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COLLANA DEL
DIPARTIMENTO DI ECONOMIA

TRADE PATTERNS AND TRADE CLUSTERS: CHINA, INDIA, BRAZIL AND SOUTH AFRICA IN THE GLOBAL TRADING SYSTEM

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Working Paper n° 125, 2011

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esemplare fuori commercio
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Trade Patterns and Trade Clusters: China, India, Brazil and South Africa in the Global Trading System*

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February 1, 2011

Abstract

The present paper analyzes the evolution of the specialization and trade patterns of China, India, Brazil and South Africa (CIBS) and other WTO countries. It aims to provide an answer to the following questions: is there a tendency to a multi-polarization of trade patterns? If so, is CIBS' rise leading to new clusters with or among CIBS or other emerging countries? Also, ultimately, does this multi-polarization have a regional element to it? The paper deals with the above questions by presenting: i) a world map of trade clusters involving WTO countries and CIBS; ii) a comparison of the above clusters and their key characteristics in the last decade; and iii) the key drivers of clusters' trends. The novelty of this study is twofold: first, it adopts a more comprehensive dataset for a wide range of countries and trade dimensions; second, it provides an evolutionary look at the clusters' trends. The empirical results do not show neither a remarkable phenomenon of multi-polarization, nor evidence of CIBS as a significant separate group and/or regional agglomeration.

Keywords: CIBS, trade patterns, trade specialization, cluster analysis, multinomial logit model

JEL classification: F10, F14, F15, C38

*__Acknowledgement__: The authors are grateful to Carlo Pietrobelli, Luca Salvatici and Amelia Santos-Paulino for helpful comments and to Rebecca Pietrelli for her valuable research assistance. They would like to thank also participants at the PRIN Workshop (University of Roma III, November 2010) and the ETSG Conference (Lausanne, September 2010). Financial support from MIUR-PRIN Italian grant 2007 is gratefully acknowledged. The usual disclaimers apply.

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1 Introduction

The world economy is undergoing a process of rapid change linked to the rise of the emerging economies on the international scene. Among these economies, China, India, Brazil and South Africa (CIBS) are undoubtedly acquiring a leading role as both economic and political actors. Thanks to their economic growth and size, CIBS have emerged as important powers at a regional as well as global level, accounting altogether for 40 percent of the world population and approximately 20 percent of world GDP (World Bank, 2010).

In the last few years, there has been a growing and large amount of attention to and research on these countries and their impact on the world economy (Antkiewicz and Whalley, 2005; Jenkins and Edwards, 2006; Winters and Yusuf, 2007; OECD, 2009; Arestis and Eatwell, 2008; Kaplinsky and Messner, 2008; Gu et al., 2008; McDonald et al., 2008; Santos-Paulino and Wan, 2010). Three main channels have been commonly taken into consideration to assess the impact of CIBS dynamism: global governance, production systems and factor movements (Nayyar 2009; Kaplinsky and Messner, 2008; Nenci, 2008; Santos-Paulino, 2010). However, there are still important knowledge-gaps with respect to a range of likely consequences of their dynamism. Focusing on trade patterns, the impact of CIBS' rise on the global trading system can be investigated by looking at the changes in the structure of global trade and the possible multi-polarization of the international trade structure.

The World Bank, in its 2005 "Global Economic Prospects" annual report, highlighted how the emergence of new poles involving developing countries foreshadowed an evolving process of segmentation and new bloc formation in world trade able to overcome the bi-polarization (USA and Europe) which had characterized world trade by the 1960s (World Bank, 2005, Ch. 2; see also Robinson and Bonilla, 2004). Recently, other studies have argued that current trade dynamics are leading to important changes in the structure of global trade and that some specific emerging economies are at the center of these dynamic realignments of the world trade structure (Athukorala and Yamashita, 2006; Evenett, 2007; Akin and Kose, 2008). Shaw et al. (2007) stated that what is currently emerging is a new 'trilateral' world influenced by emerging economies, especially China and India, given the size of their economies and position in the global economy.

To address this issue empirically we use the notion of "trade clusters", i.e. a group of countries with common trade features on a wide array of trade dimensions to a level of extent higher than countries outside the group. We thus derive a measure of the position of each country, including CIBS, across the trade specialization clusters that characterize the global trading system. Changes in trade patterns will be detected by changes in the key charac-

teristics of these trade clusters and/or in their composition. For instance, CIBS' trade dynamism could lead to the creation of new trade clusters between CIBS and economies with similar trade interests. These clusters could involve countries belonging to the same geographical area, with the likely result of fostering regional trade integration and hindering the extent of global trade flows. The traditional concern is the consolidation of "regional trading blocs" with the reduction of world trade and welfare (Krugman, 1989).

The present paper aims to explore the evolution of the specialization and trade patterns of CIBS and other WTO countries over the last ten years. This work will contribute to the above debate by providing an answer to the following questions: is there a tendency to a multi-polarization of trade patterns? If so, is CIBS' rise leading to new clusters with or among CIBS or other emerging countries? And, eventually, does this multi-polarization have a regional feature? The paper deals with the above questions by presenting: i) a world map of trade clusters involving WTO countries, including CIBS; ii) a comparison of the above clusters and their key characteristics in the last decade; and iii) the key drivers of trends in these clusters. The novelty of this study is twofold: first, it adopts a more comprehensive dataset for a wide range of countries and trade dimensions; second, it provides an evolutionary look at the trade clusters' trends.

The paper is structured as follows. First, it presents some stylized facts on CIBS' rise (Section 2). Second, it presents the empirical strategy of the work as well as the data and variables used (Section 3). Finally, it presents the main outcomes of the analysis (Section 4) and some conclusions (Section 5).

2 CIBS' performance: stylized facts

As already underlined, CIBS dynamism has a far reaching impact on the global economy. They registered an impressive economic performance in the last decade: China grew at an average annual rate of over 11 percent; India at over 8 percent; Brazil and South Africa showed a robust 4.9 and 4.5 percent, respectively (World Bank, 2010). China is surpassing Japan as the second largest economy in the World (after the United States), in terms of nominal current GDP; Brazil and India are in the top ten ; and South Africa is in the top twenty. They currently account for about 50 percent of the total GDP of low- and middle-income economies.

CIBS' performance has been also relevant in terms of international trade, one of the strongest channels of interdependence with the rest of the world. CIBS' trade growth has been well above the world average in the last decade, both in terms of exports and imports. In the period 2006-2008, India and South Africa exports increased by more than 20 percentage points with respect to the period 1996-98 (by over 15 percentage points in the case of

Brazil and China), whereas India and Brazil imports increased by over 25 percentage points (by over 15 percentage points in the case of China and South Africa) (Table 1).

China is the second largest exporter of merchandise, after the EU (with a market share of nearly 9 percent), and the third largest importer, after the EU and the USA (with a market share of nearly 7 percent) and, respectively, the sixth and fifth in commercial services. India market shares in world trade are more relevant in the service sector than in merchandise (2.7 percent of total world exports and 2.5 percent of total imports against respectively 1.2 percent and 1.9 percent). However, India's overall exports of commercial services are still less than those of China (India holds the 10th and the 12th places for exports and imports in the trade of commercial services, respectively). Less extraordinary, but no less important, is the weight of Brazil and South Africa on world trade (Table 2).

An interesting comparative picture of CIBS trade specialization in the last decade (see Fig. 1), based on the Revealed Symmetric Comparative Advantage (RSCA) index for the ten industrial clusters proposed by Leamer (1984; 1995) (see Section 3), shows that China in the last decade climbed from being mainly specialized in apparel and labor-intensive manufactures ("Lab") to being specialized in textiles, rubber manufacturers and steel ("Cap") and then electronic and industrial machines ("Mach"). In the same period, India increased its exports of mineral fuels, mineral oils and products of their distillation, especially heavy petrol/bitum oils ("Petro") alongside its traditional specialization in labor- ("Lab") and capital- ("Cap") intensive manufactures (mainly apparel and clothing accessories). Brazil appears to be specialized in crops (cereals "Cer"; forest products "For"; tropical agricultural products "Trop" and animal products "Anl") while South Africa lagged behind in terms of physical capital intensity being mainly specialized in raw materials (Mat).

CIBS performance leads them to gain importance as influential global players too. Within the Multilateral Trading System, they have acquired leadership roles thanks to their ability to formulate policy and to articulate the views held by broad groups of DCs. Since the Cancún Meeting of WTO in 2003, CIBS became individually and collectively an important force inside the WTO, even if their experience in the multilateral trading system demonstrates well that the group of DCs is diverse and is not always united in its interest (Hoekman, 2003; Baldwin, 2006; Ya Qin, 2008; Nayyar, 2009). China has remained rather passive in the WTO rulemaking and dispute settlement processes. It has kept a low profile instead of fighting with other DCs for fairer trading conditions and development support. India, on the contrary, has been one of the most active members in the WTO. It is rigidly defensive in agriculture and rather defensive in

NAMA[1] and remains in favor of strong Special and Differential Treatment for developing countries. It has frequently presented itself as a leader of the developing world. In this respect, India currently has much in common with South Africa and Brazil, as these countries have also taken up this role and the creation of a democratic G3 of the South in 2003 (through the IBSA - India, Brazil and South Africa Dialogue Forum) and not integrating China, reflected their common views and attested their aim to play a more prominent role as non-industrialized countries. Brazil, as a major exporter of agricultural and agro-industrial goods, has adopted an offensive stance in negotiations on the liberalization of trade in agriculture taking place in the WTO as well as in other negotiations. It has been a lead player in the Doha Round, especially through its leadership of the G20 in agriculture. However, Brazil's position remains ambiguous, being at the same time the voice of the poor countries and a pursuer of its self-interest (consider the role of Brazil in voicing multilateral rhetoric while simultaneously adopting regional policies towards Mercosur). South Africa does not actively or effectively identify the role of African countries within the WTO. It has gradually and then overtly diverged from the African countries that have claimed a special and differential treatment for years and focused essentially on the agricultural and implementation issues, while South Africa was basically in favor of a multilateral and multi-dimensional agenda.

CIBS' rise has an impact also on the strengthening of regionalism. All CIBS are currently fully involved in regional as well as bilateral agreements showing a particular dynamism in promoting new partnerships. They have concluded 33 regional agreements and have 8 others under negotiation (Table 3). The question of whether regional arrangements represent WTO-plus, by accelerating and extending the liberalization process on a non-discriminatory basis, or whether they are likely to weaken the WTO by bypassing is still open (see Bhagwati, 1994; Panagariya, 1999; Baldwin, 2006; Baldwin and Low, 2009). Without going into details on this debate, it is undisputable that changing trade patterns, the rise of new trade interests and conflicts, and the strengthening of regional integration involving CIBS are expected to have considerable repercussions for the global trading system.

3 Empirical strategy

The empirical analysis of this work follows three methodological steps. The first step is aimed at creating a robust sample of world countries and an original dataset of variables and indices to be considered in the analysis. The

[1]NAMA refers to all products not covered by the Agreement on Agriculture. It includes manufacturing products, fuels and mining products, fish and fish products, and forestry products (sometimes referred to as industrial products or manufactured goods).

second step describes and classifies the sample of countries, including CIBS, using a cluster analysis technique. We thus retrieve a world map of WTO countries' clusters sharing similar trade patterns. To get an evolutionary look, cluster analysis has been carried out at more than one point in time: in the second half of 1990s and the second half of 2000s. It allows us to verify whether clusters are stable and, at the same time, evaluate the possibility that the changing in trade patterns leads to the formation of new clusters involving CIBS. The third step aims to analyze the key determinants and the driving forces of the clusters dynamics by applying a Multinomial logit model. This analysis will provide us with a more comprehensive picture of the likely evolution of trade clusters grounded in the actual trade and economic performance.

3.1 Countries and data

To analyze the trade patterns of CIBS and the other WTO countries, we selected a sample of 46 countries that fulfill three main criteria: i) WTO membership (all countries in the sample are subject to the multilateral trading system set of regulations); ii) world trade representation (the countries in the sample account for about 80 percent of world trade flows) iii) regional trade representation (the countries in the sample account for 60 percent of total trade of their own geographical area) (Table 4).

Regarding the data, to characterize trade patterns, and to assess whether or not they follow a clustered nature among countries, we selected a set of variables and indices grounded on trade theory and gathered them according to the following trade dimensions: economic features; trade specialization; trade policy; heterogeneity and intra-regional trade concentration (Table 5).

Economic features. According to applied trade literature, good proxies of supply and demand factors are countries' total and per capita GDP (Helpman and Krugman, 1985; Helpman, 1987). Total GDP captures the so-called "dimension effect", that is, the well-known phenomenon whereby larger countries trade more than smaller ones, whereas per capita GDP captures the so-called "income effect" (i.e., richer countries trade more than poorer ones). In addition, in this work, GDP growth has been considered alongside total and per capita GDP to take into account growth performance, which is one of the key characteristics of CIBS's performance. Trade openness, measured as total trade as a share of GDP, is considered within this trade dimension as well. GDP variables are taken from the World Bank's World Development Indicators database (constant 2000 U.S. dollars).

Trade specialization. To explore the dynamics of trade specialization we compute a variant of the Balassa index of Revealed Comparative Advantage (RCA) (1965), namely the "Revealed Symmetric Comparative Advantage (RSCA)"[2] (Dalum et al., 1998). This index compares the share of a sector

[2]The revealed symmetric comparative advantage is defined as:

in a country's total exports with the share of the same sector in total global exports. It ranges from minus one to one. A RSCA close to one shows the country is specialized in sector j (i.e., a revealed comparative advantage). A RSCA close to minus one implies, on the contrary, the country has a revealed disadvantage in sector j. The RSCA index has been calculated for the 10 industrial clusters classified by Leamer (1984; 1995). The Leamer aggregation scheme includes two raw-material aggregates (petroleum and raw materials), four crops (forest products, animal products, tropical agricultural products, and cereals), and four types of manufactures (labor-intensive, capital-intensive, machinery and chemicals. These four types of manufactures indicate a path of development that many countries have experienced, beginning with the export of labor-intensive manufactures, moving on to capital-intensive manufactures, and then moving to machinery and chemicals (Leamer, 1995). Leamer's classification does not include the service sector. The RSCA is calculated using data on exports, SITC rev.3, 2-digit, as from UN Comtrade.

Trade policy. According to the standard literature (Stolper and Samuelson, 1941; Bhagwati, 1959; Johnson, 1965), trade policy is represented by the average (for all partner countries and all products) of the "effectively applied" tariff rates (AHS), i.e. the total weighted (with total imports) tariff average of the minimum tariff granted by a reporter. This duty type is equal to the MFN applied tariff unless a preferential tariff exists in the database. This measure is affected by the likely bias to give more weight to the lower duties but presents the advantage to permit global comparisons of the most important duties across WTO countries. Another interesting feature of this measure is that using the effectively applied rates avoids the "water in tariffs" issue (i.e., the difference between bound and effectively applied MFN rates). The effectively applied tariff rates are available for the full set of countries in the sample calculated on the nomenclature HS 2002 at the chapter level (two-digit). Alongside the tariff level, we took into account another key issue in WTO negotiations: the number of tariffs that are particularly high (peaks). For the sake of international comparison, we used the number of international peaks (i.e., duties over 15 percent). Tariff data are from the UN-WITS TRAINS database.

Heterogeneity: From the research carried out by Hummels and Klenow (2005), Felbermayr and Kohler (2006), and Helpman, Meltiz and Rubinstein (2008), we know that countries differ in the variety of goods they trade and also in the range of countries with which they trade (the so-called "extensive margin" of trade). To deal with this issue, we took into account three

$RSCA_{ij} = \frac{(\frac{x_{ij}}{X_i})-1}{(\frac{x_{wj}}{X_w})+1} = \frac{RCA_{ij}-1}{RCA_{ij}+1}$

where x_{ij} and x_{wj} denote the export of product $j$from country i and the total export of product j for the whole world, and X_i and X_w refer to the total exports of country i and total global exports, respectively.

measures: the simple UNCTAD Comtrade "number of products" exported measure, i.e., the number of products greater than $100,000 or representing more than 0.3 percent of the country's total exports at the three-digit SITC, Rev. 2 level; the "number of markets", computed for each country as the numbers of bilateral exports flows different from zero (data are from IMF-DOTS, annual values, US Dollars); the "Herfindahl-Hirschmann export concentration index (HH)", which is a measure of the degree of market concentration (data come from UN Comtrade)[3].

Intra-regional trade concentration. To deal with the key issue of regionalism, we adopt two different indicators: an "outcome indicator" of the intensity of regional trade and a regional trade "policy indicator"[4]. Regarding the first index, we compute for each country in the sample a modified version of the adjusted "Symmetrical Index of Intra-regional Trade Intensity[5] (Dalum et al., 1998; Frankel and Rose 1997). This index ranges from minus one (no intra-regional trade) to one (no extra-regional trade) and is equal to zero in the case of neutrality. The intra-regional trade intensity variable is computed using trade data (exports and imports, US Dollars current value) from UN Comtrade. Regarding the second index, we computed, for each country in the sample, the average level of AHS weighted tariff towards its regional area. Tariff data are from the UN-WITS TRAINS database.

Data for all the above variables have been aggregated into three-year averages for two decades. Time span are 1996-98 and 2006-08[6].

[3]We used the Unctad Comtrade Index which is normalized to obtain values ranging from 0 to 1 (maximum concentration), according to the following formula:

$$H_j = \sqrt{\frac{\sum_{i=1}^{n} (\frac{x_i}{X}) - \sqrt{1/n}}{1 - \sqrt{1/n}}}$$

where Hj is the country index; x_i the value of exports of product i; $X = \sum_{i=1}^{n} x_i$; n is the number of products (at SITC Revision 3, 3-digit group level). .

[4]The term "regional trade" is here used as a synonimous of trade among countries belonging to the same geographical area. Geographical areas have been classified according to WITS database classification.

[5]Our adjusted Symmetrical Index of Intra-regional Trade Intensity (SHI_i) is defined as follows:

$$\text{SHI}_i = \frac{\left(\frac{\frac{t_{ir}}{t_i}}{\frac{t_{ie}}{t_{row}}}\right) - 1}{\left(\frac{\frac{t_{ir}}{t_i}}{\frac{t_{ie}}{t_{row}}}\right) + 1}$$

where:

t_{ir} = country i's intra-regional trade

t_i = country i's total trade

t_{ie} = country i's extra-regional trade

t_{row}= total trade of the rest of the world.

[6]When data were partially or not available for the time period (such as in the case of the effectively applied rates for a few countries in 1996-1998), the closest year to the three-year average was considered.

3.2 Cluster analysis

Cluster analysis is a technique used to organize multivariate data into groups (clusters) maximizing the homogeneity (similarity) within each cluster while also maximizing heterogeneity (dissimilarity) between different clusters. It is a form of data dimensionality reduction, which compacts information from an entire population or sample into information about specific, smaller groups (Kaufman and Rousseeuw, 1990; Hair et al. 1998; Everitt, Landau, and Leese, 2001).

In this study, we perform hierarchical clustering analysis, particularly, the agglomerative method. The hierarchical clustering procedure begins by estimating the dissimilarities between every pair of objects using the basic distance measure. Cluster analysis allows a variety of distance measures for determining the similarity or dissimilarity between observations. According to the literature in the field, we applied the Euclidean distance measure. The method used to compare groups is called a linkage method[7]. In our case, the linking of clusters (or proximity) is measured using three linkage methods, namely single-linkage (sl), average-linkage (al) and weighted-average-linkage (awl) methods. Single-linkage clustering computes the similarity or dissimilarity between two groups as the similarity or dissimilarity between the closest pair of observations between the two groups. Average-linkage clustering uses the average similarity or dissimilarity of observations between the groups as the measure between the two groups. Weighted-average-linkage is a variation on average-linkage; the difference is in how groups of unequal size are treated when merged. In weighted-average linkage, the two groups are given equal weighting in determining the combined group, regardless of the number of observations in each group.

Dendrograms are used to display the groups formed by clustering of observations and their dissimilarity levels. The heights of the links of the dendrogram represent the distance at which each fusion is made such that a greater dissimilarity between the objects indicates a greater distance between them and a taller link. The dendrogram is the most useful tool to show cluster divisions: large changes in fusion levels indicate the best cut for forming clusters. Various "stopping rules" have been proposed as auxiliary tools to derive the best number of clusters (Everitt, Landau and Leese, 2001). In this study, the optimal number of groups has been derived by merging dendrogram observations with large values of the Calinski and Harabasz pseudo-F-statistic index (Calinski and Harabasz, 1974), which, according to Milligan and Cooper (1985), appears to be the best performer among thirty cluster-stopping rules in four hierarchical methods.

Two main statistical issues need to be addressed before any clustering exercise: the existence of multicollinearity (i.e., the existence of a high de-

[7]Among the best-known hierarchical agglomerative linkage methods are the following: single, complete, average, Ward's method, centroid, median, and weighted average.

gree of linear correlation amongst explanatory variables) and the presence of outliers (i.e., extreme values of some of the variables or a unique combination of them). Regarding multicollinearity, the risk lies in giving additional weight to the underlying characteristic represented by the collinear variables, where the presence of outliers biases cluster's results. These issues should be identified early in the analysis. Therefore, a correlation matrix has been preliminary performed for all the variables in the dataset[8]. We also highlighted the presence of outliers, which have been removed from the sample[9].

To analyze the evolution of the specialization and trade patterns of CIBS and other WTO countries in the last decade, two clustering exercises have been performed, one for the period 1996-98 and one for the period 2006-08. This allows us to answer questions about change both in the overall structure of trade patterns and in the positions of particular countries in the clusters. Considering our specific focus on trade specialization, we first performed a clustering exercise based exclusively on the average RSCA index values for the ten industrial clusters and, secondly, a more comprehensive exercise taking into account all the five trade dimensions. Before performing this second cluster exercise, variables have been converted to z-scores (subtracting the mean and dividing by the standard deviation) to avoid giving more weight to any one variable because of its unit of measure. In addition, a Principal Component Analysis (PCA) has been applied to reduce the ten RSCA variables into three principal components[10]. We thus substituted to the ten RSCA variables three new specialization variables for each decade ($pcI1$; $pcI2$ and $pcI3$ for 1996-08 and $pcII1$; $pcII2$ and $pcII3$ for 2006-08) which are the uncorrelated linear combinations of the RSCA variables and represent a good approximation of the variance in the original variables (around 70 percent)[11]. According to the eigenvectors (Table 6), the new *pc* vari-

[8]Due to a high correlation between total GDP and GDP growth, total GDP has been left out from the analysis. The "dimension effect" is thus captured by the variable of trade openness (i.e., total trade/GDP ratio), which appears not to be correlated with GDP growth. In addition, because of problems of correlations among the variables that proxy extensive margins the HH index has been excluded from the cluster analysis.

[9]Countries with high polarization in petroleum and raw materials aggregate (namely, Nigeria, Saudi Arabia and Venezuela).

[10]Principal component analysis (PCA) is a statistical technique used for data reduction. The leading eigenvectors from the eigen decomposition of the correlation or covariance matrix of the variables describe a series of uncorrelated linear combinations of the variables that contain most of the variance (Pearson, 1901; Mardia, Kent and Bibby, 1979; and Rencher, 2002). All principal components combined contain the same information as the original variables, but the important information is partitioned over the components in a particular way: the components are orthogonal, and earlier components contain more information than later components. PCA thus conceived is just a linear transformation of the data.

[11]We follow the so-called "Kaiser rule" by taking into account only the components with eigenvalues ¿1 (i.e., the principal components that show higher variance than single

ables can be interpreted as follows: $pcI1$ stands for crops in 1996-98; $pcI2$ stands for manufacturers in 1996-98; $pcI3$ stands for petroleum & chemicals in 1996-98; $pcII1$ stands for mainly manufacturers in 2006-08; $pcII2$ stands for mainly crops in 2006-08 and $pcII3$ stands for petroleum & chemicals in 2006-08.

3.3 Multinomial Logit Model

To assess the key determinants of the dynamics of our cluster exercise, we apply a Multinomial Logit (MNL) Model[12]. It expresses the probability π that an observation unit i_{th} with characteristics x_i is in the j_{th} category. In its general form with j alternatives, the multinomial logit is expressed as:

$$\pi_{ij} = \frac{\exp[x_i' \beta_j]}{\sum_j^k \exp[x_i' \beta_j]} \tag{1}$$

where i is the observation unit, j is the category, k is the number of outcomes being modeled, x_i is a vector of explanatory variables and β_j is the coefficient vector. This model requires a *Theil normalization*, i.e., one β_j must be chosen as the base category and set to zero. All the other sets are then estimated in relation to it considered as a benchmark. In our analysis the base category has been always set to the larger cluster.

MNL coefficients are usually expressed as log-odds relative to the base outcome. It is possible to translate the odds ratio to probability points by calculating the marginal effects[13], i.e. the effects for a small change in x on the probability of one of the events occurring on average and *ceteris paribus*. It has to be noted that if a change in x increases the probability of belonging to one category, it must reduce the probability in one or more categories to compensate for this to ensure the underlying probabilities sum to one. It is also to be noted that probabilities π are computed by using the sample average characteristics.

The distinguishing feature of the multinomial logit model is that data consist of individual-specific characteristics. One of the main advantages of the multinomial logit model is that, once we have the estimated parameters, given a new unit (in our case a new country) with a specified set of characteristics, we can predict the probability that the country will be in any one of k unordered categories. In general terms, the MNL specification adopted is the following:

$$c_{ij} = \alpha_{j1} x_i + ... + \alpha_{jn} x_n \tag{2}$$

variables).

[12]For an introduction to multinomial logit models, see Greene (2008), Hosmer Jr. and Lemeshow (2000) and Long and Freese (2006).

[13]In general terms, the marginal effects for the non-normalized categories are given by $\frac{\partial \pi_j}{\partial x} = \pi_j[\beta_j - \sum_k \beta_k \pi_k]$. For additional details, see Greene (2008).

where c is the category and α is the probability associated to each category, with $i = 1, \ldots .., n$ and $j = 1, ...k$.

One of the main weaknesses of the MNL model is the "independence of irrelevant alternatives" (IIA) property. The implication of the IIA is that the odds ratio is not affected by the addition or deletion of a particular category. In our case, because the categories come directly from the cluster analysis, the IIA assumption is not problematic.

4 Empirical outcomes

Following Kaufman and Rousseeuw (1990)[14], to present the final outcomes of our clusters' comparisons, we opt for the average-linkage (al) method that best represents our data. The first cluster exercise, based on the average RSCA values for the ten Leamer's industrial clusters, suggests three distinct clusters for the period 1996-98 (the taller link is at the level of dissimilarity of 1.75; see Fig. 2). The Calinski and Harabasz index clearly confirms this choice. The RSCA clustering exercise for the period 2006-08, at the same level of dissimilarity, shows five distinct clusters (see Fig. 3). In this case, the Calinski and Harabasz index suggests the possibility of a further disaggregation into seven distinct clusters (Table 7). The striking feature of this first exercise is, on the one hand, the constancy in the last decade of a large group of countries characterized by a low level of dissimilarity, which can be further split into two main groups (one of which is formed by the majority of OECD countries). The second striking feature is the CIBS dynamism, which in the last decade actually branched out in different groups starting from the same position[15]. More specifically, Brazil, India and South Africa tend to converge to the groups of countries mainly specializing in crops (cluster 1), whereas China, according to its trade specialization in capital intensive manufactures, tends to converge to the specialization of Japan and Korea (cluster 4) (see Table 8).

Concerning the second, more comprehensive, cluster exercise, the analysis of the dendrogram suggests, for the period 1996-98, six distinct clusters (the taller link is now at the level of dissimilarity of 4.80; see Fig. 4). This choice is confirmed by the Calinski and Harabasz stopping rule. It is worth noting that among the above clusters, China and Brazil, together with Argentina, formed a totally separate cluster. In the period 2006-08, at the same level of dissimilarity, we obtained six distinct clusters as well but, unlike in the previous decade, they reveal a strong polarization, i.e., the convergence of most of the countries to a single large cluster (see Fig. 5).

[14] According to Kaufman and Rousseeuw (1990) average linkage works well for many situations and is reasonably robust

[15] For South Africa, due to the lack of trade specialization data, the analysis is run only for the 2006-08 period.

Consistently with the results of the RSCA cluster, the Calinski and Harabasz index also in this case suggests the possibility of a further disaggregation into ten distinct clusters at a lower level of dissimilarity (Table 9). As with the RSCA cluster, the striking feature of this second exercise is that the larger cluster can be split into two main groups, the first one formed by mainly developing countries and the second one formed by mainly advanced OECD countries (Table 9). It is worth noting, in this more comprehensive cluster for the period 2006-08, that China and India show now a separate position from the two main groups in terms of trade characteristics. More specifically, while India shares with Korea a significant GDP growth, high tariffs and a revealed specialization in "petroleum & chemicals", China shows an even higher GDP growth, higher international peaks on tariffs, strong despecialization in crops, low intra-regional trade and a significant level of markets' variety (Table 10). Meanwhile, Brazil and South Africa share similar trade features with the majority of developing countries, i.e., low per capita GDP but high GDP growth; high average tariffs; revealed specialization in crops; low trade openness and low product and market diversity (Table 10). This second, more comprehensive, cluster exercise suggests, on the one hand, a clear tendency toward a polarization of countries in a single large group, on the other hand, the clear distinctive patterns of China and India that tend to converge to two distinct clusters. Unlike what is argued by the literature, this does not appear to be a trend of multi-polarization; rather, it seems to be attributable to the peculiar performance of the two "giants" (China and India) with distinct trade characteristics from the rest of the developing and industrialized world.

To assess the key drivers of the probabilities of countries to be in different clusters, according to the variation of their characteristics, we run, as underlined above, a set of MNL specifications, one for each of the five trade dimensions taken into account in the cluster analysis. Starting from the results of the complete cluster exercise for the period 2006-08, we derive five possible mutually exclusive categories with no particular ordering (Table 11): Category 1-Developing countries; Category 2- Advanced OECD countries; Category 3-India & Korea; Category 4-China; Category 5-Rest of the world. India & Korea and China have been treated as separated categories in this exercise, consistently with their distinctive path highlighted by the cluster analysis. We normalize on the parameters for category $j = 2$ and set these to zero.

For each of the five trade dimensions, we can thus predict the probability that a country with a specified set of characteristics will be in any one of the above k unordered categories. The results of these sets of multinomial logit exercises confirm the relevance of all the dimensions considered in our analysis (Table 12). More specifically, regarding *economic features*, a percentage point increase in GDP growth reduces the probability of being in category 2 (advanced OECD countries) by over 40 percentage points and

increases the probability of being in category 4 (China) by 29 percentage points, on average and ceteris paribus. A percentage point increase of GDP per capita reduces the probability of being in cluster 1 (developing countries) by over 45 percentage points and increases the probability of being in category 2 (advanced OECD countries) by over 30 percentage points. Trade openness seems instead not to be a characteristic relevant for being in one of the main clusters. Concerning *trade specialization,* a percentage-point increase of $pcII1$ rises the probability of being in clusters 1 and 2 (developing countries and advanced OECD countries) by around 30 percentage points and reduces the probability of being in category 3 (India and Korea) and 4 (China) by around 20 percentage points. A percentage-point increase in $pcII2$ rises the probability of being in cluster 1 (developing countries) by around 20 percentage points and reduces the probability of being in category 2 (Advanced countries) by more than 20 percentage points. Finally, $pcII3$ seems not to be a characteristic relevant for being in one of the clusters. In terms of *trade policy*, a percentage-point increase of the average tariffs level increases the probability of being in categories 1 (developing countries) and 3 (India and Korea) by around 20 percentage points and increases the probability of being in category 2 (advanced OECD) by over 50 percentage points, on average and ceteris paribus, while the level of international peaks seem not to be a characteristic relevant for being in one of the main clusters. Regarding *heterogeneity*, a percentage-point increase in the number of export markets augments the probability of being in category 2 (advanced OECD countries) by over 50 percentage points, on average and ceteris paribus. Finally, concerning *intra-regional concentration*, a percentage-point increase of SHI rises the probability of being in category 1 (developing countries) by over 60 percentage points and reduces the probability of being in category 4 (China) by 18 percentage points, on average and ceteris paribus.

Starting from the above results, we can derive predictions, in terms of probability points, on average and ceteris paribus, about the relative position of any country following changes in the key trade characteristics for each of our five dimensions. This represents a useful tool to make predictions about the future clusters' dynamics.

5 Conclusion

The present paper analyzes the evolution of the specialization and the trade patterns of CIBS and other WTO countries. It provides: a world map of trade clusters involving WTO countries and CIBS; a comparison of the above clusters and their key characteristics in the last decade; the key drivers of clusters' trends. In addition, it provides a useful tool to make predictions about the future clusters' dynamics.

This work contributes to the debate of the impact of CIBS' rise on the global trading system by answering to the following key questions: is there a tendency toward the multi-polarization of trade patterns? If so, is CIBS' rise leading to new clusters with or among CIBS or other emerging countries? And, eventually, does this multi-polarization have a regional feature?

Our cluster analysis does not show remarkable multi-polarization; rather, it shows a convergence towards a single large cluster or, at low levels of dissimilarity, a light phenomenon of polarization between developing and advanced countries, excluding a regional nature of similar trade characteristics. Moreover, our cluster exercise gives no evidence of CIBS as a significant separate group and/or regional agglomeration. CIBS trade patterns appear to be diversified. Whereas China and India show separated and peculiar paths, Brazil and South Africa share trade specialization with developing countries.

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6 Appendix

Table 1 - CIBS Trade Performance 1996-98 and 2006-08 (US dollars current values)

Countries	Exports (av. growth)		Imports (av. growth)	
	1996-98	2006-08	1996-98	2006-08
Brazil	3,3	18,7	4,6	33,2
China	7,7	23,4	2,0	19,8
India	1,6	21,9	5,1	31,2
South Africa	-11,3	16,4	0,5	16,7
World	3,2	14,9	3,2	14,9

Source: World Bank, World Development Indicators database, 2010

Table 2 - CIBS' weight in world trade, 2008

	MERCHANDISE			
Countries	Rank in world trade		Share in world	Share in world
	Exports	Imports	total exports	total imports
China	2	3	8.9	6.9
Brazil	22	24	1.2	1.1
India	23	14	1.2	2.0
South Africa	41	34	0.5	0.6
European Union	1	1	15.9	18.4
United States	3	2	8.0	13.5
	COMMERCIAL SERVICES			
Countries	Rank in world trade		Share in world	Share in world
	Exports	Imports	total exports	total imports
China	6	5	3.9	4.5
Brazil	32	23	0.8	1.3
India	10	12	2.7	2.5
South Africa	47	41	0.3	0.5
European Union	1	1	26.8	23.5
United States	2	2	13.6	10.3

Source: World Trade Organization, 2010

Table 3 - Regional Trade Agreements (RTAs) involving CIBS

Country	Notified RTAs in force	Announced RTAs	Total RTAs
China	10	2	12
Brazil	5	-	5
India	14	5	19
South Africa	4	1	5
TOTAL	33	8	41

Source: WTO RTA database, August 2010

Table 4 - Countries and regions of the sample

Country	Code	Region	Country	Code	Region
Argentina	ARG	South & Central America	Japan	JPN	Asia
Australia	AUS	Asia	Kenya	KEN	Africa
Austria	AUT	Europe	Korea, Rep.	KOR	Asia
Belgium-Luxembourg	BLX	Europe	Malaysia	MYS	Asia
Brazil	BRA	South & Central America	Mexico	MEX	North America
Canada	CAN	North America	Morocco	MAR	Africa
Chile	CHL	South & Central America	Netherlands	NLD	Europe
China	CHN	Asia	Nigeria	NGA	Africa
Colombia	COL	South & Central America	Peru	PER	South & Central America
Cote d'Ivoire	CIV	Africa	Philippines	PHL	Asia
Czech Republic	CZE	Europe	Poland	POL	Europe
Denmark	DNK	Europe	Portugal	PRT	Europe
Egypt, Arab Rep.	EGY	Africa	Romania	ROM	Europe
Finland	FIN	Europe	Saudi Arabia	SAU	Middle East
France	FRA	Europe	South Africa	ZAF	Africa
Germany	DEU	Europe	Spain	ESP	Europe
Ghana	GHA	Africa	Sweden	SWE	Europe
Greece	GRC	Europe	Thailand	THA	Asia
Hungary	HUN	Europe	Tunisia	TUN	Africa
India	IND	Asia	Turkey	TUR	Europe
Indonesia	IDN	Asia	United Kingdom	GBR	Europe
Ireland	IRL	Europe	United States	USA	North America
Italy	ITA	Europe	Venezuela, RB	VEN	South & Central America

Dimensions	Variables	Description	Code	Data Source
Economic features	Total GDP	GDP level (constant 2000 US$)	*gdp*	WDI
	GDP per capita	GDP per capita (constant 2000 US$)	*gdppc*	
	GDP growth	GDP growth (annual %)	*gdpg*	
	Trade Openness	Trade as a share of GDP	*top*	
Trade specialization	Revealed symmetric comparative advantage index -RSCA	Revealed Symmetric Comparative Advantage for the 10 industrial clusters classified by Leamer - SITC rev.3, 2 digit	*rsca-*	UN-COMTRADE
Trade policy	Effectively Applied rates	The minimum tariff granted by a reporter to a partner for the considered product	*ahs-*	UN-WITS TRAINS DATABASE
	total weighted average	The total weighted (with total imports) tariff average	*ahswatot*	
	total nr. of international peaks	Number of international peaks, i.e. duties over 15%	*ahswaip*	
Heterogeneity	Nr products	Number of products exported (> $100,000 or representing more than 0.3% of the country's total exports)	*nprod*	UN-COMTRADE
	Nr markets	Number of bilateral exports flows different from zero	*nmkts*	IMF-DOTS
	Export concentration index	The Herfindahl-Hirschmann export concentration index as a measure of the degree of market concentration.	*cindex*	UN-COMTRADE
Intra-regional trade concentration	Regional trade intensity	Adjusted symmetrical index of intra-regional trade intensity	*shi*	UN-COMTRADE
	Regional trade policy	Average level of AHS	*reqtar*	UN-WITS TRAINS

Table 5 - The five dimensions of the international trade patterns

Table 6 - Principal Component Analysis (eigenvectors)							
	1996-98				2006-08		
Variable	pcI1	pcI2	pcI3	Variable	pcII1	pcII2	pcII3
Petro	-0.2232	-0.3970	0.3256	Petro	-0.3086	0.2594	0.3978
Mat	0.3574	-0.1863	-0.2818	Mat	0.1625	0.3228	-0.2901
For	0.1770	0.0866	-0.7090	For	0.2979	0.0226	-0.6558
Trop	0.4514	-0.2668	0.0545	Trop	0.3102	0.4012	0.0548
Anl	0.4999	-0.1327	0.0227	Anl	0.4087	0.3092	0.1048
Cer	0.4330	-0.1503	0.1965	Cer	0.3717	0.3212	0.1680
Lab	0.2895	0.3714	0.2719	Lab	0.3980	-0.1990	0.3081
Cap	0.2097	0.3974	0.1993	Cap	0.2931	-0.3295	0.0127
Mach	-0.0538	0.5085	-0.2245	Mach	0.1998	-0.5240	-0.1012
Chem	0-1392	0.3666	0.3252	Chem	0.3225	-0.2135	0.4244

Table 7 - RSCA Clusters (al) 1996-1998 and 2006-2008

RSCA 3 Clusters 1996-98		RSCA 5 Clusters 2006-08		RSCA 7 Clusters 2006-08	
Cluster 1	ARG-AUS-CIV-COL-EGY-GRC IDN-KEN-MAR-PER	Cluster 1	ARG-AUT-BLX-BRA-CAN-COL-CZE-DEU-DNK-EGY-ESP-FIN-FRA-GBR-GRC-HUN-IDN-IND ITA-KEN-MAR-MEX-MYS-NLD PHL-POL-PRT-ROM-SWE-THA TUN-TUR–USA-ZAF	Cluster 1	ARG-BRA-CAN-COL-EGY-GRC IDN-IND-KEN-MAR-MYS-ZAF
Cluster 2	AUT-BLX-BRA-CAN-CHN-CZE DEU-DNK-ESP-FIN-FRA-GBR HUN-IND-IRL-ITA-JPN-KOR MEX-MYS-NLD-PHL-POL-PRT ROM-SWE-THA-TUN-TUR-USA	Cluster 2	IRL	Cluster 2	AUT-BLX-CZE-DEU-DNK-ESP FIN–FRA-GBR-HUN-ITA-MEX NLD-PHL-POL-PRT-ROM-SWE THA-TUN-TUR-USA
Cluster 3	CHL-GHA	Cluster 3	CHN-JPN-KOR	Cluster 3	IRL
		Cluster 4	AUS-CHL-PER	Cluster 4	CHN-JPN-KOR
		Cluster 5	CIV-GHA	Cluster 5	AUS-CHL-PER
				Cluster 6	CIV
				Cluster 7	GHA

Source: Authors' elaboration

Table 8 - Mean vectors of RSCA (al) 7 clusters, 2006-2008

CLUSTERS	PETRO	MAT	FOR	TROP	ANL	CER	LAB	CAP	MACH	CHEM
1	-0.03	0.25	-0.08	0.37	0.23	0.28	-0.10	-0.03	-0.45	-0.12
2	-0.40	-0.26	0.05	0.01	-0.04	-0.04	0.01	0.03	0.01	-0.08
3	-0.88	-0.66	-0.58	-0.06	0.39	0.01	-0.22	-0.76	-0.15	0.64
4	-0.59	-0.46	-0.50	-0.59	-0.60	-0.65	-0.21	0.12	0.21	-0.15
5	-0.39	0.77	-0.06	0.30	0.34	0.21	-0.40	-0.62	-0.84	-0.50
6	0.53	-0.89	0.32	0.87	-0.02	0.22	-0.46	-0.74	-0.77	-0.48
7	-0.86	-0.41	0.56	0.86	-0.13	-0.06	-0.57	-0.56	-0.92	-0.76

Source: Authors' elaboration

Table 9 - Complete Clusters (al) 1996-1998 and 2006-2008

Complete 6 Clusters 1996-98		Complete 6 Clusters 2006-08		Complete 10 Clusters 2006-08	
Cluster 1	ARG-BRA-CHN	Cluster 1	ARG-AUS-AUT-BLX-BRA-CAN	Cluster 1	ARG-BRA-CHL-COL-CZE-EGY
Cluster 2	MEX		CHL-COL-CZE-DEU-DNK-EGY		HUN-IDN-KEN-PER-PHL-POL-
Cluster 3	AUS-AUT-BLX-CAN-CZE-DEU		ESP-FIN-FRA-GBR-GRC-HUN-IDN		ROM-THA-TUR-ZAF
	DNK-ESP-FIN-FRA-GBR-GRC		IRL-ITA-JPN-KEN-MYS-NLD-PER	Cluster 2	AUS-AUT-CAN-DEU-DNK-ESP-
	HUN-IND-IRL-ITA-JPN-MYS		PHL-POL-PRT-ROM-SWE-THA		FIN–FRA-GBR-GRC-IRL-ITA
	NLD-PHL-POL-PRT-SWE-TUR		TUR–ZAF		JPN-NLD-PRT-SWE
Cluster 4	CHL-CIV-COL-EGY-IND-KEN	Cluster 2	CHN-IND-KOR	Cluster 3	BLX-MYS
	KOR MAR-PER-ROM-THA-TUN	Cluster 3	MEX	Cluster 4	IND-KOR
Cluster 5	GHA	Cluster 4	MAR-TUN	Cluster 5	CHN
Cluster 6	USA	Cluster 5	CIV-GHA	Cluster 6	MEX
		Cluster 6	USA	Cluster 7	MAR
				Cluster 8	TUN
				Cluster 9	CIV-GHA
				Cluster 10	USA

Table 10 - Mean vectors of Complete (al) 10 clusters, 2006-2008

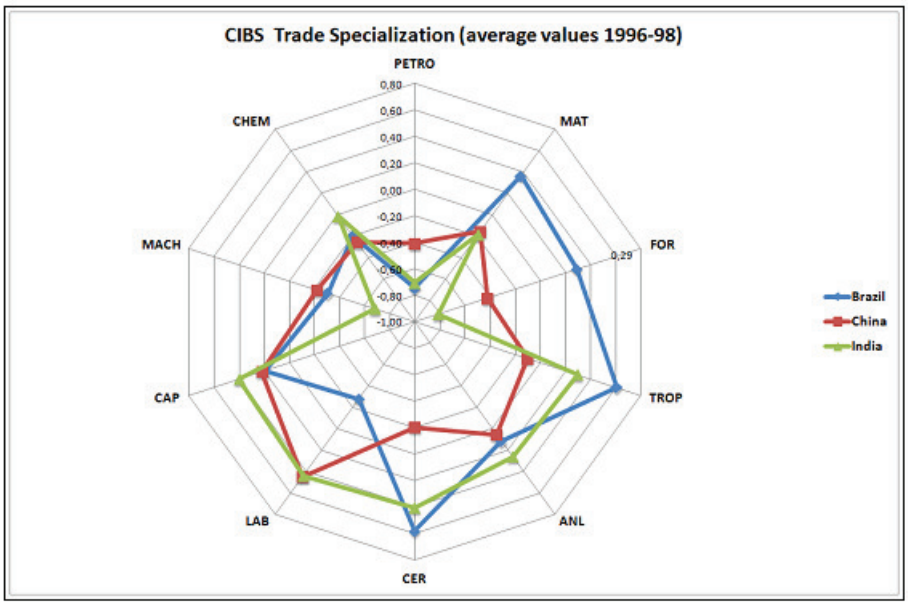
CLUSTERS	gdgg	gdppc	top	pcII1	pcII2	pcII3	ahswatot	ahswaip	nprod	nmkts	shi
1	0.51	-0.72	-0.15	0.28	0.42	-0.34	0.26	-0.15	0.11	0.04	0.27
2	-0.85	1.05	-0.10	0.35	-0.40	0.03	-0.86	-0.30	0.51	0.59	0.21
3	-0.13	0.24	3.17	0.44	-0.14	0.17	-0.66	0.46	0.53	0.62	0.34
4	0.82	-0.40	-0.35	-0.39	-0.70	1.05	2.20	-0.30	0.33	0.55	-0.12
5	2.90	-0.90	-0.34	-0.10	-1.64	-0.28	0.20	0.50	0.48	0.69	-1.38
6	-0.43	-0.51	-0.58	-0.96	-0.52	0.39	-0.62	0.55	0.45	-4.16	0.32
7	0.42	-0.91	-0.09	0.81	0.44	1.00	1.55	5.03	-1.21	-0.36	-0.17
8	0.50	-0.83	0.63	0.22	-0.30	1.81	3.18	1.26	-0.74	-1.00	0.23
9	-0.13	-1.01	0.34	-0.52	1.43	-1.00	0.94	0.17	-3.37	-1.62	0.52
10	-1.10	2.07	-1.23	0.41	-0.50	0.05	-0.79	-0.20	0.55	0.55	-5.42

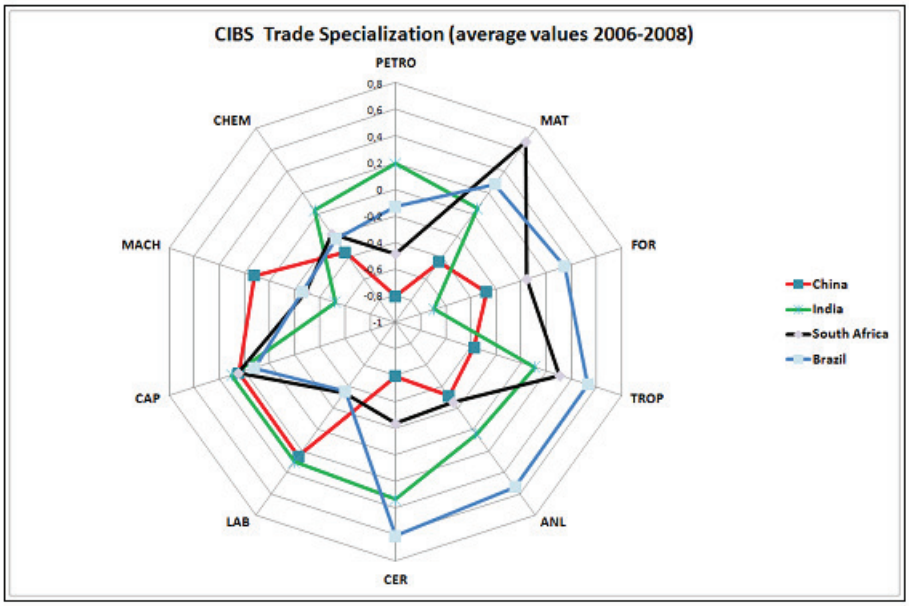
Table 11 - Mlogit categories	
Complete 10 Clusters 2006-08	
Ctg 1	ARG-BRA-CHL-COL-CZE-EGY HUN-IDN-KEN-PER-PHL-POL-ROM-THA-TUR-ZAF
Ctg 2	AUS-AUT-CAN-DEU-DNK-ESP-FIN–FRA-GBR-GRC-IRL-ITA JPN-NLD-PRT-SWE
Ctg 3	IND-KOR
Ctg 4	CHN
Ctg 5	BXL-MYS-MEX-MAR-TUN CIV-GHA-USA

	Marginal effects 2006-08					Wald Test
Obs=43	Category 1	Category 2	Category 3	Category 4	Category 5	
Characteristics	DCs (15)	Advanced OECD Countries (16)	IND-KOR	CHN	RoW	P>chi2
Economic features						
GDP growth	0.05	-0.42**	0.20	0.29**	-0.12	0.146
	0.08	0.19	0.14	0.13	0.14	
GDP pc	-0.46***	0.33**	0.12	0.20	-0.19	0.001
	0.11	0.14	0.17	0.16	0.13	
Trade Openness	-0.01	-0.09	-0.04	0.00	0.15**	0.182
	0.08	0.10	0.12	0.10	0.07	
Specialisation						
pcii1	0.27**	0.34**	-0.24***	-0.18**	-0.19**	0.026
	0.16	0.16	0.07	0.10	0.09	
pcii2	0.19**	-0.24***	-0.000	-0.01	0.06	0.065
	0.08	0.09	0.05	0.06	0.06	
pcii3	-0.17**	0.01	0.08	0.01	0.06	0.258
	0.08	0.08	0.06	0.07	0.06	
Trade Policy						
av. tariff level	0.18***	-0.53***	0.19***	0.04	0.12	0.000
	0.07	0.12	0.07	0.09	0.08	
int.l peaks	-0.16	-0.08	-0.03	0.07	0.19**	0.247
	0.12	0.13	0.11	0.10	0.09	
Extensive Margins						
nr. exp. Markets	-0.11	0.55***	-0.07	-0.10	-0.27***	0.000
	0.10	0.14	0.11	0.10	0.07	
Intra-regional concentration						
SHI	0.61***	-0.06	-0.15*	-0.18**	-0.21***	0.018
	0.20	0.11	0.09	0.08	0.07	
Reg. Trade policy	0.09	-0.56***	0.22***	0.12	0.13**	0.000
	0.08	0.12	0.06	0.08	0.07	

Table 12 - Mlogit marginal effects

Figure 1: CIBS' trade specialization, 1996-98 and 2006-08 (average values)





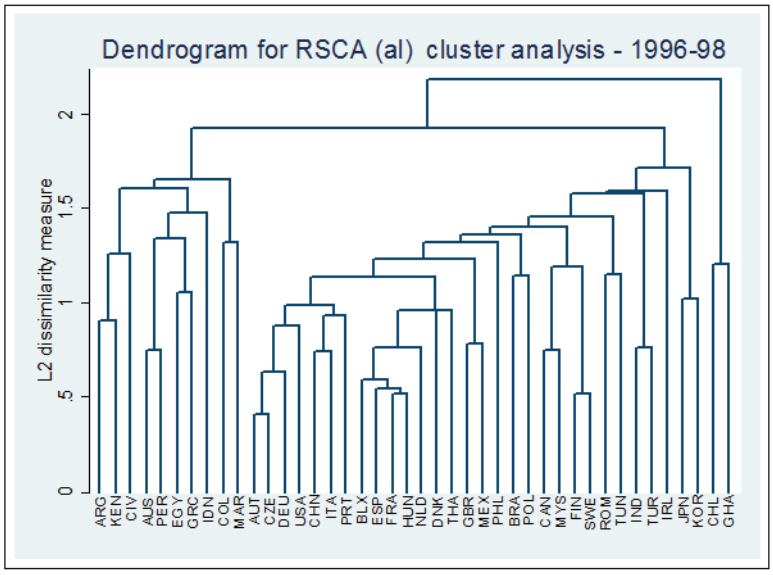


Figure 2 - Cluster analysis for trade specialization, 1996-98

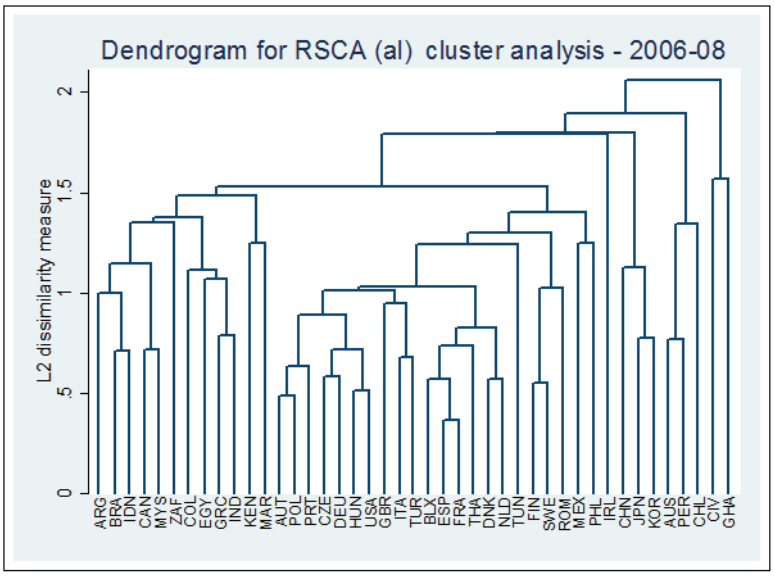


Figure 3 - Cluster analysis for trade specialization, 2006-08

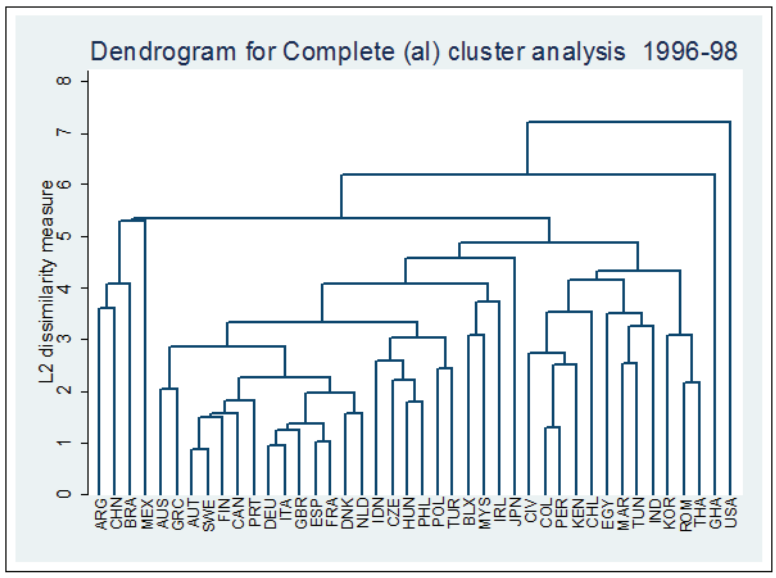


Figure 4 - Cluster analysis for the five trade dimensions, 1996-98

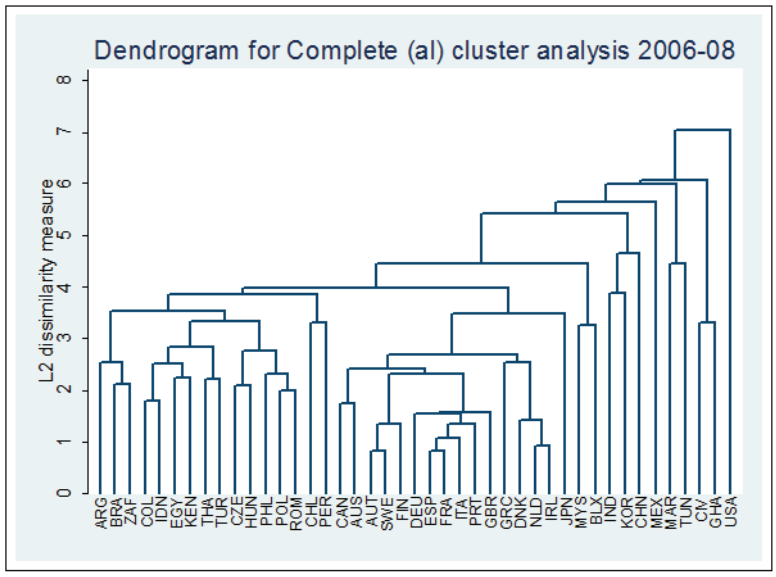


Figure 5 - Cluster analysis for the five trade dimensions, 2006-08