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## Long term evolution of the bilateral Trade between China and Spain, 1988-2011

### *Abstract*

This paper offers the first results of an ongoing research project on the Intra Industry Trade (IIT) in Spanish trade using microdata from COMEXT database to calculate the levels of IIT in manufactures trade between 1988 and 2011. The analysis offers the figures of the long term evolution of the bilateral trade, [the advantages](#) and IIT between China and Spain, and also its distribution between horizontal and vertical IIT. Besides, the paper offers the sectorial levels of IIT.

JEL: F14 Empirical studies of trade

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### **1.- Introduction**

This paper offers the first results of an ongoing research project that use microdata from COMEXT database to calculate the Intra Industry Trade (IIT) levels of the Spanish trade in manufactures between 1988 and 2011. The starting point of this analysis is the information on IIT in Spain generated for the Ph.D. thesis of one of the coauthors (De Diego, 2004) that covers the period 1988-1999, where a comprehensive analysis of the literature on the subject was done and where IIT levels were measured with different indexes and procedures, and compared with those calculated by other authors.

COMEXT database experienced a change in the units from ECU to euro at parity in 1999 and the TARIC classification was also modified. The authors has opted for a similar procedure of that used in the Ph.D. dissertation cited above to build a series that, although is not fully homogeneous, it allows the analysis of the long run development of this phenomenon between 1988 and 2011 in depth. Plenty of attention was dedicated to IIT in the 90s and first years of this century, but later less papers has been prepared on the subject, perhaps because the analysis developed reflected an increasing level that contributed to

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<sup>1</sup> The authors want to express their gratitude to María del Carmen Flores Troyano for her collaboration in the preparation of IIT indexes for the period 2000-2011. [This paper was accepted to be presented at the XV World Economy Meeting held at Santander, June 2013.](#)

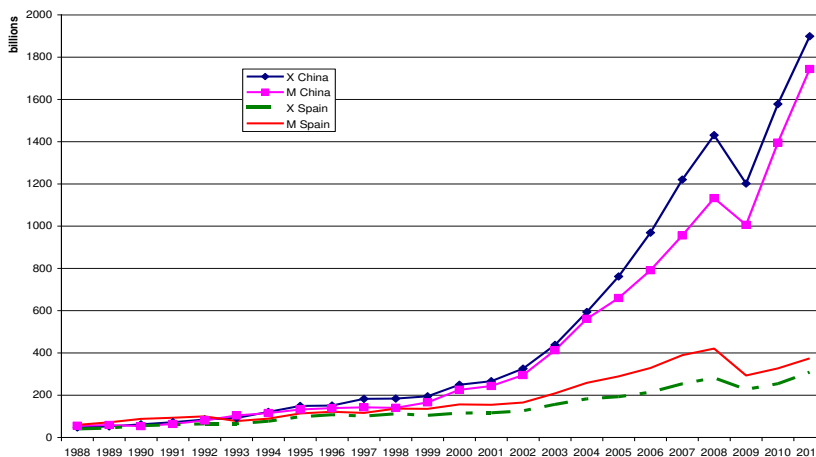
explain a great deal of the low costs of adjustment in Europe in a period to trade liberalization. The economic crisis has brought back the attention to the external sector of the Spanish economy that is by now the only contributor to the recuperation of growth. It is worth questioning what has happened to IIT, in these years when external trade is experiencing big changes that are impacting our manufacturing industry.

So, after this introduction, the paper is structured in the following way: in the second section we pay attention to the trade of and between China and Spain in this period to show that trade has increased dramatically, to the extent that China is one of the main trade partners of Spain. In part three the methodology of measurement of IIT is presented and later in section four a closer look is dedicated to the Spanish trade with China, to reach a deeper understanding of the bilateral trade between the two countries. In section five the calculations of IIT in bilateral trade are displayed, where the series 1988-1999 calculated in De Diego (2004) are extended to 2011 and IIT is divided between horizontal and vertical IIT, while part six offers data for 13 sectors of the manufacturing industry and a shift-share analysis is conducted to understand the participation of the different sectors in the evolution of IIT. Finally, in the last section are presented the main conclusions.

## 2.- Bilateral trade between China and Spain

Chinese trade has increased amazingly during the period, with exports measured in US\$ growing annually at 17.4 % while imports have increased at 16.2 % doubling global trade growth rates (8.4 and 8.3, respectively). Spanish trade has also been growing strongly, with an exports growth slightly faster than world trade (9.3 and 8.3, respectively) (Figure 1).

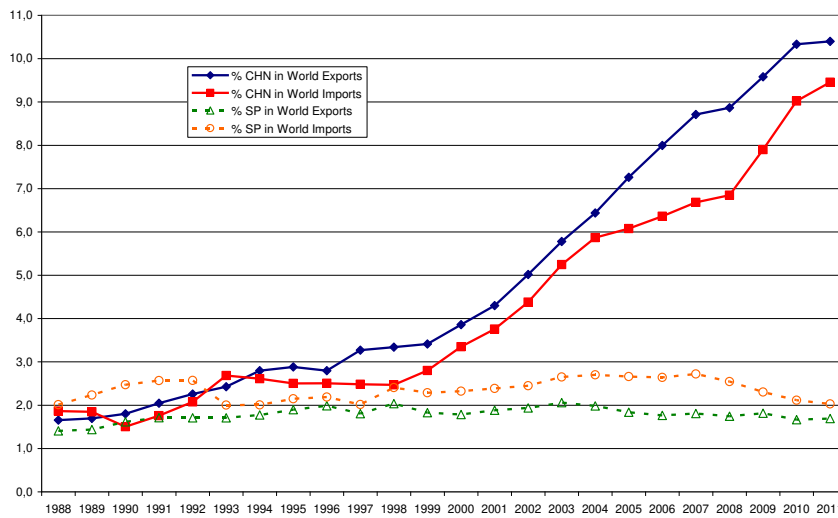
Figure 1.- Evolution of Chinese and Spanish total trade, 1988-2011 (billions of current US dollars)



Source: Own elaboration based on data from WTO.

Both countries depart from a very similar quantity of trade, but these dissimilar growth rates generates that Chinese exports more than sextuply Spanish exports at the end of the period while Chinese imports almost quintuply Spanish imports. These growth rates also results in an expanding share of China in the world trade with a share around 10% of world trade at the end of the period while Spanish share remains almost at the same level (Figure 2).

Figure 2.- Evolution of Chinese and Spanish share in world trade, 1988-2011 (%)

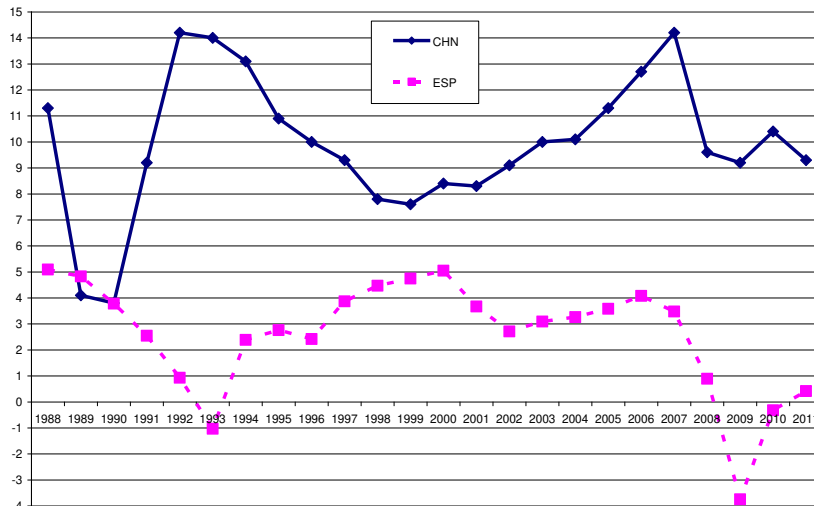


Source: Own elaboration based on data from *WTO*.

This dissimilar evolution of both countries in world trade also relates to the different evolution of their share in world GDP. Chinese GDP growth in constant 2000 US\$ averaged 9,8% in the period while the Spanish one was only 2,5% (Figure 3).

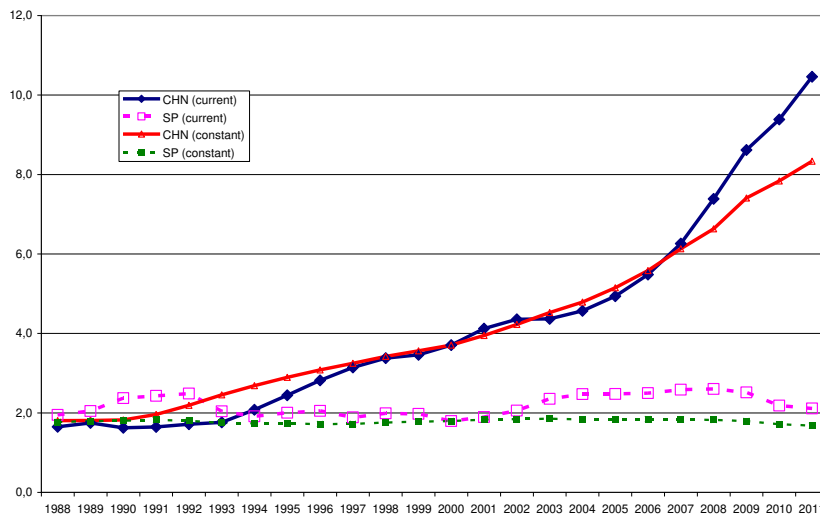
According to World Bank data in current US\$ China has increased its share of world GDP from less than 2% to more than 10% in the period while the Spanish share has maintained around 2 % (Figure 4) with an evolution during the period very similar to that of Spanish share in world imports presented above. The figures in constant 2000 US\$ show a somewhat different evolution with Chinese share slightly over 8% at the end of the period but with a more steady path of growth during the period

Figure 3.- GDP growth of China and Spain, 1988-2011 (constant 2000 US\$)



Source: Own elaboration based on data from *World Bank*.

Figure 4.- Evolution of Chinese and Spanish share in world GDP, 1988-2011 (% of figures in current US \$ and constant 2000 US\$)

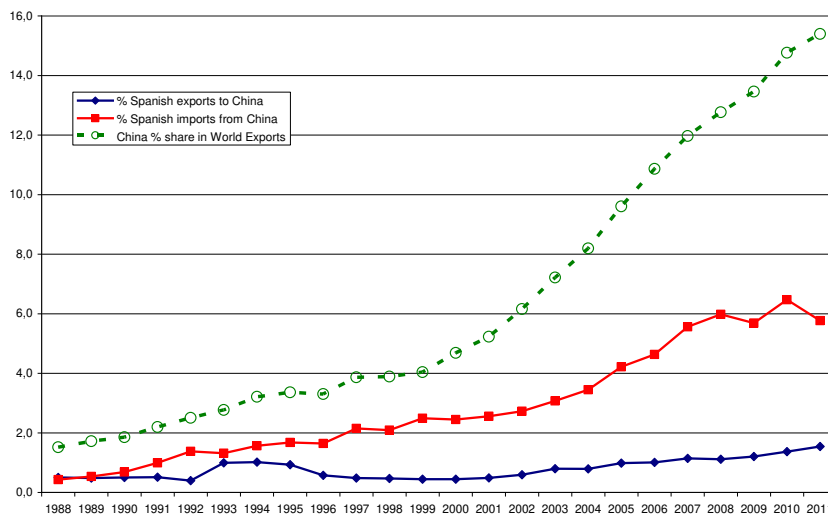


Source: Own elaboration based on data from *World Bank*.

China and Spain have an expanding bilateral trade relationship that has been growing uninterruptedly in the period 1988-2011, except in the recent crisis. Spanish exports to China measured in euros have grown annually at 13,5% in the period and Spanish imports from China have grown at 20,7% while

Spanish total exports have increased at 8,1% and total imports have increased at 7,8%. These growth rates generated a sharp increase in the Chinese share in Spanish imports, from 0,5 to almost 6,0%. This increased participation of China in Spanish imports has allowed China to achieve the fourth place between Spanish suppliers (after Germany, France and Italy). However, this 6% Chinese share in Spanish imports remain well behind that of China in world exports (almost 16%). At the same time, the Chinese share in Spanish exports has trebled (Figure 5) but the share (1,5%) is very far from that of imports.

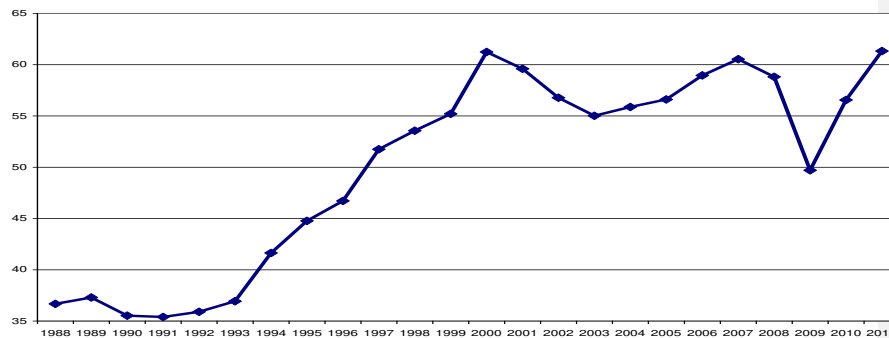
Figure 5.- China participation in Spanish total trade, 1988-2011



Source: Own elaboration based on data from <http://datacomex.comercio.es> and WTO.

The growth rates of trade and GDP in Spain result in an increase of the share of trade in GDP. Spain increased its openness from 36% in 1988 to a maximum of 61% in 2000 (Figure 6).

Figure 6.- Trade openness index of Spain, 1988-2011 (trade as % of GDP)

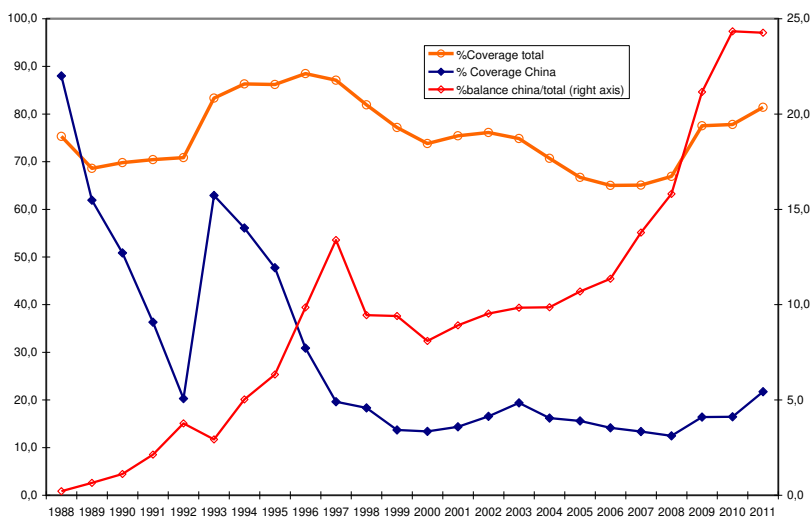


Source: Own elaboration based on Worldbank data.

Finally, it is worth taking into consideration the coverage ratio in the Spanish global trade that has oscillated around 80 % in the global trade (decreasing in the phases of GDP growth and increasing after the 93 and 2008 onwards crisis). When this global coverage ratio is compared with that of trade with China, it must be noted that it has suffered a sharp decline from the almost 90 figure of 1998 to the almost 20% in the last decade (Figure 7). China has not just elevated its share in the Spanish trade but also has a major role in the explanation of the trade deficit of Spain. Its share in the trade deficit has increased from almost none to almost 25%.

It is worth noticing that this extremely low level of coverage in the bilateral trade will also put an upper bound to the level of Intra Industry Trade (IIT). As the exports only account for a 20% of the imports, the maximum level of two-way-trade will be only 20, and that figure could only be reached if all the exports from Spain to China would be in products also exported by China to Spain.

Figure 7.- Coverage ratio of exports, 1988-2011 (exports as % of imports)



Source: Own elaboration based on Worldbank data.

This short review of the trade of China and Spain in the period shows clearly that China is the country that has increased most its trade with Spain in the period, mainly its exports to Spain, and is by now the main contributor to the explanation of the Spanish trade deficit, thus the interest to know better the commercial flows between the two countries and the degree of IIT in it.

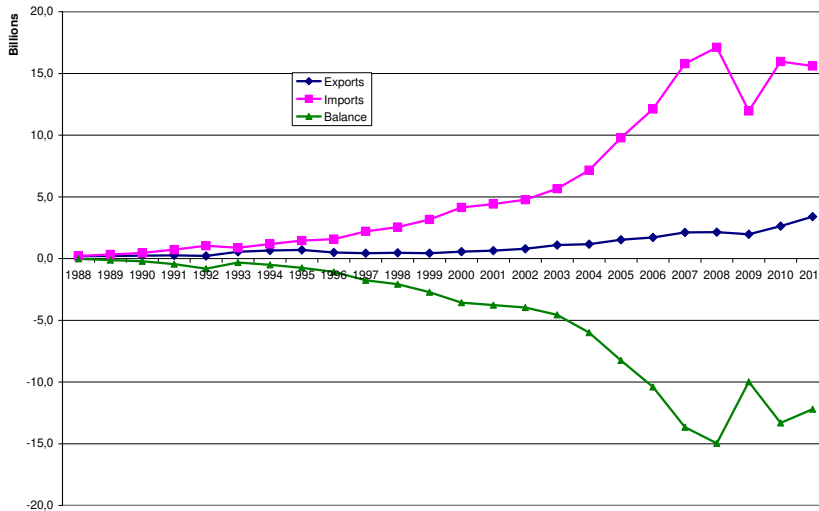
### 3.- A closer look to Spanish trade with China

In this section we are going to use data of the total trade of goods of Spain with China from database Comex (<http://datacomex.comercio.es>) for the

period 1988-2011 to reach a deeper understanding of the characteristics of the bilateral trade Spain-China.

As presented above, China exports to Spain have grown much faster than exports, thus generating an increasing trade unbalance with Spain that has reached 15 billions of euros in 2008 and has somewhat moderated with the economic crisis (Figure 8)

Figure 8.- Spanish imports, exports and trade balance with China, 1988-2011



Source: Own elaboration based on data from <http://datacomex.comercio.es>.

When the sectoral distribution of this trade deficit is considered is very clear the concentration of the Spanish trade deficit with China in four aggregate sectors of manufactures: Semimanufactured good, Equipment, Consumer manufactures and Durable consumer goods (figure 9).

Following Alonso (1993), we have calculated two indicators of comparative trade advantage: first, the relative trade balance (RTB) and second, the balance contribution index (BCI). Both have been calculated beginning with the trade balance of each sector. In the first, the trade balance is divided by the total trade in the sector while in the second, the RTB of each sector is compared with the global RTB of the Spanish trade and later weighted by the share of the sector in total trade. These two indicators are calculated:

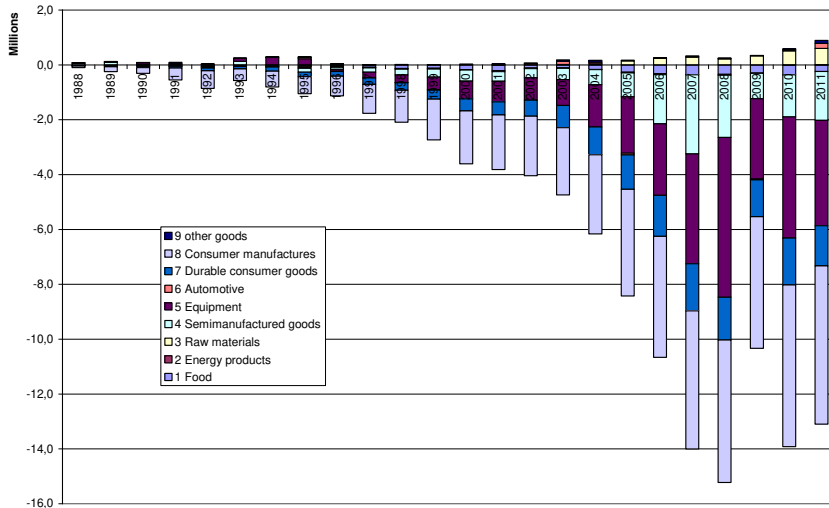
$$RTB_i = \left( \frac{X_i - M_i}{X_i + M_i} \right) \times 100$$

$$BCI_i = \left[ \frac{X_i - M_i}{X_i + M_i} - \frac{\sum_i X_i - \sum_i M_i}{\sum_i X_i + \sum_i M_i} \right] \left[ \frac{X_i + M_i}{\frac{\sum_i X_i + \sum_i M_i}{2}} \right] \times 100$$



where  $X$  and  $M$  are exports and imports, respectively, and subindex  $i$  refers to the sector considered. RTB varies between +100 and -100: in the first case there are only exports and the advantage is maximum while in the second only the imports are present and the disadvantage is a maximum.

Figure 9.- Spanish trade balance with China by sector, 1988-2011



Source: Own elaboration based on data from <http://datacomex.comercio.es>.

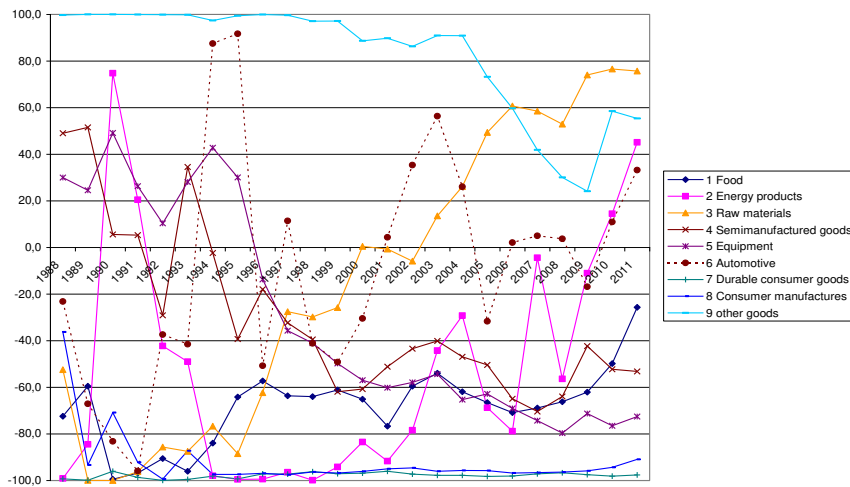
BTR index reflects that Spain only had in 2011 advantage in four sectors: Raw materials, Other goods, Energy products and Automotive (Figure 10). The advantage has only been persistent during all the period in Other goods, while in automotive has alternated and in Raw materials and Energy products Spain has reached a balance of net exporter. On the contrary Spain has its main disadvantages in Semimanufactured good, Equipment, Consumer manufactures and Durable consumer goods. That specialization is exactly the opposite of what could be expected in the trade of a high income country with a low income country.

BCI allows a better understanding of the evolution of relative advantages and disadvantages because, in the one hand, they are compared with the global RTB of the country (that reflects the intensity of the internal demand or the evolution of prices and exchange rates) and, in the other hand, the advantages are weighted by the share of the different sector in trade.

The results obtained show that during the period the Spanish trade with China has arrived to a less contrasted specialization. Two sector maintain all along the period worse results than the national average: Consumer manufactures and Durable consumer goods. In the almost 20 first years of the period the sector Equipment had a better performance than the national average and was a sector of relative advantage, however in the last 4 years its contribution to the balance has been negative. Transport equipment has been

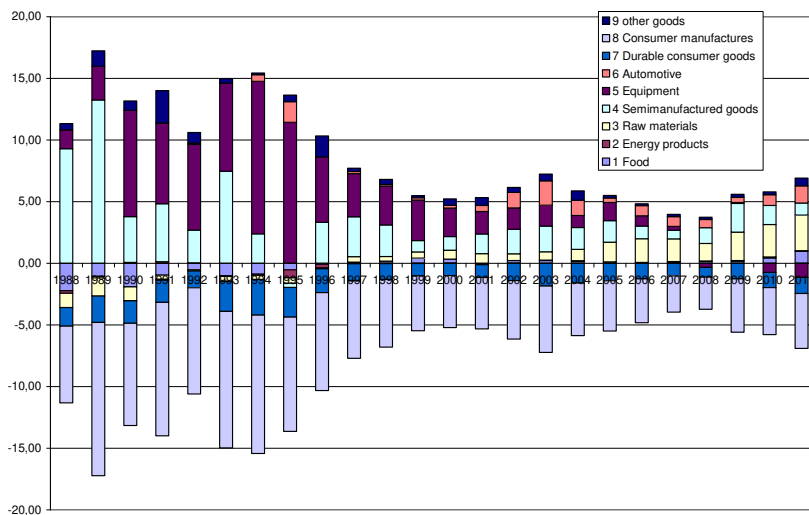
also a sector of Spanish relative specialization as Semi-manufactured goods. Finally Raw materials reflects clearly the changing pattern of Spanish trade with China. In the first part of the period Spain had a disadvantage in that sector but that disadvantage has been changing and, at the last part of the period, that sector is the main positive contributor to the trade balance, against the expectations of Heckscher-Ohlin theory (Figure 11 and Table A1).

Figure 10.- Spanish relative trade balance with China by sector, 1988-2011



Source: Own elaboration based on data from <http://datacomex.comercio.es>.

Figure 11.- Balance contribution index in the Spanish trade with China, 1988-2011



Source: Own elaboration based on data from <http://datacomex.comercio.es>.

#### 4.- Methodology to measure IIT

IIT has been calculated using the Grubel y Lloyd (GL) index, that measures the level of overlapping in trade flows, that is, it measures el part of two way trade in total trade<sup>2</sup> and allows to distinguish between IIT and inter industrial trade.

The index for one product  $j$  is:

$$B_i = GL_{ij} = \left[ 1 - \frac{|X_{ij} - M_{ij}|}{(X_{ij} + M_{ij})} \right]$$

while for total trade of a country or sector it would be:

$$\bar{B}_i = GL_i = \left[ 1 - \frac{\sum_{j=1}^n |X_{ij} - M_{ij}|}{\sum_{j=1}^n (X_{ij} + M_{ij})} \right]$$

where  $X_{ij}$  and  $M_{ij}$  are exports and imports of country  $i$  in the product  $j$ . This index varies between 0 and 1. If the value is zero, then all the trade is inter industrial, so one of the directions of trade (either exports or imports) are not present. In the opposite if it reaches 1, all trade is IIT, exports and imports are of equal value and all trade is two way trade.

Fontagné and Freudenberg (1997) from CEPIL proposed a different procedure (FF index) to analyze IIT in the EU that has been also widely used in literature. These authors consider that a exchange between two partners in a product is IIT when the lesser one is, al least, one tenth of the greater one. It can be formulated in the following way:

$$\frac{\min(X_{it}^{kz}, M_{it}^{kz})}{\max(X_{it}^{kz}, M_{it}^{kz})} > 10\%$$

They use this limit of 10% because under this threshold the minority flow must not be considered as relevant and, then, are not a structural characteristic of trade. An analisis comparing both indexes can be found in De Diego (2004): both indexes offer similar tendencies although FF index reaches sistematically higher values than GL index.

In the IIT literature it has been noted that there may be a problem of "statistical aggregation" that may generate measured levels of IIT bigger that the real ones when trade classification with low level of disaggregation are used (Lipsey, 1976). So, in this paper we have used a 6 digit disaggregation of TARIC classification, where manufacturing is divided in 4.751 tariff headings por the period 1988-1999 and 5.083 for 2000-2011<sup>3</sup>.

<sup>2</sup> Ample expositions of the different ways to measure IIT can be found in Vona (1991) and De Diego (2004).

<sup>3</sup> Results has been calculated also for 4 and 8 digits of the TARIC classification, dividing the manufacturing industry, respectively, in 1.063 and 11.600 products for 1988-1999 and, 1.089

Another kind of problems relates to the nature of IIT. In the literatura two types of product differentiation are considered: horizontal and vertical. The horizontal types relates to varieties characterized by different atributes [in the sense of Lancaster (1980)]. Vertical differentiation is found when different varieties offer disparate levels of service or diverse levels of quality. In the IIT literature this vertical differentiation is associated with dissimilarities in factor content and in the technologies used in production. In this case, an increase in trade of these kind of products could generate bigger adjustment costs (in terms of unemployment, firm closure, etc.), more similar to those generated by inter industrial trade.

Greenaway, Hine and Milner (1994) proposed a methodology to distinguish between vertical and horizontal IIT (VIIT and HIIT, respectively). They used Abd-el-Rahman (1991), who differentiated VIIT and HIIT based on export and import unit values as a proxy to prices and as an indicator of quality. It is asumed that the more expensive good is also of a better quality than other of lesser price. Export and import unit values are compared and if the difference between them is lesser than 15% then it is supposed that the exchanged good have a similar quality and the two way trade is VIIT. Its expression is<sup>4</sup>:

$$0,87 < \frac{VUX_{ij}}{VUM_{ij}} < 1,15$$

where  $VUX_{ij}$  y  $VUM_{ij}$  refer to export and import unit values in the trade of country  $i$  in product  $j$ .

If, in the opposite case, the difference between the unit values is bigger than 15%, then it is supposed that the exchanged goods have different levels of quality and thus the two way trade is VIIT<sup>5</sup>. Its expression is:

$$\frac{VUX_{ij}}{VUM_{ij}} < 0,87 \quad \text{ó} \quad \frac{VUX_{ij}}{VUM_{ij}} > 1,15$$

However, using unit values is not exempted of problems that may result in measurement errors in HIIT and VIIT.

Greenaway, Hine and Milner (1994) also proposed to differentiate the VIIT in two parts: VIIT of superior quality (VIITs) and VIIT of inferior quality (VIITi). So, a two way trade would be VIITi if the price of exports is inferior to that of imports:

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and 11.946 for 2000-2011, respectively. These results are not presented in the text for economy of space.

<sup>4</sup> The values 0,87 and 1,15 have been selected so that is indifferent which value is used as numerator, VUX o VUM, i.e., if values 1,15 and 0,85 are used:  $1,15/1 = 1,15$  and  $1/0,85 = 1,17$ , in this case, the variation would be 17% and not 15%. Then it would not be the same to select one value or the other as numerator and denominator.

<sup>5</sup> Abd-el-Rahman (1991) and Greenaway, Hine and Milner (1994) use the 15% threshold. Although this is an arbitrary selection the figure is justified because freight cost do not impose a difference of 15%. However, Greenaway, Hine and Milner (1994) and Gordo and Martín (1996) used a 25% threshold and did not find different results than using 15%.

$$\frac{VUX_{ij}}{VUM_{ij}} < 0,87$$

while it would be VIITs if the price of exports is superior to that of imports, that is:

$$\frac{VUX_{ij}}{VUM_{ij}} > 1,15$$

In this paper we have use this methodology and we have used data from Eurostat COMEXT database that offers exports and imports in euros and tons, using thus unit values per ton.

So, to develop VIIT and HIIT we have used GL index, being  $j$  the products and  $i$  the partners of the reporting country, the value of HIIT in the bilateral trade with country  $i$  would be::

$$HIIT_i = \frac{\sum_{j^*} [(X_{ij} + M_{ij}) - |X_{ij} - M_{ij}|]}{\sum_j (X_{ij} + M_{ij})} \quad \forall j^* | 0,87 < \frac{VUX_{ij}}{VUM_{ij}} < 1,15$$

where  $X_{ij}$  and  $M_{ij}$  refer to exports with destination and imports with origin in country  $i$  of product  $j$  and  $VUX_{ij}$  and  $VUM_{ij}$  are, respectively, export and import unit values of product  $j$  with country  $i$ .

VIIT is calculated with the same equation, changing only the conditions in the summation:

$$VIIT_i = \frac{\sum_{j^*} [(X_{ij} + M_{ij}) - |X_{ij} - M_{ij}|]}{\sum_j (X_{ij} + M_{ij})} \quad \forall j^* | \frac{VUX_{ij}}{VUM_{ij}} < 0,87 \quad \text{ó} \quad \frac{VUX_{ij}}{VUM_{ij}} > 1,15$$

In the same way VIIT<sub>i</sub>, where exports have a lesser price than imports, can be calculated:

$$VIIT_i = \frac{\sum_{j^*} [(X_{ij} + M_{ij}) - |X_{ij} - M_{ij}|]}{\sum_j (X_{ij} + M_{ij})} \quad \forall j^* | \frac{VUX_{ij}}{VUM_{ij}} < 0,87$$

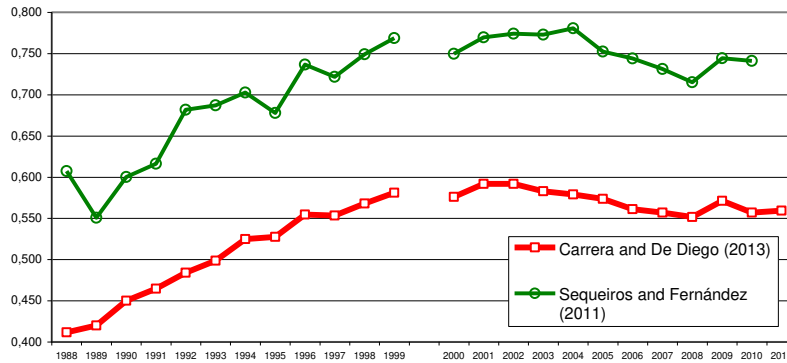
And VIIT<sub>s</sub>, where exports price are bigger than import price:

$$VIIT_s = \frac{\sum_{j^*} [(X_{ij} + M_{ij}) - |X_{ij} - M_{ij}|]}{\sum_j (X_{ij} + M_{ij})} \quad \forall j^* | \frac{VUX_{ij}}{VUM_{ij}} > 1,15$$

## 5.- IIT in the bilateral trade between China and Spain

In the case of Spain we can find a big increase of IIT in Spain in the period 1988-1999, that from levels of 40 % to levels of 60 por 100 measured with GL indexes and from 60 to almost 80 % measured with FF indexes (Figure 12). However, that tendency stops around 2001 and later the indexes drop to levels of 55 % with GL and 75 with FF. Carrera and De Diego (2013) and Sequeiros and Fernández (2011) use different indexes but the tendencies in the indexes are very similar. As in De Diego (2004) FF values are always superior to those offered by GL but the tendencies shown are the same.

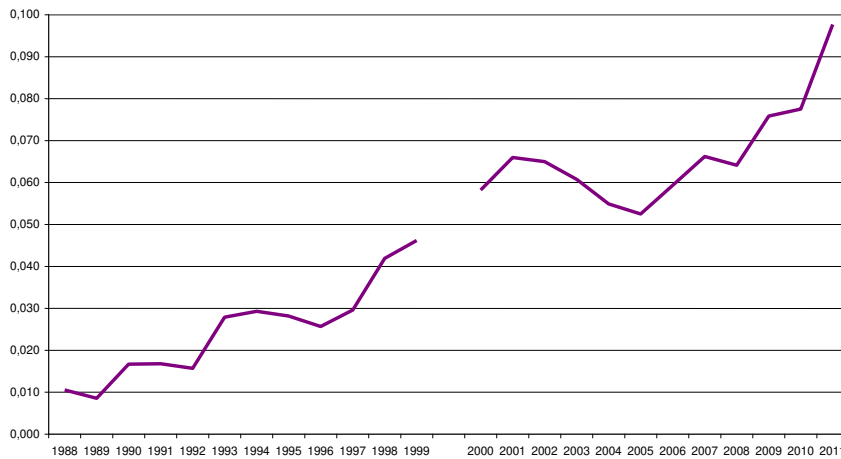
Figure 12.- IIT of Spain, 1988-2011 (GL and FF indexes calculated with TARIC 6 dígitos)



Source: Own elaboration on Carrera and De Diego (2013) and Sequeiros and Fernández (2011).

We offer a series 1998-2011 of total IIT measured with GL index in the bilateral trade between China and Spain. Data show a clear long run tendency of growth, beginning with only 1% and reaching almost a 10% level (Figure 13), however, the level is well below the aggregate level presented above.

Figure 13.-Total IIT on the bilateral trade between China and Spain, 1988-2011 (GL index)



Source: Own elaboration.

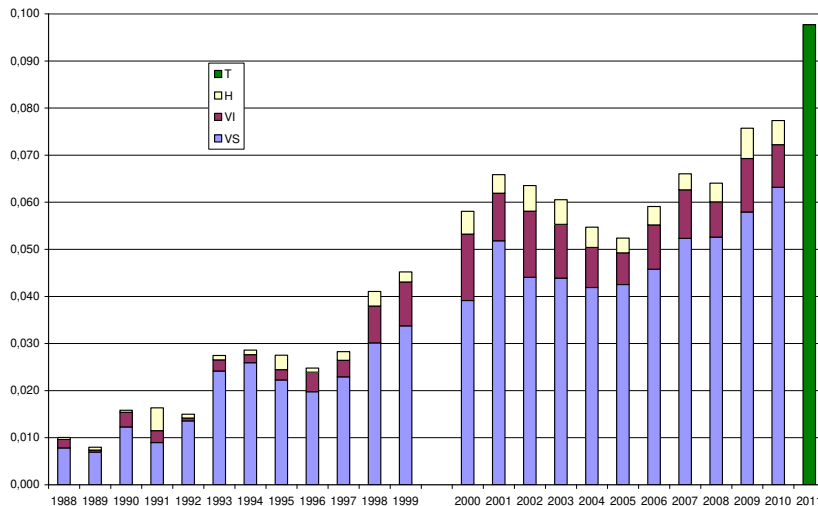
Our series show inferior values than those offered by Hellvin (1996), who measured 10,3% for 1992, and Hu and Ma (1999), who offered 49,6% for 1995, both using a very aggregated 3-digit SITC classification. The value offered by

Hu and Ma (1999) is extremely high if we take into account that, according to the EU data presented above, the coverage ratio for that year was 47,7.

When the nature of IIT is considered using the Greenaway, Hine and Milner (1994) methodology some interesting results emerge from the new series from 1988 to 2010 (Figure 14). First of all, the value of horizontal IIT is extremely low, always under 1%.

The Vertical IIT (the exchange of goods of different levels of quality) has been divided between VIIT of superior quality (when the goods exported by Spain has a higher price) and inferior quality (when the goods exported by Spain has a lower price), according with the Greenaway, Hine and Milner (1994) methodology presented above.

Figure 14.-Horizontal IIT on the bilateral trade between China and Spain, 1988-2010 (GL and FF indexes)



Con formato: Inglés (Reino Unido)

Source: Own elaboration. See Table A in the Annexes for the IIT series 1988-2011.

The level of Vertical IIT of superior quality experienced during the period a clear upward trend from figures of 1% at the beginning to levels of more than 6% in 2010. Finally, our estimation of the level of VIIT of inferior quality show a very low level in the first 10 years of the period and values around 1 % from the beginning of the new century

When the three parts of IIT are put together, it is plain to see that VIIT of superior quality has been the main driver of the upward evolution of IIT in the bilateral trade between China and Spain, while the other two parts has less clear tendencies. Therefore, it can be said that when Spain can compete with China and is able to export to that country products in the same categories where it imports from China, Spain, which is much capital intensive than China,

exports products of superior quality, something that is coherent with the theory of IIT, where different endowments will produce Vertical IIT, in this case, with products exported by Spain of a superior quality than those imported from China.

### 6.- Variation across sectors of IIT

Here will be presented the evolution of IIT in the different branches of Industry using the 13 sectors of NACE-CLIO R-25. We can find in all sectors an increase in the levels of IIT in the period 1989-2011, however the behaviour varies strongly across sectors (Table 1 and Figure A2).

Table 1.- Sectors classified by their level of IIT in 2011 and their evolution between 1989 and 2011

Level in 2011 Increment	1-8%	8-16%	16-25%
Less than 8% points	<ul style="list-style-type: none"> <li>• Office machinery and other</li> <li>• Wood and other manufactured products</li> <li>• Textiles and footwear</li> <li>• Ferrous and non-ferrous metals</li> <li>• Paper and derived products</li> <li>• Food, beverages and tobacco</li> </ul>		
Between 8 and 16% points	<ul style="list-style-type: none"> <li>• Chemical products</li> </ul>	<ul style="list-style-type: none"> <li>• Electrical goods</li> <li>• Rubber and plastic products</li> <li>• Non-metallic minerals and mineral products</li> <li>• Metal products</li> </ul>	
More than 16% points			<ul style="list-style-type: none"> <li>• Transport equipment</li> <li>• Agricultural and industrial machinery</li> </ul>

Source: Own elaboration. See Table A3 in the Annexes for the series 1989-2011 of the IIT in sectors.

There is a very clear relationship between the level of IIT in 2011 and the increase in the period 1989-2011. Almost all sectors had a very low level (close to 0) of IIT at the beginning of the period so almost all the level they had in 2011 has come from the increase experienced in the period.

To understand better the influence of each sector in the evolution of the total level of IIT we have performed a shift-share analysis of the variation of IIT in the



bilateral trade between China and Spain. Our goal is to decompose this variation on three parts:

- The effect of the variation of IIT in each one of the sectors.
- The effect of the variation of the weight of the sectors in trade.
- The effect of the interaction between these two effects.

The analysis begin with Grubel y Lloyd index, where for every sector at every moment of time:

$$IIT_{it} = 1 - \frac{|X_{it} - M_{it}|}{X_{it} + M_{it}}$$

where  $t = 1989, \dots, 2011$  and  $i =$  sector. For the IIT in the bilateral trade between China and Spain it would be:

$$IIT_t = 1 - \frac{\sum_i |X_{it} - M_{it}|}{X_t + M_t}$$

where:

$$\sum_i X_{it} = X_t$$

$$\sum_i M_{it} = M_t$$

This same expression of  $IIT_t$  can be reached beginning with the summation of the product of the weight of every sector for the IIT level in the sector:

$$IIT_t = \sum_i \left( \frac{X_i + M_i}{X + M} \right) IIT_{it} \quad (1)$$

In one moment of time:

$$IIT = \sum_i \left( \frac{X_i + M_i}{X + M} \right) IIT_i = \sum_i \left( \frac{X_i + M_i}{X + M} \right) \left( 1 - \frac{|X_i - M_i|}{X_i + M_i} \right) = \sum_i \left( \frac{X_i + M_i}{X + M} \right) - \sum_i \left( \frac{X_i + M_i}{X + M} \right) \left( \frac{|X_i - M_i|}{X_i + M_i} \right) = 1 - \frac{\sum_i |X_i - M_i|}{X + M} \quad (2)$$

From (1) IIT change could be divided between the change in the share of sectors and the change in the levels of IIT in each sector. We would begin with the expression:

$$IIT_t - IIT_{t-1} = \sum_i \left( \frac{X_i + M_i}{X + M} \right) IIT_{it} - \sum_i \left( \frac{X_i + M_i}{X + M} \right)_{t-1} IIT_{it-1} \quad (3)$$

And then we can add up and subtract the following products:

$$\begin{aligned} & \sum_i \left( \frac{X_i + M_i}{X + M} \right)_{t-1} IIT_{it-1} \\ & \sum_i \left( \frac{X_i + M_i}{X + M} \right)_{t-1} IIT_{it} \\ & \sum_i \left( \frac{X_i + M_i}{X + M} \right)_{t-1} IIT_{it} \end{aligned}$$

And we can put them into groups:

$$\begin{aligned}
IIT_t - IIT_{t-1} &= \sum_i \left( \frac{X_i + M_i}{X + M} \right)_t IIT_{it} - \sum_i \left( \frac{X_i + M_i}{X + M} \right)_{t-1} IIT_{it-1} = \\
&= \sum_i \left( \frac{X_i + M_i}{X + M} \right)_{t-1} (IIT_{it} - IIT_{it-1}) + \sum_i \left[ \left( \frac{X_i + M_i}{X + M} \right)_t - \left( \frac{X_i + M_i}{X + M} \right)_{t-1} \right] IIT_{t-1} + \\
&+ \sum_i \left[ \left( \frac{X_i + M_i}{X + M} \right)_t - \left( \frac{X_i + M_i}{X + M} \right)_{t-1} \right] (IIT_t - IIT_{t-1})
\end{aligned} \quad (4)$$

So the first addend reflect the effect of the variation of the IIT of each sector, supposing that the relative share of the sectors do not change; the second addend account for the effect of the variation in the relative share of the sectors, if the level of IIT in every sector remains unchanged; finally the third addend offers the effect of the interaction of the previous effects.

Using expression (4), we have divided the IIT rise described above into these three effects in the period 1989-2011. Calculations have been performed using the COMEXT database to extract information of the first and last year of the series for the trade of China and Spain.

Before presenting the results of the shift-share analysis it is worth mentioning that there has been some relevant changes in the relative weight of the sectors (Table 2).

Table 2.- Share of sector in trade, exports plus imports, 1989-2011 (%)

Sector	1989 %	2011%	Difference
Electrical goods	6,7	18,1	11,4
Office machinery and other	3,4	5,5	2,2
Chemical products	19,7	9,6	-10,1
Rubber and plastic products	3,1	3,9	0,8
Transport equipment	0,1	3,8	3,7
Agricultural and industrial machinery	7,7	7,3	-0,4
Wood and other manufactured products	12,9	8,1	-4,7
Textiles and footwear	17,5	25,8	8,3
Ferrous and non-ferrous metals	19,6	5,1	-14,4
Non-metallic minerals and mineral products	1,6	2,0	0,4
Metal products	3,8	7,1	3,4
Paper and derived products	1,1	1,6	0,6
Food, beverages and tobacco	2,9	2,0	-0,9
Total	100,0	100,0	

Source: Own elaboration.

The most relevant sectorial decrease is the relative downsize of Ferrous and non-ferrous metals (-14,4), Chemical products (-10,1) and Wood and other manufactured products (-4,7). On the contrary, Electrical goods (+10,1), Textiles and footwear (+8,3), Transport equipment (+3,7) and Metal products (+3,4) have increased its share in the trade of manufactures between China and Spain.

In the period 1989-2011 the total IIT level has increased 8,9 per cent points, from 0,009 to 0,098. The analysis show that all sectors have contributed positively to the increase of IIT, since IIT has increased in all of them. On the contrary, the loss of weight of Chemical products in trade involves a little setback to the evolution of IIT since it was one of the sectors with higher IIT at the beginning of the period. When the total effects by sector are considered five sectors explain 75% of the IIT growth: Textiles and Footwear (20,3%), Electrical goods (19,7%), Agricultural and industrial machinery (17,0%), Transport equipment (10,5) and Metal products (8,9) (Table 3). These sectors are very different in the technological content and the growth of the demand, so we can conclude that the growth of IIT, although still not so important, has spread around all sectors, the traditional sectors contribute with almost 40%, intermediate sector with another 38% and the most innovative sectors with 22%.

Table 3.- Results of the shift-share analysis of the IIT evolution, 1989-2011

<i>Sectores</i>	IIT		Effects (%)			
	1989	2011	IIT	Share	Interaction	Total
Electrical goods	0,001	0,098	7,2	0,2	12,3	19,7
Office machinery and other	0,008	0,047	1,5	0,2	0,9	2,6
Chemical products	0,034	0,110	16,9	-3,9	-8,6	4,4
Rubber and plastic products	0,000	0,144	5,0	0,0	1,3	6,3
Transport equipment	0,014	0,248	0,3	0,6	9,6	10,5
Agricultural and industrial machinery	0,004	0,211	17,9	0,0	-0,9	17,0
Wood and other manufactured products	0,001	0,025	3,5	0,0	-1,3	2,2
Textiles and footwear	0,000	0,070	13,8	0,0	6,6	20,3
Ferrous and non-ferrous metals	0,000	0,053	11,6	0,0	-8,6	3,0
Non-metallic minerals and mineral products	0,003	0,158	2,8	0,0	0,7	3,5
Metal products	0,024	0,124	4,2	0,9	3,8	8,9
Paper and derived products	0,009	0,044	0,4	0,1	0,2	0,7
Food, beverages and tobacco	0,000	0,041	1,4	0,0	-0,4	0,9
<i>TOTAL</i>	0,009	0,098	86,5	-2,0	15,5	100,0

Source: Own elaboration.

## 7.- Conclusions

This paper has offered some interesting contributions to the knowledge of IIT in the bilateral trade of manufactured goods between China and Spain. The first one is a long-term series of IIT that has been set in the context of the evolution of Chinese and Spanish economies. The trade between both

countries has increased dramatically in the period and China has arrived to be one of the main trade partners of Spain. The level of IIT has also increased but the level continue to be low in relation with the medium level of the Spanish trade and the level of IIT with EU countries.

IIT has been divided between horizontal and vertical IIT. The horizontal IIT has not improved significantly in the period and remains close to zero. Vertical IIT of superior quality shows a increasing value and is the main driver of the growth of IIT while IIT of inferior quality has increased but in a very little quantity.

We have presented the evolution of IIT in the 13 sectors of NACE-CLIO R-25 classification. The growth and the levels of the sectors are clearly correlated and the most interesting result obtained from the analysis is that the IIT growth has spread accross different sectors. A shift-share analysis has been performed for the period 1989-2011 to understand the effects of the different sectors in the total level of IIT, due to the change in the level of IIT in the sector or because of the change in the weight of the sector in total trade. On the one hand, all sectors contribute positively to IIT increase since the level of IIT has risen across all industry. Textiles and Footwear, Electrical goods, Agricultural and industrial machinery, Transport equipment and Metal products explain more than 75% of the IIT growth in the period

This paper arise interesting questions and lines of research that the authors hope to address in the future, mainly the effect of this trade evolution in the Spanish industry. IIT theory points out that a high level of IIT allows for big increases of trade with little adjustment costs. Since the trade with China has increased so much and there are very little levels of IIT, the effect of this increased trade on industry and on employment is a relevant issue to address.

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## Annexes

Table A1.- Balance Contribution Index, 1988-2011

	1 Food	2 Energy products	3 Raw materials	4 Semimanufactured goods	5 Equipment	6 Auto-motive	7 Durable consumer goods	8 Consumer manufactures	9 other goods
1988	-2,2	-0,2	-1,2	9,3	1,5	0,0	-1,5	-6,2	0,5
1989	-1,1	-0,1	-1,5	13,2	2,7	0,0	-2,1	-12,4	1,3
1990	-1,9	0,1	-1,1	3,7	8,6	0,0	-1,8	-8,3	0,8
1991	-1,0	0,1	-0,3	4,7	6,6	-0,1	-1,8	-10,8	2,6
1992	-0,5	0,0	-0,1	2,7	6,9	0,1	-1,4	-8,6	0,9
1993	-1,0	-0,1	-0,4	7,5	7,1	0,0	-2,4	-11,1	0,4
1994	-0,9	-0,1	-0,3	2,4	12,4	0,5	-2,9	-11,2	0,1
1995	-0,5	-0,7	-0,4	-0,3	11,4	1,7	-2,4	-9,3	0,5
1996	-0,1	-0,3	-0,1	3,3	5,3	0,0	-1,9	-7,9	1,7
1997	0,1	0,0	0,4	3,2	3,5	0,2	-1,4	-6,3	0,3
1998	0,2	0,0	0,4	2,6	3,2	0,1	-1,3	-5,5	0,4
1999	0,4	0,0	0,5	0,9	3,3	0,2	-1,0	-4,5	0,2
2000	0,3	0,0	0,7	1,1	2,3	0,2	-1,0	-4,2	0,5
2001	0,0	-0,1	0,8	1,6	1,8	0,5	-1,0	-4,2	0,6
2002	0,2	0,0	0,6	2,0	1,7	1,3	-1,4	-4,8	0,4
2003	0,2	0,0	0,7	2,1	1,7	2,0	-1,8	-5,4	0,6
2004	0,2	0,0	0,9	1,8	1,0	1,2	-1,6	-4,3	0,8
2005	0,1	0,0	1,6	1,7	1,5	0,4	-1,4	-4,1	0,2
2006	0,1	0,0	1,9	1,0	0,8	0,8	-1,3	-3,6	0,1
2007	0,1	0,0	1,8	0,7	0,3	0,8	-1,0	-2,9	0,2
2008	0,2	0,0	1,4	1,3	-0,3	0,7	-0,8	-2,6	0,2
2009	0,2	0,0	2,3	2,3	0,1	0,4	-1,3	-4,3	0,3
2010	0,4	0,1	2,6	1,5	-0,7	0,9	-1,2	-3,8	0,2
2011	1,0	0,1	2,9	1,0	-1,1	1,4	-1,3	-4,5	0,6

Source: Own elaboration based on data from <http://datacomex.comercio.es>.

Table A2.- IIT in the bilateral trade between China and Spain, by type, 1988-2011  
(GL indexes calculated with 6 digit TARIC)

	Total	Vertical Superior	Vertical Inferior	Vertical	Horizontal
1988	0,011	0,008	0,002	0,010	0,000
1989	0,009	0,007	0,000	0,007	0,001
1990	0,017	0,012	0,003	0,015	0,000
1991	0,017	0,009	0,003	0,011	0,005
1992	0,016	0,014	0,001	0,014	0,001
1993	0,028	0,024	0,002	0,027	0,001
1994	0,029	0,026	0,002	0,028	0,001
1995	0,028	0,022	0,002	0,024	0,003
1996	0,026	0,020	0,004	0,024	0,001
1997	0,030	0,023	0,004	0,026	0,002
1998	0,042	0,030	0,008	0,038	0,003
1999	0,046	0,034	0,009	0,043	0,002
2000	0,058	0,039	0,014	0,053	0,005
2001	0,066	0,052	0,010	0,062	0,004
2002	0,065	0,044	0,014	0,058	0,005
2003	0,061	0,044	0,011	0,055	0,005
2004	0,055	0,042	0,009	0,050	0,004
2005	0,052	0,043	0,007	0,049	0,003
2006	0,059	0,046	0,009	0,055	0,004
2007	0,066	0,052	0,010	0,063	0,003
2008	0,064	0,053	0,007	0,060	0,004
2009	0,076	0,058	0,011	0,069	0,006
2010	0,078	0,063	0,009	0,072	0,005
2011	0,098				

Source: Own elaboration.

Table A3.- IIT in the bilateral trade between China ~~Portugal~~ and Spain, by sector, 1989-2011 (GL indexes calculated with 6 digit TARIC)

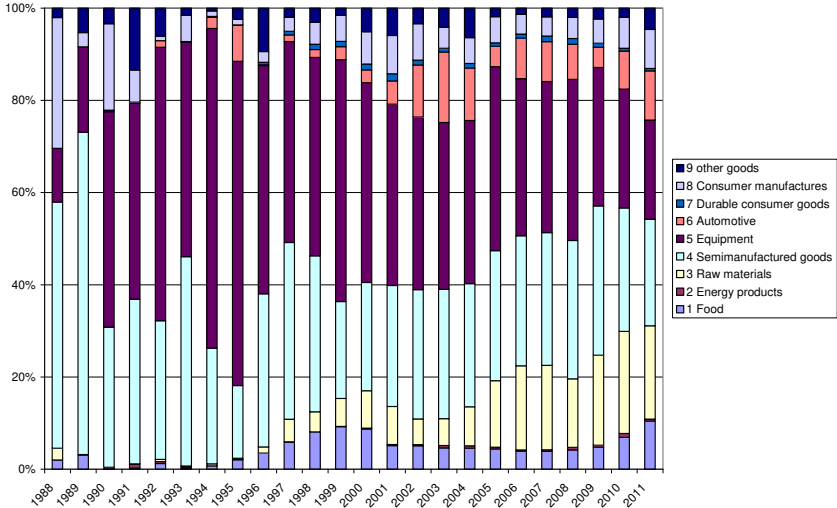
	Electrical goods	Office machinery and other	Chemical products	Rubber and plastic products	Transport equipment	Agricultural and industrial machinery	Wood and other manufactured products	Textiles and footwear	Ferrous and non-ferrous metals	Non-metallic minerals and mineral products	Metal products	Paper and derived products	Food, beverages and tobacco
1989	0,001	0,008	0,034	0,000	0,014	0,004	0,001	0,000	0,000	0,003	0,024	0,009	0,000
1990	0,013	0,012	0,042	0,035	0,000	0,030	0,001	0,000	0,010	0,002	0,046	0,003	0,000
1991	0,044	0,005	0,034	0,023	0,016	0,019	0,001	0,002	0,005	0,004	0,058	0,010	0,006
1992	0,043	0,007	0,041	0,020	0,007	0,041	0,000	0,001	0,002	0,003	0,026	0,011	0,004
1993	0,055	0,004	0,047	0,014	0,074	0,051	0,002	0,002	0,000	0,007	0,095	0,057	0,014
1994	0,045	0,015	0,052	0,017	0,019	0,019	0,008	0,007	0,000	0,011	0,148	0,014	0,006
1995	0,023	0,006	0,044	0,032	0,026	0,013	0,002	0,013	0,040	0,034	0,134	0,033	0,041
1996	0,035	0,009	0,048	0,025	0,215	0,029	0,013	0,010	0,006	0,039	0,039	0,018	0,034
1997	0,046	0,009	0,072	0,032	0,131	0,032	0,013	0,004	0,003	0,018	0,077	0,016	0,021
1998	0,078	0,014	0,070	0,037	0,262	0,068	0,019	0,008	0,001	0,044	0,079	0,019	0,017
1999	0,094	0,014	0,107	0,032	0,190	0,076	0,015	0,011	0,027	0,064	0,052	0,058	0,021
2000	0,137	0,029	0,108	0,041	0,327	0,068	0,015	0,009	0,019	0,061	0,085	0,058	0,032
2001	0,125	0,039	0,143	0,054	0,342	0,109	0,021	0,009	0,024	0,108	0,064	0,087	0,024
2002	0,092	0,047	0,161	0,037	0,186	0,101	0,024	0,009	0,051	0,109	0,081	0,067	0,048
2003	0,075	0,067	0,124	0,073	0,064	0,114	0,017	0,010	0,082	0,137	0,088	0,080	0,064
2004	0,058	0,046	0,103	0,084	0,107	0,117	0,018	0,013	0,044	0,110	0,064	0,044	0,061
2005	0,056	0,083	0,098	0,089	0,105	0,101	0,017	0,012	0,065	0,047	0,059	0,043	0,066
2006	0,061	0,075	0,089	0,113	0,205	0,164	0,020	0,012	0,043	0,039	0,061	0,052	0,046
2007	0,075	0,079	0,100	0,131	0,185	0,171	0,018	0,016	0,048	0,041	0,074	0,045	0,048
2008	0,047	0,070	0,095	0,158	0,219	0,179	0,021	0,019	0,063	0,068	0,073	0,049	0,068
2009	0,072	0,060	0,097	0,134	0,290	0,204	0,020	0,028	0,082	0,088	0,099	0,029	0,077
2010	0,066	0,029	0,095	0,126	0,268	0,190	0,018	0,038	0,055	0,111	0,141	0,048	0,053
2011	0,098	0,047	0,110	0,144	0,248	0,211	0,025	0,070	0,053	0,158	0,124	0,044	0,041

Source: Own elaboration.

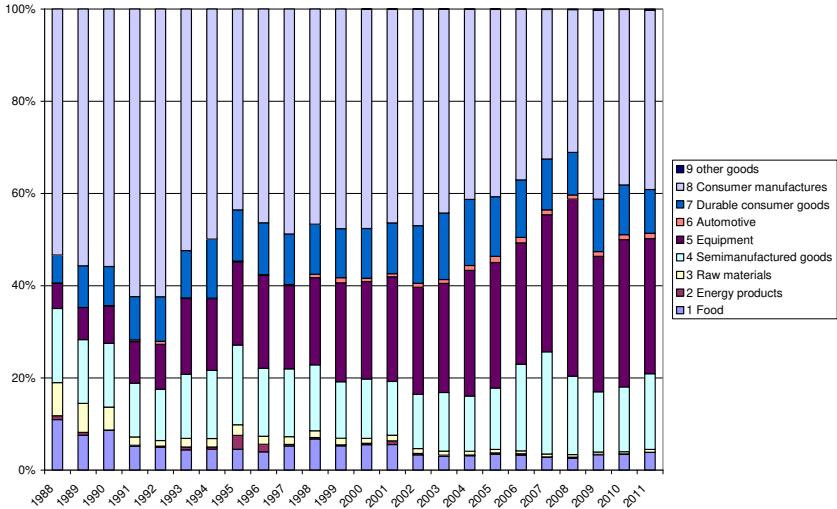


Figure A1.- Structure of the bilateral trade between Spain and China, 1988-2011

a) Exports



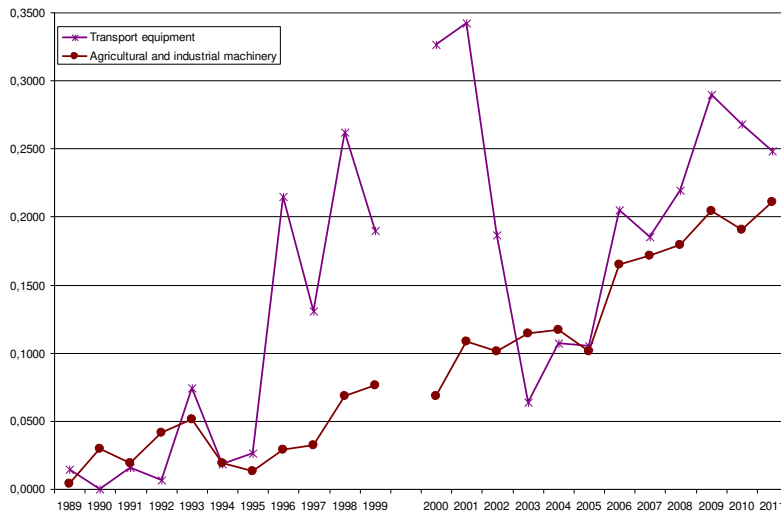
b) Imports



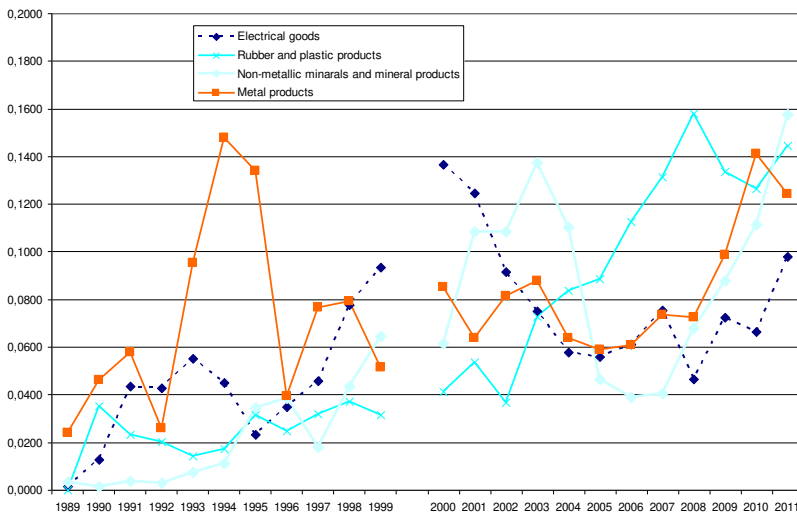
Source: Own elaboration based on data from <http://datacomex.comercio.es>.

Figure A2.- Evolution of IIT in different sectors in the bilateral trade between Spain and China, 1989-2011

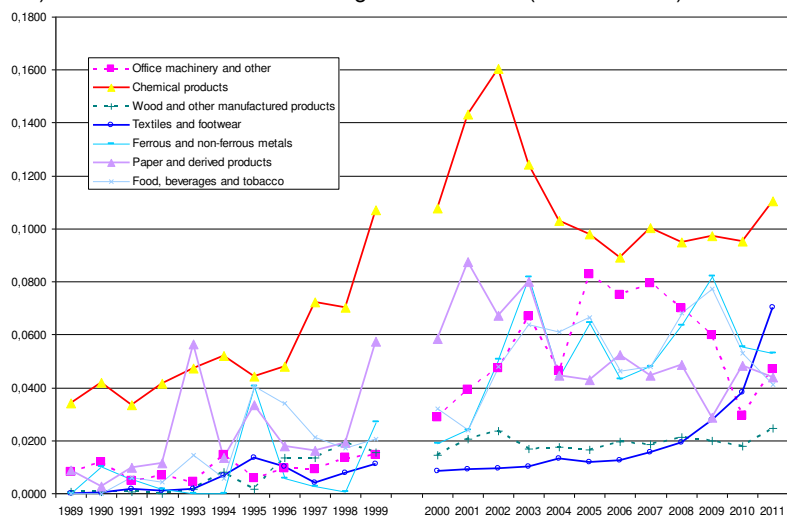
a) The sectors where IIT has grown the most (more than 16%)



b) The sectors that have had an intermediate growth (between 8 and 16%)



c) The sectors where IIT has grown the least (less than 8%)



Source: Own elaboration.