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Trade complementarity and intra-industry trade between MERCOSUR and its main European Partners during 1991-2012: What does the evidence suggest?

Alejandro D. Jacobo, Bernardo J. Tinti

TRADE COMPLEMENTARITY AND INTRA-INDUSTRY TRADE BETWEEN MERCOSUR AND ITS MAIN EUROPEAN PARTNERS DURING 1992-2012: WHAT DOES THE EVIDENCE SUGGEST?

Alejandro D. Jacobo

Universidad Nacional de Córdoba
Av. Valparaíso s/n, Córdoba 5000
Argentina
Correo: jacoboa@eco.unc.edu.ar

Bernardo J. Tinti

Universidad Nacional de Córdoba
Av. Valparaíso s/n, Córdoba 5000
Argentina

Resumen

Este trabajo estudia la Complementariedad Comercial (CC) y el Comercio Intra- Industrial (CII) entre el MERCOSUR y sus principales socios europeos durante 1992-2012 utilizando los índices de Krugman y Grubel-Lloyd a nivel sectorial. La disminución de la CC entre Argentina y Brasil, junto con una convergencia a niveles similares con sus socios clave (Alemania y España) indica que las economías de América del Sur han tendido a asemejarse en algunos aspectos durante los últimos 20 años en lugar de complementar a sí mismas. Además, el aumento de la CII entre Argentina y Brasil en los principales sectores manufactureros parece ser consistente con la hipótesis de la diversificación productiva, a pesar de la reducción en el CII con sus socios europeos sugiere que tal diversificación no se produjo bajo un proceso de transferencia tecnológica.

Palabras clave: Complementariedad Industrial, Comercio Intra-Industrial, UE, MERCOSUR.
Área Temática: Economía Internacional y de la Unión Europea

Abstract

This paper studies the Trade Complementarity (TC) and the Intra-industry Trade (ITT) between MERCOSUR and its main European partners during 1992-2012 using sectoral Krugman and the Grubel-Lloyd Indexes. The decline in TC between Argentina and Brazil together with a convergence to similar levels with their key partners (Germany and Spain) indicates that the South American economies have tended to resemble in some aspects during the last 20 years rather than complementing themselves. Additionally, the increase in ITT between Argentina and Brazil in major manufacturing sectors seems to be consistent with the hypothesis of productive diversification, although the reduction in IIT with their European partners suggests that such diversification does not occur under a technology-transfer process.

Key Words: Trade Complementarity, Intra-Industry Trade, EU, MERCOSUR.
Thematic Area: International and EU Economics

1. INTRODUCTION[1]

Trade complementarity (TC) is the degree of matching of one country's exports with a partner's imports as compared with the world's imports. In other words, TC measures how well one country's specialization in exports complements another country's import demands and hence it indicates the potential for cooperation rather than international trade competition. Among other possible explanations, the differences in technology, factor endowments or economies of scale are ultimately the sources of TC.

While as an indicator TC suggests the existence of mutual gains from current (or potential) trade, in the case of countries involved in integration processes TC could shed some light on the existence of "natural trading partners". In fact, trading partners are "natural" if their trading structure is characterized by high TC value indicators. It should be remarked that TC can be not only the cause but also the result of the regional integration process itself, however. Thus, the study of the evolution of complementarity in economic integration process may reveal in which features the productive structures of the countries involved in the process are affected.

Regarding Intra-Industry Trade (IIT), there are some relationships with TC that reflect changes in the patterns of trade between the different countries. For example, the simultaneous reduction of TC and rise of IIT between Europe and China during the last ten years reveals a technology-transfer process from the first to the second partner. Therefore, to study the joint evolution of TC and IIT may clarify some aspects of trade dynamics.

Following Jacobo and Tinti (2014a,b), this paper measures and compares TC between the two main economies of MERCOSUR (Argentina and Brazil) among themselves together with two main extra-regional European Union members (Germany and Spain) during 1992-2012. The choice of these two extra- regional countries is not arbitrary as Germany and Spain are their main European trade partners of Brazil and Argentina.

The paper is organized as follows. Section 2 briefly introduces the indicator of TC used. Section 3 analyzes the evolution of TC between Argentina and its trading partners, while section 4 does the analysis for Brazil. Section 5 estimates an indicator of IIT. Section 6 presents some concluding remarks.

2. TC INDEX

The analysis of TC usually uses several indicators which provide quantitative measures on the productive differentiation among economies. In this case, since we want to compare productive structures between pairs of countries, we use the Krugman Index (KI) defined as follows:

$$KI = \sum_{k=1}^{n} \left| p_i^k - p_j^k \right|$$

where: p_i^k is the share of good k in total exports of country i; p_j^k is the share of product k in total exports of country j; and n represents the number of products.[2]

The KI compares the export structures of two countries to determine whether there is any "overlap" between them; that is, in other words, to what extent the countries tend to produce and export the same goods. The KI assumes values between 0 and 2. It is equal to 0 if countries have the same export structures (there is not any TC) and 2 in if countries have a perfect complementary export structures (each country produces and consequently exports what the other does not). Additionally, this indicator has the advantage that it can be broken down into the n-sectors (or products) for which it was estimated thus determining in which of these sectors (or products) TC exists.

In this particular study, the KI is estimated classifying exports according to the Standard International Trade Classification (SITC) in its third revision, 3 digits. The export data for the period 1992-2012 for Argentina, Brazil, Germany and Spain come from *World Integrated Trade Solution* (WITS).

3. THE KI FOR ARGENTINA AND ITS TRADE PARTNERS

Figure 1 shows the estimates for the KI for Argentina with Brazil, Germany and Spain. The indicator reveals that TC between Argentina and Brazil shows a decreasing trend from 1992 to 2006 and that this trend is (with some ups and downs) partially reverted from 2006.

The figure also illustrates that TC between Argentina and its EU partners was higher than the TC between Argentina and Brazil. It must be remarked the trend

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[2] We strictly follow Durán Lima and Alvarez (2008).

declines and stops in values higher than unity thus revealing the persistence of a significant degree of TC with Germany and Spain.

Figure 1
**Krugman Index for Argentina**
1992 - 2012
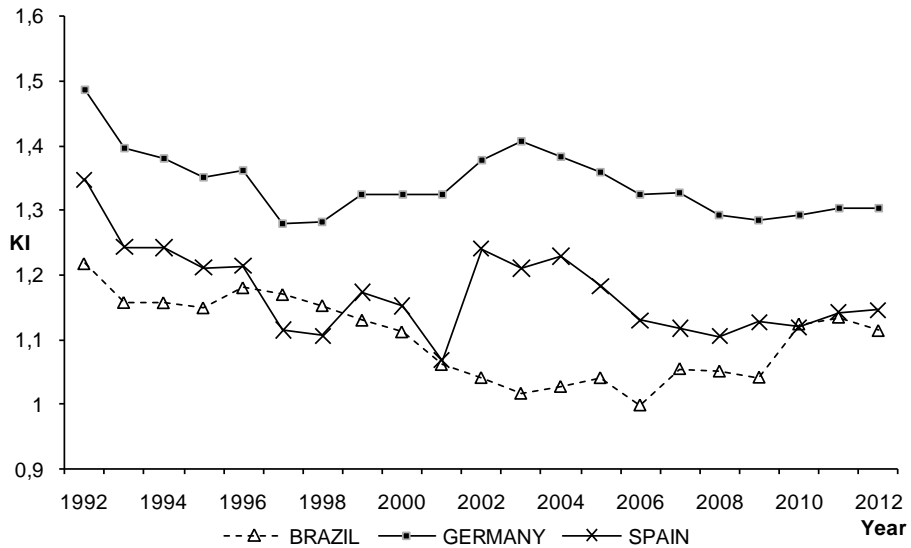
Source: Own estimates based on World Integrated Trade Solution

Since the aim of the analysis of TC is the comparison between productive structures, it is convenient to estimate the KI for different sectors in order to identify which of these sectors are complementary. These sections (with their corresponding codes between brackets) are: "Food and live animals" (0), "Beverages and tobacco" (1), "Crude materials, inedible, except fuels" (2), "Mineral fuels, lubricants and related materials" (3), "Animal and vegetable oils, fats and waxes" (4), "Chemicals and related products, n.e.s" (5), "Manufactured goods classified chiefly by material" (6), "Machinery and transport equipment" (7) and "Miscellaneous manufactured articles"(8).

Figure 2 presents the sectorial disaggregation for the listed items of KI in Argentina and Brazil between 1992 and 2012. [3]

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[3] Although the KI was estimated at 3-digit level of the SITC, in order to simplify this presentation the sectors are aggregated to one digit. The results using 3-digit level may be requested to the authors.

Figure 2
Sectoral Structure of Trade Complementarity between Argentina and Brazil
1992 and 2012
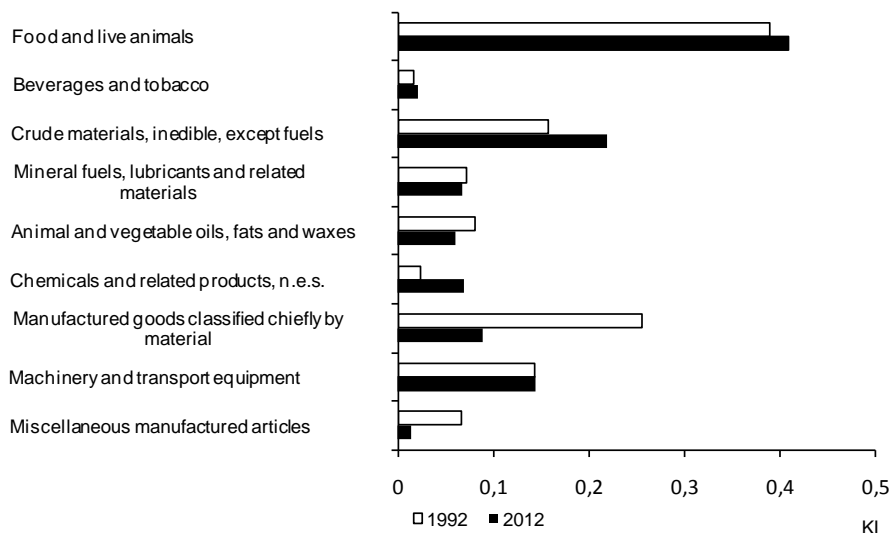
Source: Own estimates based on World Integrated Trade Solution

As observed, the item that generates a greater TC with Brazil is "Food and live animals". The TC value in this field has remained unchanged and above the TC values of other items. This observation is not surprising considering that trade in this particular sector depends mainly on the natural resource endowments.[4]

One item that has experimented a substantial change is "Manufactured goods classified chiefly by material", in which Argentina and Brazil have significantly reduced their TC. This reduction is not focused on a specific product but it is distributed in almost all of the products included in the item. TC decreases only in 8 of the 52 products of the section and two mutually compatible hypotheses explain this observation.

First, the expansion of local markets due to the launching of MERCOSUR could have induced producers to diversify their manufacturing production (i.e. they produce different varieties of the same product). This situation leads to a greater overlap of manufacturing production structures of both countries. Under this hypothesis, the existence of imperfect competition and economies of scale in the manufacturing sector would make the market size the main determinant of the diversity of products traded. Second, the relative shares of the categories in total

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[4] From a more profound analysis not presented here, complementarity between Argentina and Brazil appears in the categories "Feeding stuff for animals", "Wheat" and "Maize", goods typically produced in mild climates like the Argentinean one, and in the categories "Sugars, molasses and honey" and "Cofee" which correspond to Brazil's tropical climate.

exports of both members of MERCOSUR have been reduced due to the increase in the share of primary products.[5]

A similar hypothesis could also explain what came about to the category "Miscellaneous manufactured articles", in which a reduction of TC is observed.

In contrast, "Crude materials, inedible, except fuels" is the only item in which Argentina and Brazil have substantially increased their TC. In this case, the increase is explained by the augment of Brazilian exports of products "Iron ore and concentrates" and "Copper ores and concentrates; copper mattes; cement copper", which in turn have kept a low share in Argentinean exports. By the increase of the differences between relative shares in total exports, the KI increased.

On the other hand, the product "Oil-seeds and oleaginous fruits" exhibits a reduction of TC which partially offsets the effect of the above products ("Iron" and "Copper") The increase in exports of soybeans in these two countries account for the greater overlap between their production structures (CEPAL, 2011; p. 106).

Finally, in the trade relationship between Argentina and Brazil, the category "Mineral fuels, lubricants and related materials" seems not to significantly alter TC, since the decrease in the index value is minimal between 1992 and 2012. However, this item includes a major qualitative change: whereas in 1992 TC arose from the fact that Argentina exported more oil than Brazil, in 2012 these countries have reversed the roles and TC arises from a Brazilian export capacity beyond of that of to Argentina (Campodónico, 2008; p. 39).

Regarding TC between Argentina and Germany, Figure 3 shows that reduction of KI observed between these two countries in the period 1992-2012 is uniformly distributed across sectors. The items that generate a greater TC are "Food and live animals" and "Machinery and transport equipment". TC between sectors of a low and a high level of industrialization respectively corresponds to the general idea of the North-South trade pattern through which raw materials are exchanged for capital goods and/or manufactures. The fact that such a structure has been maintained for 20 years and after the launching of MERCOSUR gives evidence that the economic transformations generated by the agreement have not been deep enough to position its members as exporters of highly industrialized goods to extraregional partners; not least in the case of Argentina.

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[5] That trend may have reduced the values of the sectorial KI or may have affected both countries in different magnitude.

Figure 3
Sectoral Structure of Trade Complementarity
between Argentina and Germany
**1992 and 2012**
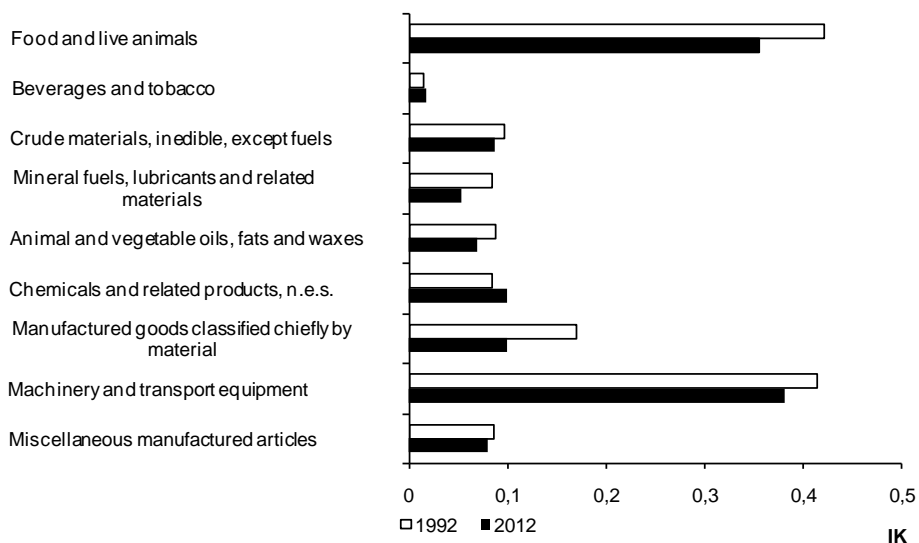
Source: Own estimates based on World Integrated Trade Solution

The only category in which Argentina and Germany have reduced their TC is "Manufactured goods classified chiefly by material".

As shown in Figure 4, TC between Argentina and Spain is similar than TC between Argentina and Germany. However, there is an important difference: TC in "Machinery and transport equipment" is considerable reduced. This reduction was mainly due to the product "Motor cars and other motor vehicles principally designed for the transport of persons", where two trends can be described. On the one hand, the share of this product in Argentina's total exports increased by almost 600% during 1992-2012. On the other hand, the share of the product in Spanish total exports fell by 47%. The combination of both trends resulted in a significant drop in the sectoral KI. In the case of Argentina, the trend would be explained mainly by the exchange with Brazil in the context of regionalization of automotive production (Arza and López, 2008). The smaller share of the automotive industry in the Spanish exports could find its origin (according to the *International Labor Organization*) Eastern Europe capturing a much larger share of new investment in the European automotive sector (OIT, 2005).

Figure 4
Sectoral Structure of Trade Complementarity between Argentina and Spain
1992 and 2012
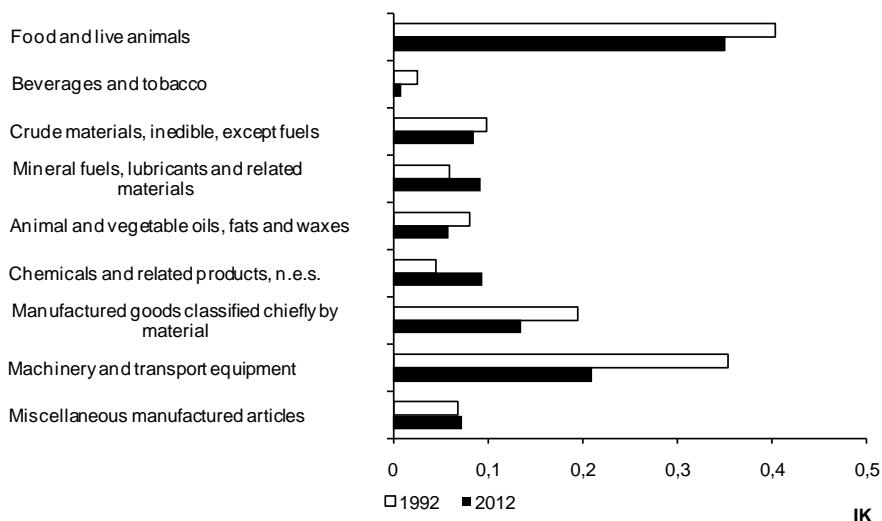
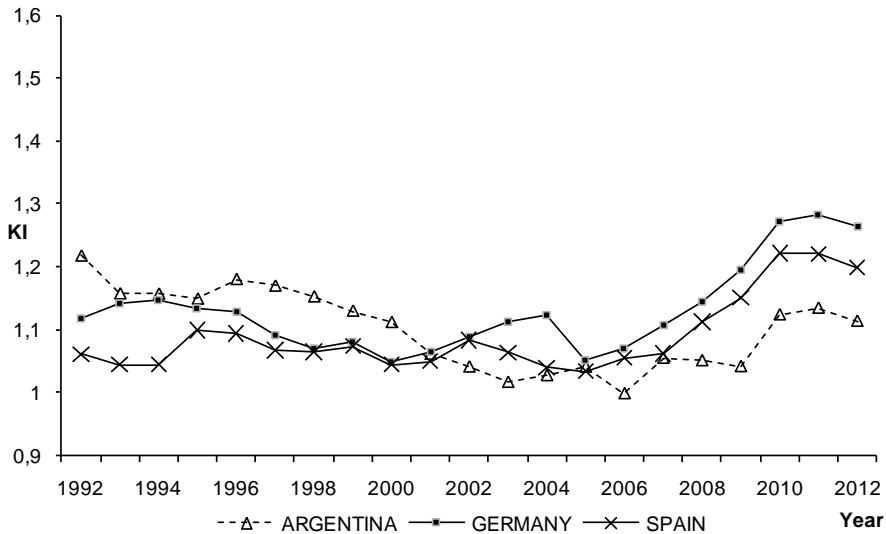Source: Own estimates based on World Integrated Trade Solution

4. ANALYSIS OF KI FOR BRAZIL AND ITS EUROPEAN TRADE PARTNERS

Figure 5 shows the evolution of KI for Brazil and its three partners during 1992-2012. Two stages can be distinguished.

The first stage covers the period 1992-2001. Its main feature is that the TC between Brazil and Argentina is clearly superior to that of Brazil with Germany or Spain. However, although TC is higher, this trend is decreasing, while TC with European partners remains stagnant.

The second stage is initiated in 2001. There is a break in the trend of TC with Brazil's European partners and the trend begins to increase. This raise exceeds TC value with Argentina, which remains stagnant until 2010. With regard to this stagnation, although in 2010 there is a modest jump in complementarity (which places the KI values close to 1.12) this value is lower than that recorded between Brazil and its European partners. To sum up, Brazil altered the order of TC with their partners observed in the previous stage.

Figure 5
Krugman Index for Brazil
1992 - 2012

Source: Own estimates based on World Integrated Trade Solution

On the other hand, if the evolution of global measures of TC between Argentina and Brazil (presented respectively in Figures 1 and 5) is compared, one can observe three characteristics.

First, Argentina has shown higher levels of TC with its European partners than those of Brazil with the same partners. However, such TC in Argentina shows a declining trend and stagnation in recent years.

Second, and in a clear contrast to the Argentine case, since 2005 there is a sharp increase in the TC of Brazil with its European partners. This increase reaches a magnitude of 20% when the values of 2005 and 2012 are compared. This augment in TC in a relatively short period of time would indicate the occurrence of major changes in the Brazilian productive structure over the last decade.

Third, when comparing the two trends mentioned, TC of the two South American countries with their European partners tend to converge in both cases to a value close to 1.3. In the case of Argentina, TC diminished, while in the case of Brazil TC increased. This convergence, coupled with the decrease in the TC of the MERCOSUR may indicate that the economies of Argentina and Brazil have tended to resemble during the last 20 years.

Finally, Figure 6 presents TC values between Brazil and Germany.[6] It disaggregates the values of KI to one digit SITC, in order to compare the productive structures of both countries.

TC between Brazil and Germany is mainly based on the items "Food and live animals" and "Machinery and transport equipment". This structure has virtually remained unchanged between 1992 and 2012. As in the case of Argentina and Germany, TC between Brazil and Germany seems not to be the exception to the North-South trade pattern.

Figure 6
Sectoral Structure of Trade Complementarity between Brazil and Germany
1992 and 2012
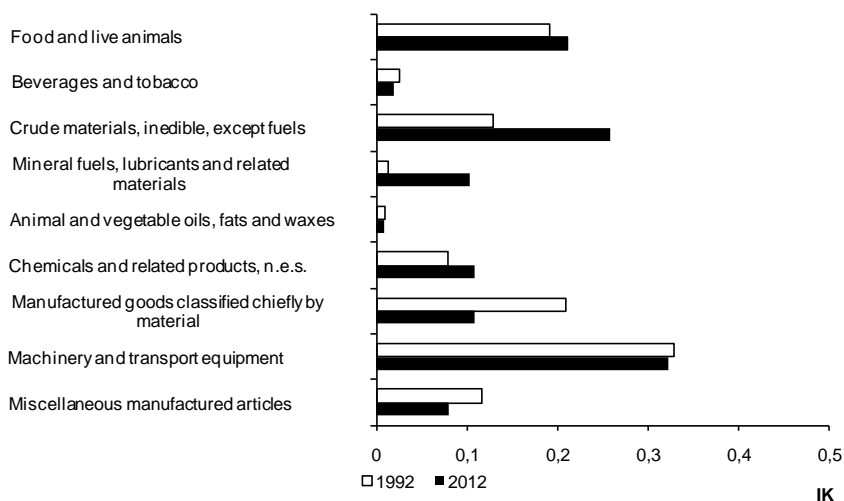
Source: Own estimates based on World Integrated Trade Solution

However, the overall increase TC between Brazil and Germany during 1992-2012 (Figure 5) is originated in two different categories: "Crude materials, inedible, except fuels" and "Mineral fuels, lubricants and related materials".

In the first of the categories mentioned, two products have significantly increased their share in total exports from Brazil (thus increasing the value of the KI). One is "Oil-seeds and oleaginous fruits (excluding flours and meals)". The increase in international prices explains the significant augment in the relative share of the sector over total exports (CEPAL, 2011). The other product is "Iron ore and concentrates". In this case, while the German production has remained relatively stagnant over the same period, Brazil has increased its production in the last twenty years (World Steel Association).

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[6] Recall that TC between Argentina and Brazil was already discussed in the previous section.

The notable augment in TC between Brazil and Germany in the category "Mineral fuels, lubricants and related materials" had its origin in the rising share of the product "Petroleum oils and oils obtained from bituminous minerals, crude" in Brazil's total exports. This share has doubled during 2006-2012, after Brazil reached oil self-sufficiency in 2006 thanks to the institutional sector reforms that this country initiated in 1997 (Campodónico, 2008).

One item has significantly reduced its TC and it stands out from the rest: "Manufactured goods classified chiefly by material". As the in the case of Argentina-Germany TC, it could be explained by the same hypothesis of diversification as a result of the expansion of markets in the MERCOSUR.

Figure 7
Sectoral Structure of Trade Complementarity between Brazil and Spain
1992 and 2012
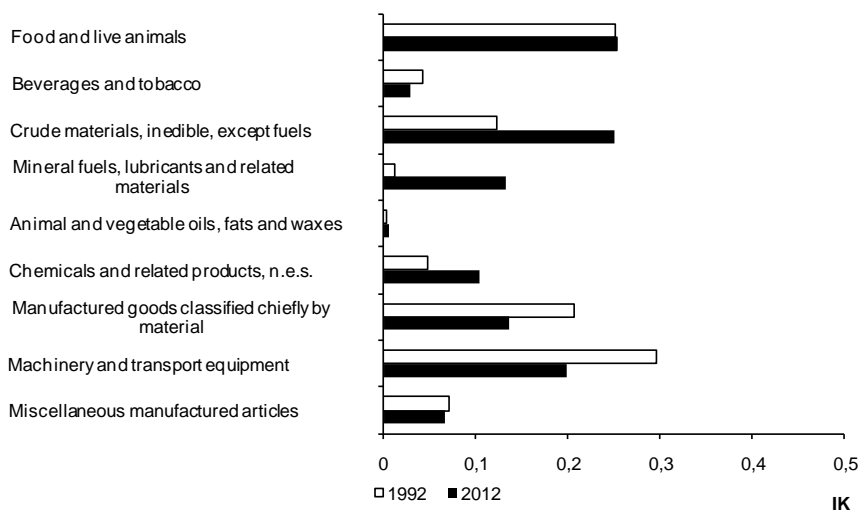
Source: Own estimates based on World Integrated Trade Solution

Figure 7 considers TC between Brazil and Spain. As shown, the sectoral structure is relatively similar to that analyzed between Brazil and Germany. However, two key differences should be highlighted: the category "Machinery and transport equipment" accuses a significant reduction in its TC, while "Chemicals and related products" shows a significant increase. The reduction of TC in the first of these categories would be explained by the same trends presented in the case of Argentina and Spain, which corresponds to the product "Motor cars and other motor vehicles principally designed for the transport of persons". As for the category "Chemicals and related products", the augment is explained by a variety of products, among which stand out the "Medicaments (including veterinary medicaments)", "Perfumery, cosmetic or toilet preparations (excluding soaps)" and "Polyacetals, other polyethers and epoxide resins, in primary forms". In general, in both countries (Brazil and in Spain) the share of these products in exports has

grown between 1992 and 2012. However, in Spain this growth has been higher thus explaining the increase in KI.[7]

On the other hand, the changes in "Crude materials, inedible, except fuels", "Mineral fuels, lubricants and related materials" and "Manufactured goods classified chiefly by material" would be explained by similar trends to those presented in the case of Brazil and Germany.

5. TC AND IIT BETWEEN ARGENTINA, BRAZIL AND THEIR EUROPEAN PARTNERS

The trade dynamics between the main economies of MERCOSUR and its European partners can be reviewed following the analysis delineated by Dettmer *et al*. (2009). This paper studies the changes in trade structure of China and the EU, where there is an inverse relationship between complementarity and IIT. The authors hypothesize that the increases in TC induce economies to specialize in different sectors. This situation results in an increase of Inter-Industry Trade and in a consequent reduction in IIT.

In the opposite direction, reducing TC in some sectors would increase two-way trade per horizontal intra-industry specialization (in different varieties of a product with similar capital/labor requirements), vertical (in different varieties a product with different requirements of capital/labor) or international fragmentation of the production process (value chains).[8] Dettmer *et al*. particularly analyzes the reduction of China-EU TC in high-technology manufactures as the Chinese economy reaches higher levels of economic development. When comparing the reduction of TC with the increase in IIT, the authors conclude that there is a pattern of technology transfer from the EU to China on a specific group of traded products.

Based on the above mentioned hypothesis, the relationship between TC and IIT could shed some light on the trade dynamics of MERCOSUR. For this purpose, we analyze the changes in the KI and an adequate indicator of IIT. We want to compare trade patterns identified in Dettmer *et al*. with those observed in Argentina, Brazil, and its main EU partners.

The Grubel and Lloyd Index (GLI) is one of the most common indicators for measuring IIT.[9] These authors define the two-way trade between a couple countries in a category or item i as total trade ($X_i + M_i$) less IIT ($X_i - M_i$). The index is as follows:

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[7] As noted in footnote 3, this kind of trend can alter the KI value without any implication for a clear change in complementarity between two countries.
[8] Czarny (2003) mentions that these patterns imply the existence of complementarity between subsectors inside the same industry, which is not capture due to aggregation problems.
[9] Gruber and Lloyd (1975).

$$GLI_i = 1 - \frac{|X_i - M_i|}{X_i + M_i}$$

When subtracting to 1 the proportion of Inter-Industry Trade in total trade, the index value represents the share of IIT over the total.

To obtain an aggregate measure of IIT, either in different industries within the economy or sub-sectors to the same industry, Grubel and Lloyd (1975) propose a weighted version of the index defined as:

$$GLI_i = 1 - \frac{\sum_k |X_{ik} - M_{ik}|}{\sum_k (X_{ik} - M_{ik})}$$

where X_{ik} and M_{ik} are respectively exports and imports in each sub sector k belonging to the industry i. This indicator was also constructed from sectors SITC 3 digits, adding them to 1 digit through the weighted version of the GL index. The percent changes in KI and GL index between 1992 and 2012 for the two largest economies of MERCOSUR and its European partners are presented in Table 1.

Table 1
Trade Complementarity and Intra-Industry Trade Variations between
Argentina, Brazil and their Main European Partners
1992 – 2012
(in %)

Sectors		Krugman and Grubel-Lloyd indexes variations between:				
		Argentina			Germany	Spain
				and		
		Germany	Spain		Brazil	
Chemicals and related products, n.e.s.	IK	18,3	107,0	190,5	36,9	120,7
	GL	14,6	-62,9	27,7	-54,0	114,2
Manufactured goods classified chiefly by material	IK	-40,9	-31,1	-65,2	-48,5	-34,2
	GL	-66,4	-41,5	161,0	-41,2	124,8
Machinery and transport equipment	IK	-7,6	-40,6	0,7	-2,3	-33,2
	GL	36,0	274,9	94,3	-12,1	-57,1
Miscellaneous manufactured articles	IK	-7,3	5,4	-77,7	-31,1	-5,0
	GL	-58,6	-63,3	31,2	-9,7	126,6

Source: Own estimates based on World Integrated Trade Solution

The categories "Manufactured goods classified chiefly by material" and "Miscellaneous manufactured articles" show an increase in IIT and a reduction of TC for Argentina and Brazil. This observation would be consistent with the hypothesis horizontal intra-industry specialization within MERCOSUR. On the other hand, TC in the category "Machinery and transport equipment" remains stable between 1992 and 2012, although the level of IIT increases considerably within the industry. As posited by Lucángeli (2008) and Arza and López (2008), the fragmentation of the production process in the automotive industry at the regional level could explain this increase in IIT without having modified the pattern of specialization (3-digit level) between Argentina and Brazil.

In trade between Argentina and Germany only the category "Machinery and transport equipment" shows a drop of TC together with an increase in IIT. Since this is a relationship between an industrialized country (Germany) and a semi-industrialized one (Argentina), this observation may indicate a pattern of technological development closer to the one posited by Dettmer *et al.* (although one with a much smaller scale and restricted to the automotive sector).

Finally, in the relationship between Argentina and Germany and Brazil and Germany, there are joint reductions in TC and IIT in the categories "Manufactured goods classified chiefly by material" and "Miscellaneous manufactured articles". This reduction of two-way trade with an industrialized country would add to the hypothesis of horizontal intra-industry specialization within MERCOSUR that this hypothesis has not occurred in the context of a technological development process in the members of this agreement.

6. CONCLUDING REMARKS

The study of TC through KI between countries involved in regional integration agreements points out some interesting features about their productive structures. As to MERCOSUR, the declining TC between Argentina and Brazil together with convergence to similar levels of TC with key partners outside the region (Germany and Spain) would indicate that the economies of the two South American countries have tended to resemble in some aspects during the last 20 years rather than complementing themselves.

The sectorial analysis of TC let us appreciate the characteristics of the commercial dynamics and its relation to the productive structures of the countries studied. We highlight two observations. First, TC between the two main MERCOSUR economies and their main EU partners arises respectively between sectors of low and high level of industrialization; a feature that seems a key characteristic of North-South trade pattern. Second, the marked reduction of TC between Argentina

and Brazil in major manufacturing categories would support the hypothesis that the expansion of local markets (that follows the launching of MERCOSUR) could have induced producers to diversify their manufacturing production (producing different varieties of the same product), which resulted in a greater overlap of manufacturing production structures of both countries.

Finally, the decrease of TC simultaneously to an increase in IIT between Argentina and Brazil in major manufacturing categories is consistent with the hypothesis of productive diversification; although the reduction in IIT with European partners would suggest that such diversification does not occur in under a technology transfer process.

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