI and Population. The only big difference between these studies is that some of them include the trade imbalance in the GL index, whereas others, like Khun and Xing (2007) took the trade imbalance and made it a variable in the regression. They were following previous studies of Stone and Lee (1995) and Thorpe and Zhang (2005) and thus decided that trade imbalance should not be part of the GL index, but should be tested as an independent variable “to control for any possible bias in estimation”. (Khun and Xhing, 2007, p.8)

**Similarity:** Similarity can be interpreted as the difference in factor endowments and consumer patterns between China and a partner country. **Hypothesis 1: GDP per capita** is expected to have a negative correlation and IIT is more prominent between countries that are similar in factor endowments and consumer patterns. A low score in this case indicates that the two comparing countries have a high similarity in consumer pattern and factor endowment. This implies that the two markets are more likely to trade. A high score indicates that the income difference between China and its trading partner is high.

**Economic Size:** Is a measure of the economic size of a country. **Hypothesis 2: GDP ppp** (purchasing power parity in terms of prices) and **Population** are expected to have negative correlations and IIT is higher among countries that are similar in economic size. A high score in these two determinants indicates a large economic size. If two markets have similar sizes then it is more likely that they will trade similar commodities. The bigger the difference in market size, the smaller the share of IIT. Helpman and Krugman (1985) claim that the degree of IIT depends not only on relative factor endowments, but also on the relative economic size of trading countries.

**FDI:** Measures the inward flow of foreign direct investment to China. **Hypothesis 3: FDI** is expected to have a positive correlation and IIT is higher if inward FDI is large. FDI is lagged by one year as are all the other variables except BOP. This is done to get a more realistic view of their effects on IIT. Khun and Xing (2007) only apply this lag for FDI. To be consistent and coherent, this thesis lags all the variables in order to get realistic and fair results. A high score indicates a high FDI inflow.

**Trade Imbalance:** The measure of IIT must be less than 100 since exports can’t match imports in every sector when there an imbalance between imports and exports, no matter what the trade pattern is. (Grubel and Lloyd 1975) **Hypothesis 4: BOP** (Balance of payments) is expected to have a negative correlation. I decided to follow Khun and Xing (2007) and made the BOP part of the regression instead of including it in the GL index formula. When there is a trade imbalance between imports and exports, the measure of IIT must be less than 100 no matter what the trade pattern is at that time because Grubel and Lloyd say exports can’t match imports in every sector. This would result in bias coefficients in the regression analysis. BOP can induce rather than reduce bias in calculations.

**Distance:** Is the geographical distance in km between China and its partner country. **Hypothesis 5: Distance** is expected to be positively correlated so the closer the partner country is to China, the higher the IIT will be. Zhang, Witteloostuijn and Zhang (2005) interpret this variable by saying that a “high factor score indicates a large functional distance.”

It’s the alikeness in the country specific factors like economic size and similarity that decides the intensity of IIT. If two countries have similar GDP per capita and factor endowments, it is safe to assume that they are in the same stage of economic development. Transition economies like China, are expected to have a higher intensity of IIT with neighboring countries like Korea, Malaysia and Singapore then it will with Brazil. When two countries are similar in culture and language it is logical that this will have a positive effect. Overall communication is far more likely to be better than between a Japan and China, than it is expected to be between Holland and China. The large distance between Holland and China enhances the argument even more, since large distances have a negative effect on IIT. FDI increases market size and allows for more product differentiation. This increases IIT so this determinant is expected to have a positive sign.

# 4 Methodology and Data Sources

## 4.1 Methodology

 The first part of this thesis is to calculate and analyze the pattern of IIT in seven sectors over a twenty year period using twenty partner countries. The fifth equation of the Grubel and Lloyd index was used to calculate total IIT as well as IIT per sector.

 (5)

 The second part uses the IIT indices calculated in the first part to test country specific determinants. In order to do this the following regression model was made:

 is the intra-industry trade index between China (c) and its partner (p) country at time (t). All the control variables except BOP, enter the regression in logarithm form to represent the difference between China and its partner country in terms of GDP. Following Balassa and Bauwens (1988) and Thorpe and Zhang (2005), the difference in the GDP’s can be derived from the following formula:

 (9)

w represents the ratio of China’s GDP\_PC or GDP\_PPP to the sum of its GDP\_PC or GDP\_PPP and the trade partner’s GDP\_PC or GDP\_PPP.

 (10)

## 4.2 Data Sources

The bilateral import and export data for each sector was gathered using the SITC (Rev. 2) trade data from the United Nations Commodity Trade Statistics database, named COMTRADE. The three digit SITC (Rev. 2) was extracted for China and all its 20 partners from COMTRADE. Using one databank like UN Comtrade reduces the risk of bias import or export numbers.

The seven sectors are classified as follows:

**Table 2**

|  |  |
| --- | --- |
| **Sectors** | **SITC (Rev. 2)** |
| Chemical | 511 – 598 |
| Electrical | 771 – 778 |
| Food | 001 – 098 |
| Machinery | 711 – 764 |
| Metal | 671 – 699 |
| Textile | 261 – 269, |
|  | 651 – 659, |
|  | 831 – 851 |
| Transport | 781 – 793  |

Khun and Xing (2007) used the method of data aggregation shown in table 2 and found them to be sufficient and accurate enough. One problem that has always been an issue when it comes to IIT, is data aggregation problems since different types of goods are grouped together in the same industry. Using the SITC (Rev. 2), this problem can be relatively solved. At the 1 digit SITC level there are ten different broad sectors. Each of these 1 digit sectors can be subdivided into 10 more detailed 3 digit sectors. This divisions start at 1 number divisions like 0 Food, which places all food products together. This is not very useful if one was studying the trade in fish since meats, and all other edible products are represented as part of that value as well. SITC (Rev. 2) is a 3 digit level, which makes the sectors specific enough to get realistic results. Now fish products and meat products can be grouped separately. The more detailed the commodities are, the less likely that data will be aggregated and the more realistic the results from the regression will be. For example, in division 5 chemicals, organic and inorganic chemicals have their own codes and are not aggregated.

The data for the control variables, GDP per capita, GDP ppp, population, BOP, and FDI was extracted from The World Bank database. The geographical distance was extracted from the website [www.distancefromto.com](http://www.distancefromto.com)

# 5. Results

## 5.1 Trend of China’s IIT

The IIT’s per sector for 20 countries over a period of 22 year led to some surprising results. (attachment II) In order to get a more clear view the table below gives the averages for the 22 year period.

**Table 3: Average IIT from 1990-2011**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **IIT\_Chemicals** | **IIT\_Electrical** | **IIT\_Food** | **IIT\_Machinery** | **IIT\_Metal** | **IIT\_Textile** | **IIT\_Transport** | **IIT\_AllSectors** |
| **Australia** | 0,716789473 | 0,344837205 | 0,427370218 | 0,451109018 | 0,732814668 | 0,769511082 | 0,223876477 | 0,587966 |
| **Brazil** | 0,518465845 | 0,181973614 | 0,505588814 | 0,343254168 | 0,49105975 | 0,519092618 | 0,483522705 | 0,349683 |
| **Canada** | 0,375100818 | 0,650886241 | 0,545492709 | 0,493948041 | 0,641207045 | 0,124811227 | 0,669411405 | 0,410565 |
| **Hong Kong** | 0,705905155 | 0,477445632 | 0,0609192 | 0,380077327 | 0,295383523 | 0,269313518 | 0,131452277 | 0,325271 |
| **France** | 0,642305941 | 0,780373918 | 0,742218564 | 0,509407873 | 0,87427805 | 0,196648455 | 0,301494891 | 0,497078 |
| **Germany** | 0,754956248 | 0,848271576 | 0,1529339 | 0,624609638 | 0,811445462 | 0,111503257 | 0,415336114 | 0,585132 |
| **Indonesia** | 0,762362227 | 0,603721814 | 0,505369618 | 0,418819145 | 0,478579064 | 0,553697382 | 0,146816991 | 0,543204 |
| **Japan** | 0,519812864 | 0,450128714 | 0,081237782 | 0,611509291 | 0,576501745 | 0,381452573 | 0,497413264 | 0,490542 |
| **South Korea** | 0,391455718 | 0,380620705 | 0,140840218 | 0,636333732 | 0,692447405 | 0,760641973 | 0,628423905 | 0,557423 |
| **Malaysia** | 0,661915677 | 0,463027577 | 0,300966127 | 0,807590095 | 0,575362664 | 0,44429585 | 0,278720936 | 0,53151 |
| **Mexico** | 0,629250036 | 0,6625014 | 0,24866005 | 0,423616586 | 0,432499668 | 0,403409423 | 0,420993324 | 0,500279 |
| **Netherlands** | 0,707068455 | 0,4313876 | 0,445946273 | 0,330262218 | 0,204642568 | 0,053082536 | 0,38596345 | 0,31006 |
| **Philippines** | 0,46202625 | 0,349290555 | 0,588375091 | 0,495742786 | 0,718138336 | 0,096216327 | 0,060212195 | 0,414965 |
| **Russia** | 0,310082695 | 0,381927985 | 0,690046965 | 0,42352808 | 0,32183062 | 0,051405115 | 0,12678609 | 0,24109 |
| **Singapore** | 0,463089823 | 0,872094286 | 0,409093914 | 0,818547468 | 0,384514155 | 0,089447091 | 0,313297009 | 0,59441 |
| **South Africa** | 0,747734508 | 0,054434008 | 0,461013333 | 0,157003842 | 0,485163017 | 0,080989525 | 0,115838025 | 0,28128 |
| **Spain** | 0,785306927 | 0,437091305 | 0,367852927 | 0,503984895 | 0,358092723 | 0,179633827 | 0,567686714 | 0,429076 |
| **Thailand** | 0,619176368 | 0,587341127 | 0,54634525 | 0,649929936 | 0,404954645 | 0,787360736 | 0,290011236 | 0,596498 |
| **United Kingdom** | 0,603316609 | 0,514700704 | 0,40779756 | 0,500520924 | 0,509644759 | 0,347210202 | 0,344336742 | 0,458113 |
| **United States** | 0,624496768 | 0,690210536 | 0,821958123 | 0,527882695 | 0,430623423 | 0,204335309 | 0,724481327 | 0,485141 |

In Table 3 the averages of IIT indices are shown over a 22 year period per sector for 20 countries. It reveals that IIT occurs between developed and developing or transitional economies. A developed economy like the United States shows a total average IIT (IIT\_AllSectors) of 48,51 % and Thailand, a developing country, shows a total IIT of 59,64%. This shows that trade occurs not only between two countries with big differences in factor endowments like the HOS model predicts, but also between countries with small differences in factor endowments.

The IIT’s per sector, per country over a 22 year period reveals that most of the bilateral IIT\_AllSectors indices have increased during the analyzed time period. Some exceptions are the Netherlands, South Africa, Spain, United States and most surprisingly, Hong Kong. The exceptions, excluding Hong Kong, have slight drops in IIT indices over 22 years. The United States went from 43.4% in 1990 to 42.4% in 2011 so the average intensity of IIT has remained the same. This is because the intensity of trade between China and the United States has changed per sector as time passed on. The IIT index of the textile sector was 48.3% in 1990 and dropped to 15.7% in 2011. However, the transport sector showed an IIT index of 26.3% in 1990 and increased to 99,6% in 2011.

Hong Kong revealed the most surprising results. Previous studies, Hu and Ma (1999) and Zhang, Witteloostuijn and Zhou (2005), have produced high IIT indices between China and Hong Kong. It must be mentioned that in these studies, the trade imbalance was included in the GL formula. This could result in bias results so the trade imbalance enters the regression formula as an independent variable in this study. The results are similar at the beginning of the analysis, but as time goes on, the IIT\_AllSectors between China and Hong Kong decreases whereas it increases in other studies. Hu and Ma (1999) give different reasons for the high intensity of IIT between Hong Kong and China. They say that first of all, Hong Kong has been a major depot used by China to sell exports and buy imports. Only 40% of China’s exports were consumed and the remaining 60% were re-exported to other countries. Furthermore, 84.5% China’s imports from Hong Kong came from outside Hong Kong.

The second reason they give for such a high IIT index is the similarity in culture and language. They go on and say that 98% of the Hong Kong population is ethnic Chinese, so the demand for Chinese goods is big. However, they say that many of these goods are produced and consumed in both countries. The reason for this according to them is the that Chinese IIT is more differentiated by quality instead of preference.” This observation suggests that not IIT, but comparative advantage might be the reason for the high levels of IIT. Zhang, Witteloostuijn and Zhou (2005) share this observation of comparative advantage in explaining the increase in IIT between China and Hong Kong. They explain that Hong Kong was China’s predominately largest trade partner between 1992 and 2001 and that trade between them was determined by price and quality. The trade in these differentiated goods increased during their time period, which led them to the conclusion that comparative advantage might be the reason for the bilateral IIT and not consumer preference.

**5.2 Regression Analysis**

The regression analysis for Chinese IIT was based on 8 sectors from 1990 to 2011 with 20 partner countries. Table 4 shows the regression results per sector as well as the total IIT (IIT\_AllSectors). The controlled variables are GDP\_PC (gdp per capita), GDP\_PPP (gdp in terms purchasing power parity), FDI (inward), BOP (trade imbalance), Distance, and Population. All the variables are in logarithm and are lagged by one year. Since this study analyses variables that vary over time, country and year fixed effects were included in the regression in order to reduce the threat of omitted variable bias and to improve the explanatory power of the model. Dummy variables were introduced for each year and each country and they show the effect for each year and each country. They can be interpreted as, how big was the intensity of IIT of a specific sector in a specific year and how big was the intensity of IIT of a specific sector for a specific country. These dummy variables show that variations in IIT can be accredited to either a particular year or country.

**Table 4**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| VARIABLES | IIT\_Chemicals | IIT\_Electrical | IIT\_Food | IIT\_Machinery | IIT\_Metal | IIT\_Textile | IIT\_Transport | IIT\_AllSectors |
| L.GDPD\_GDP\_PC | -20.706 | 3.130 | 38.044\*\* | -18.421 | -5.260 | -1.279 | 18.323 | 6.577 |
|  | (16.741) | (19.289) | (18.937) | (23.812) | (22.683) | (12.816) | (23.246) | (11.432) |
| L.GDPD\_GDP\_PPP | -3.140 | 5.967 | -6.753 | 1.703 | -17.790\*\*\* | -0.941 | 6.059 | -6.381\* |
|  | (4.842) | (5.579) | (5.477) | (6.888) | (6.561) | (3.707) | (6.722) | (3.306) |
| L.FDI | 0.003\*\* | -0.002 | 0.001 | -0.005\*\*\* | 0.002 | -0.000 | -0.003\* | -0.000 |
|  | (0.001) | (0.001) | (0.001) | (0.002) | (0.002) | (0.001) | (0.002) | (0.001) |
| L.BOP | -0.006\*\* | -0.006\*\* | 0.000 | 0.007\*\* | 0.005\* | -0.003\* | -0.008\*\* | -0.001 |
|  | (0.002) | (0.003) | (0.003) | (0.003) | (0.003) | (0.002) | (0.003) | (0.002) |
| L.Distance | -0.000\*\* | -0.000\*\*\* | 0.000\*\*\* | 0.000 | 0.000 | -0.000 | -0.000\*\* | 0.000 |
|  | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| L.Population | 0.000 | 0.000\*\*\* | -0.000\*\*\* | -0.000\* | -0.000\* | -0.000 | 0.000\*\*\* | -0.000\* |
|  | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Constant | 0.984\*\*\* | 1.089\*\*\* | -0.288 | 0.459\* | 0.687\*\*\* | 0.913\*\*\* | 0.709\*\*\* | 0.688\*\*\* |
|  | (0.194) | (0.224) | (0.219) | (0.276) | (0.263) | (0.149) | (0.271) | (0.133) |
|  |  |  |  |  |  |  |  |  |
| Observations | 396 | 396 | 396 | 396 | 396 | 396 | 393 | 393 |
| R-squared | 0.538 | 0.634 | 0.651 | 0.453 | 0.470 | 0.834 | 0.538 | 0.578 |
| adj. R-squared | 0.480 | 0.588 | 0.608 | 0.384 | 0.403 | 0.813 | 0.479 | 0.525 |
| F-statistic | 9.297 | 13.790 | 14.905 | 6.602 | 7.063 | 40.068 | 9.205 | 10.842 |
| p(F) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Standard errors in parentheses\*\*\* p<0.01, \*\* p<0.05, \* p<0.1 |

IIT\_AllSectors (total IIT) revealed expected results. The first variable GDP\_PC, which represents the difference in factor endowments and consumer patterns between China and its trade partner, yielded the opposite sign, but is not significant at the 1%, 5%, and 10% level. These results are opposite to the results presented Khun and Xing (2007). They obtained a negative correlation and they did get a statistical significance at the 1% level. However, they compare China with two countries (Japan and USA), whereas this study’s regression includes 20 partner countries. The results indicate that the smaller the gap between China and its partner’s GDP\_PC, the higher IIT will be.

The variables GDP\_PPP and Population reflect the difference in economic size between China and its partner country. The variables yielded the expected sign and are both significant at the 10% level. This implies that these variables are important in measuring the extent of IIT between China and its partner countries. Hu and Ma (1999) got similar results in their study of the influence economic size between China and 45 partner countries. They yielded the same negative sign, but the results were not significant as opposed to mine. They say that the expected negative sign suggest that the bigger the economic size of a country, the smaller the need for international trade because they can produce more variety themselves. This study shows that economic size does imply that bilateral trade will intensify when two countries are similar.

The variable FDI yielded the opposite negative sign and was not significant at any level. This in contrary to Zhang, Witteloostuijn and Zhang (2005) whom did find a significance between FDI inflow and an increase in IIT at the 10% level.

Like Khun and Xing (2007), this study uses the unadjusted GL index. Trade imbalance (BOP) is a variable in the regression and not part of the GL index formula. BOP did yield the expected negative sign, but is not significant. This implies that trade imbalances between China and its partner countries do not lower or influence the bilateral IIT.

Distance revealed the positive expected sign, but was also not significant. The hypothesis that the closer the trading distance between China and its partner, the higher the bilateral IIT will be, does not hold. These findings are opposite of Zhang, Witteloostuijn and Zhang (2005) who did find a significance with the same positive sign. They included two variables, distance and border, whereas this study only used distance between two countries. This could account for the difference in results.

Looking at table 4 reveals that each sector has different results. Economic size, which is determined by GDP\_PPP and Population, is very important in determining the intensity of IIT. GDP\_PPP is only significant at the 1% level in the metal industry, but Population is significant in almost all seven sectors, except for Chemical and Textile. The Electrical, Food and Transport sectors showed a significance at the 1% level, indicating that Population is very important in determining the amount of IIT. The Metal sector is the only sector in which both the determinants of economic size are significant. This indicates that the Population is more important in determining economic size than GDP\_PPP.

GDP\_PC is only significant in the Food sector at the 5% level. This result was very surprising since the expectation was that the more similarities in terms of factor endowments there are between China and its partner country, the higher the IIT will be. This results shows that a relative big difference exists in factor endowments between China and its trading partners, which results in low levels of IIT.

FDI was significant in the Chemical, Machinery and Transport sectors at the 5% level and twice at the 1% level respectively. These high levels of significance indicates that FDI increases IIT as proposed in hypothesis 3. FDI increases market size which is likely to increase IIT.

The most influential determinant following the regression would have to be BOP. Even though it is not significant in Total IIT, it is significant in 6 of the 7 sectors. Only the Food sector has not yielded a significance. Most of the sectors showed a significance at the 5% level. “This is an indication that trade imbalances between China” and its partner countries “substantially bias down the calculated IIT index”. Khun and Xing (2007) This shows how the adjusted GL formula can induce rather than reduce bias in IIT levels and that the trade imbalance should enter into the regression.

Distance was not significant in the Total IIT, but it is quite significant in 4 of the 7 sectors. The Electrical and Food sectors reveal a significance at the 1% level, which is highly significant. The Chemical and Transport sectors are significant at the 5 % level. These results indicate that Distance can be very important in measuring IIT, but that it is sector dependent.

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# 6 Conclusions

 Since 1978 China has changed its economic policy and gradually started to liberalize and open up their economy to the rest of the world. The Chinese gradually introduced systems in order to enhance the growth of their economy. The Household Responsibility System and a dual pricing system were introduced, which led to the increase of wealth for hundreds of millions of Chinese. In 1992 the Shanghai Stock Exchange was re-opened after it had been closed for 40 years. State-owned enterprises declined and in 2001 China joined the WTO.

 The Grubel and Lloyd index was used to calculate the intra industry trade in seven sectors covering the period of 1990 up to 2011 using 20 partner countries. The partner countries are neighboring countries, countries on the other side of the world, developed economies and undeveloped or transitional economies. The results show that intra-industry trade does not only take place between China and developing countries, but also developed countries. Market size and population are important in determining the extent of IIT, but BOP has shown to be just as important. It is therefore surprising that that China’s IIT with Russia is the lowest of all 20 partner countries. It is a bordering country with a large population and market size. The high significant levels of BOP show that not only market size influences IIT. The significance of BOP implies that IIT values are biased, which is the reason why this study did not use the adjusted GL formula.

 The regression analysis for all the sectors combined yielded some surprising results. Looking at the All\_Sectors (total IIT), most of the expected signs were obtained except for FDI and GDP\_PC. The significant factors are GDP\_PPP and Population at the 10% level. They represent the economic size of a partner country compared to China. This implies that the more similar the two countries are in terms of market size, the more likely it will be that IIT between them will be high.

 The transport sector yielded statistical significance for all the variables except for GDP\_PC and GDP\_PPP. FDI and Population are significant at the 1% level and BOP and Distance at the 5% level. The signs for distance, FDI and GDP\_PC have opposite signs than expected.

 The first hypothesis states that the more similar two countries are in terms of factor endowments and consumer preference, the higher the IIT will be (GDP\_PC). A negative correlation was expected and yielded in the total IIT. On top of this, this variable was only significant in the Food sector at the 5% level. It was not significant in the other 6 sectors. This shows that factor endowments are not as influential on IIT as previously expected.

The second hypothesis is concerned with the economic size and postulates that IIT will be higher among countries similar in economic size. A negative correlation was expected and was yielded most of the time in all sectors. GDP\_PPP and Population represent economic size and both were found to be significant in 1 and 5 sectors respectively. They are also the only variables significant in the total IIT. It is safe to say that economic size is important in influencing IIT.

Hypothesis three states that the more inward FDI, the higher the IIT will be and it is expected to have a positive correlation. FDI was only found to be significant in the food, machinery and transport sectors. The significance in has to be taken quite serious since they are significant at the 1% level. An increase in FDI implies that there could be more product differentiation than before and this increase in product differentiation will most likely increase IIT.

The fourth hypothesis states that BOP can induce rather than reduce bias calculations in determining IIT and it is expected to have a negative correlation. This variable was not significant in the total IIT, but was significant in 6 of the 7 sectors. This suggest that at least in these sectors, the trade imbalances between China and its partner countries had the expected effect, which is that it lowers IIT. This is why this study did not use the adjusted GL formula because this clearly shows how BOP can induce rather than reduce bias in IIT calculations.

The last hypothesis concerned distance. The bigger the distance between the trading countries, the smaller the IIT will be. The expected positive sign was yielded for most of the sectors and it is significant in 4 sectors. In the total IIT Distance is not, suggesting that distance in no longer a deterrent of IIT. However, in the Chemical and Transport sector a significance of 5% was obtained indicating that Distance is important in the intensity of IIT. The Electrical and Food sectors show a significance at the 1% level! These results show that Distance is important in determining IIT even though Total IIT did not yield a significance.

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**Attachement I**

**Table 4: 20 Partner countries**

|  |  |
| --- | --- |
| Australia | Mexico |
| Brazil | Netherlands |
| Canada | Philippines |
| Hong Kong | Russia |
| France | Singapore |
| Germany | South Africa |
| Indonesia | Spain |
| Japan | Thailand |
| South Korea | United Kingdom |
| Malaysia | United States |