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Similarity in trade structure: An evidence from ASEAN + 3

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Similarity in Trade Structure: Evidence from ASEAN + 3

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Abstract

The present paper aims to explore the competition in exports among ASEAN +3 members by applying the export similarity index for the disaggregation export data from 1990 to 2014. We also discuss the changes of comparative advantage of ASEAN + 3's exports through the revealed comparative advantage index (RCA) and its relation with similarity index. The results find that export similarity varies among ASEAN+3 member states over the period 1990-2014. Second, we find evidence of several communities of export competition. In particular, four countries, notably Malaysia, Singapore, Japan and Korea, durably show the highest competition level, mainly in the sectors of transistors and telecom equipment. Third, the revealed comparative advantage seems to be the key factor defining the similarity level of exports. Lastly, the revealed comparative advantage analysis allows us to verify the Ricardo's theory and New Trade theory in the context of free trade.

JEL: F02; F14; F15; F21; F40

Keywords: similarity index; export community; revealed comparative advantage; trade structure; ASEAN+3

1. Introduction

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Over the last two decades, a vast literature has focused on the impacts of trade integration or magnitude of trade flows on the economic growth (e.g., Rodrik and Rodriguez, 2000; Dollar and Kraay, 2004; Ravallion, 2004) or on income levels (e.g., Frankel and Romer, 1999; Ferreira and Trejos, 2002). However, the question of how economic openness might change the specialization and the export composition of a country has been a far less studied issue. In the concerned literature, Baldwin (1986) provides a survey on economists' understanding of the basic determinants of trade patterns and, in particular, on the manner in which these underlying factors change over time and are affected by various policies. According to the author, the existing literature has been reasonably successful in explaining the structure of trade at any point in time but much less successful in understanding how the determinants of the patterns of trade change over time. More recently, Fagerberg and Srholec (2004) analyze the structural changes in international trade from the 1960s and their impact on trade performance and the ability of countries to adapt to these changes for a panel set of OECD countries and fast-growing countries in Asia. The authors show that commodities from industries characterized by high R&D outlays, particularly in the electronics sector, grew much faster than other trade. In general, these changes were most favorable for the large and high-income countries of the OECD area, but some small countries that managed to carve out sustainable niches in electronics were also beneficially affected. They also find evidence of striking differences across countries in the ability to adapt to these changes. For instance, the countries with the best adaptability were not among the most advanced, but actively exploited the potential for diffusion through appropriate policies. These countries also had much better economic performance in terms of GDP growth than other countries.

To complement the existing literature, this paper provides an empirical analysis on the changes in the specialization and the export composition of international trade in the case of ASEAN + 3 (Association of South-East Asian Nations + China, Korea and Japan). In our investigation, ASEAN + 3 is chosen not only as the latest development of East Asian regional cooperation, in particular trade cooperation, but also as representative of a dynamic economic region. Free trade arrangement in East Asian region through ASEAN+3 also attempts to generate "trade creation" instead of "trade diversion" (Urata, 2007). However, measuring and investigating a region's overall export structure and its changes over time are not an easy task. To tackle this issue, we explore the disaggregation of exports among ASEAN +3 member states by applying the export similarity index initiated by Finger and Kreinin (1979), which has been also used in De Benedictis and Tajoli (2006; 2008). De Benedictis and Tajoli (2006) analyze the similarity of

trade structures by using the export flows between the pre-2004 European Union members (EU15) and four Central-Eastern European Countries (CEECs). The authors find that processed trade is crucial in explaining changes in the overall structures of exports of CEECs. They also argue that greater economic integration in terms of trade flows and processing trade does not always lead to greater export similarity between the CEECs and the EU15 members. In the same light, De Benedictis and Tajoli (2008) consider how increased similarity in trade structure among countries can induce catching-up in income levels between the CEECs and the EU15 member. In other words, they tend to study the role of export composition in the growth process. They find evidence of a positive, significant and non-linear impact of similarity in export composition on catching-up. Moreover, the growth of the main export and delocalization of production are the main factors determining the similarity in export composition.

Basing on an analysis of similarity index and using the UN ComTrade commodity databases in the SITC (Standard International Trade Classification) Revision 3 at 1, 2 and 3-digit level over the period 1990-2014, the present paper has a manifold purpose. The first one is to advance our understanding of the changes in ASEAN+3's export structure. To do so, we compute the similarity indices at different level of commodity aggregation for each country member. Second, basing on the similarity index results, we tend to determine the place of each ASEAN + 3 member in regional export structure. This allows us to address the question of whether ASEAN + 3 export structure is sensitive to different levels of commodity aggregation. The third one is to identify the main competitor countries in ASEAN + 3 exports. Fourth, we consider the similarity matrices to detect the different export communities in ASEAN+3. Lastly, we provide a study between similarity index and revealed comparative advantage index, which allows identifying the most competitive export sector for each ASEAN + 3 country member.

The paper is organized as follows. Section 2 describes the data sets and outlines the empirical methodology. Section 3 reports and discusses the empirical results on similarity index. Section 4 explains the community detection. Section 5 introduces the structural changes in revealed comparative advantage of ASEAN + 3 and the relation with similarity index. Section 6 summarizes and outlines the policy implications of the main findings.

2. Methodology and Data

As stated above, our main research objective is to analyze the evolution of export structure in ASEAN + 3 by computing the similarity index (SI) for each country member. To calculate the export SI, we use the original export similarity index, which was given by Finger and Kreinin

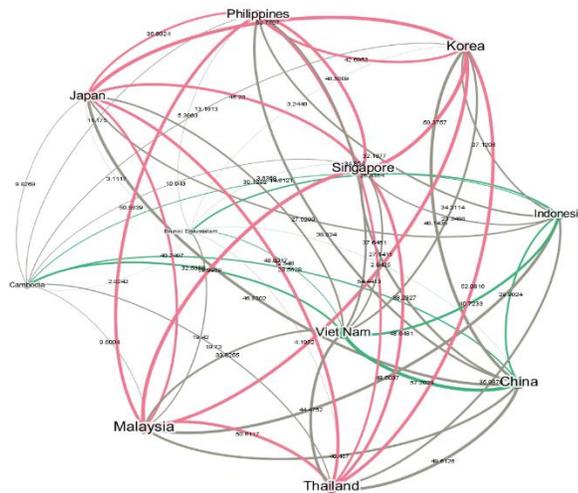
(1979) (hereafter “FK”) and largely applied to trade data. This index has been seen as the simplest measure for comparing export content across either countries or time. The FK similarity index between two countries c and d is given as follows:

$$SI_{c,d}^{FK} = \sum_{i=1}^n \min\left(\frac{x_{c,i}}{X_c}, \frac{x_{d,i}}{X_d}\right) \quad (1)$$

Where $\frac{x_{c,i}}{X_c}$ is the share of good i in the total exports of country c . This index ranges from zero, meaning completely different export shares, to 1, meaning identical export share. According to Finger and Kreinin (1979), this measure should not be affected by the relative sizes or scales of total exports as it is intended to compare only patterns of exports across product categories. In this paper, we compute the export SI at 1, 2 and 3-digit SITC level provided by UN ComTrade. Moreover, the similarity index is also calculated for intra and extra-ASEAN+3 exports.²

Another objective of the present paper is to detect the different export communities in ASEAN+3 trade network. Recently, Nguyen et al. (2016) consider the links in network as either the total value of exports or the total value of FDI. The authors also analyze such a weighted direct network by using standard network centrality measures. Different from Nguyen et al. (2016), our present paper tends to analyze the weighted undirected network by the SI values as shown in Figure 1.

Figure 1: ASEAN +3 undirected Network with the links defined by SI values



Source: Authors' creation

² Our data sample does not include Laos P.D.R and Myanmar because of data unavailability.

Basing on these data, we aim to detect whether a country belongs to a unique community due to its similarities. As suggested in Pons (2005) and Pons and Latapy (2006), the concept of community within graph theory is not clearly defined. However, it is possible to define a community as a set of vertices (links) whose density of internal connections is greater than the density of connections to the outside (Pons, 2005). According to the network/graph theory literature, to calculate the potential communities within a given network, one should split the network into a given number of groups. Among others, agglomerative algorithms are the most well-known one.³

In similar way, we define an algorithm to detect the most similar countries, and the most competitive community to which a country belongs to, by using a simple algorithm as described in Box 1.

Box 1 - PSEUDO-ALGORITHM of Community Detection based on SI VALUES

For $i = 1$ to $(N-1)$ with N the number of individual countries

- **Step 1: Calculate the SI values**
- **Step 2: Find the pair of most similar countries.**
- **Step 3: Aggregate these two countries in a community which is defined by the aggregation these two countries. The community is used as a new country for Step 1.**

Considering a network constituted by all individual countries, we first calculate the strength of the undirected link between two countries as given by the SI values (step 1). Then we seek for the pair of most similar countries, e.g. with the highest SI values (step 2). Once this pair is found, for example country A and C, we create a new country called "A-C" and we recalculate the values of exports and imports going into or outside "A-C" (step 3). The values of the total exports and imports of this new country towards other countries are calculated as the sum of the aggregating countries excluding flows between them. Go back to step 1 and recalculate the SI values in the new network composed by all the previous individual countries, except A and C that are replaced by "A-C" (step 1). Move to steps 2 and 3. The three steps are repeated until the size of the network is reduced to 2. It should be clear that the communities detected define area of strong competitiveness.

³ See Malliarosa and Vazirgiannis (2013) for a survey.

In the last step, we assess a country's export potential by computing the *revealed comparative advantage* (RCA) developed by Balassa (1965). This index tries to identify whether a country has a "revealed" comparative advantage rather than to determine the underlying sources of comparative advantage (Utkulu et al., 2004). In other perspective, the RCA indicates whether a country is in the process of extending the products in which it has a trade potential. Countries with similar RCA profiles are unlikely to have high bilateral trade intensities unless intra-industry trade is involved. If RCA is estimated at high level of product disaggregation, this measure can focus on other nontraditional products that might be successfully exported. The RCA index measures a country's exports of a commodity (or industry) relative to its total exports and to the corresponding exports of a set of countries. The RCA index is given as follows:

$$RCA_{ij} = \left(\frac{X_{ij}}{X_{it}} \right) / \left(\frac{X_{nj}}{X_{nt}} \right) = \left(\frac{X_{ij}}{X_{nj}} \right) / \left(\frac{X_{it}}{X_{nt}} \right) \quad (2)$$

where X represents exports, i is a country, j is a commodity (or industry), t is a set of commodities (or industries) and n is a set of countries. If value of RCA is more than 1, it means that the country has a revealed advantage in the commodity (or industry). If the index is less than 1, the country has a revealed comparative disadvantage.

3. Similarity in trade structure

By applying the *similarity index* (SI) between each country and the rest of ASEAN+3 members toward intra-regional market, we begin with examining the evolution of export similarity over the period from 1990 – 2014. To achieve our research goals, this paper measures the indicator by classifying commodities of thirteen countries in ASEAN+3 according to SITC Revision3. Table 1 reports the value of similarity indices in different level of commodity classification. As reported in Table 1, a high value of SI means that the country is in a strong competition with other ASEAN + 3 countries in intra-regional market. We also present the ranking of SI in order to compare the level of export competition in the region. First, looking at the value of SI from one to three digits, there is a remarkable difference across countries, especially in ASEAN zone, implying that ASEAN appears as a heterogeneous group which is approved by export composition. For instance, over the two last decades, Singapore and Malaysia have remained the index around 80, following by Philippines and Indonesia with the value approximately of 50. By contrast, Cambodia and Brunei Darussalam have a lower similarity in exports than other member states with the value of 30 and 17, respectively. Not surprisingly, the participation of

China, Japan and South Korea has influenced the intra-regional trade structure. With the highest value of SI, South Korea has the most similar export composition in the region. For example, the SI of South Korea reached 90.99 in 2005. Japan and China also have a high similarity index, which supports their competitive power in ASEAN+3 export market.

[Insert Table 1]

Second, the degree of export similarity of each country is confirmed by the ranking of SI reported in Table 1. Obviously, the ranking of SI is stable over time with the leading position belonging to South Korea followed by Thailand and Malaysia. However, the position of Thailand and Malaysia has slightly changed and alternated with that of Singapore. Since 2000, Singapore's ranking has been down from the third to the fifth. This change can be explained by the fact that Singapore's economics relies much more on services industry, which accounted for 95% to GDP in 2013.⁴ The small economies, notably Cambodia and Brunei Darussalam, have been remained the most dissimilar in exports with other countries.

Finally, drawing the SI for 3-digit commodity, Figure 2.1 shows the changes in the export similarity during the observation period. From 1990 to 2000, all the member states widened the exports categories, corresponding to an upward trend of similarity in exports. For instance, Indonesia's index grew from 32.74 to 44.96 over the period 1995 - 2000. However, after 2005, the degree of similarity has gradually declined among the countries, except Cambodia and Vietnam. This situation could be explained by the 2007 financial crisis, which affected the export performance of all countries. Furthermore, in 2013, Indonesia and Philippines witnessed a slightly rise of SI. Interestingly, Vietnam has become the potential competitor in the region with a significant increase in export similarity. In terms of export sector (SITC-1digit), SI of Vietnam has climbed from 48.08 in 2000 to 79.25 in 2014, which is higher than Japan and Singapore. This figure supports that Vietnam is deeply integrating in regional economics with a potential export competence.

[Insert Figure 2.1 & 2.2]

In addition, Figure 2.1 and 2.2 also present the difference in exports structure of ASEAN+3 to World market and to intra-regional market. On the one hand, Korea has been considered the most competitive in the region, while Thailand has maintained the first position in the world market in comparison with other members. On the other hand, China shows their advantage at

⁴ Source: ASEAN Stats Data

world level more than region. This result can be explained by the China's accession to WTO in 2001, which makes the export market of China become bigger. According to the study of Kwan and Qiu (2010), upon entering WTO, ASEAN countries bother about that they will lose their competitiveness in the world market, especially in the labor-intensive sectors. However, this event also forces China to lower its protection levels in all products, giving the benefit for ASEAN countries who export to China.

[Insert Table 2]

The similarity in ASEAN+3's trade structure is also reflected through the semi matrix in Table 2, which presents common characteristic of the exporting product between the bilateral countries. The index's calculation is based on the three-digit of SITC- Revision 3 (SITC3). Overall, ASEAN-5 including Indonesia, Malaysia, Philippines, Singapore and Thailand generally have similar export structure. For instance, Singapore has the most similar export composition with Malaysia and Thailand during the period 2000-2010 (with the index values of 74.03 and 53.38, respectively). These countries have the same export products in the electrical machine sector, notably like transistor products, office machine and petroleum sector. Regarding three East Asian member states, Korea and Japan have maintained the highest index over two decades. Particularly, in the period 1990 to 2000, the SI of Singapore and Japan is 60.11, and has remained more than 50 since 2001. Both countries have traded same products coming from telecommunication, transistor and petroleum. In ASEAN+3, Thailand also competed with Japan during the 2000s with the highest value of export similarity index of 60.11. The electrical household-type equipment such as transistor and the motor vehicles are the main competitive products of these two countries.

In the case of China, being the newest partner of ASEAN in economic cooperation by signing the CAFTA (China-ASEAN Free Trade Agreement) in 2010, both China and ASEAN have been deepened their trade liberalization vis-à-vis each other. In general, these countries have overlaps in their product lines and therefore compete in every market. In ASEAN+3, China has the most similar exports composition with South Korea, Thailand and Malaysia over the period 1990 - 2010. Among others, telecommunication equipment has been the most competitive between China and South Korea. In the meanwhile, the transistor products, petroleum and automatic data processing machine are the most similar commodity between China and

Thailand, Malaysia.⁵ Nevertheless, since 2011, Vietnam has become the competitor with China in the supply of telecommunication equipment, transistor products and articles of apparel and textile fabrics. Lejour (2001) finds that ASEAN countries benefit mainly from China's lower trade barriers in several sectors such as textiles, apparel, leather products, lumber and wood. Moreover, Kwan and Qiu (2010) argue that trade liberalization definitely hurts some sectors while it benefits some others.

A possible explanation for this result is the large intra-industry trade between countries. According to the best of our knowledge, the establishment of Free Trade Area in ASEAN (AFTA) has generated "trade creation". However, Hapsari and Mangusong (2006) suggest that the AFTA also may be causing some trade diversion and shifting trade from countries outside the bloc to possibly less efficient countries inside the bloc. The authors also find that the similar structure of export between ASEAN members has a positive effect on its bilateral exports. To sum up, intra-industry trade may be expected to increase the intra-regional trade among ASEAN members and to support the further economic integration of ASEAN zone. Furthermore, the joining of Japan, Korea and China into the bloc by creating single FTA with ASEAN has boosted the trade in the region. This result seems to be not consistent with the trade theory of Ricardo, which indicates that the countries only trade together the products having the comparative advantage⁶. We will address this issue through an analysis of the *revealed comparative advantage* index in Section 5.

4. Community detection

As mentioned in the methodology section, this paper also tends to employ the export similarity index to detect the trade community in ASEAN+3. As illustrated in Figure 3, the community is built by a bloc of countries, which has the highest similarity index. The size of community is widened from level one to level ten over the observation period, depending on the number of available member states. First, over time, the group of Singapore, Malaysia, Japan and South Korea has revealed as the first community with the most similar export structure in the region. Precisely, in 1995, Japan and Singapore has the first connection with the highest similarity, followed by South Korea and Malaysia. Since 2000, Singapore and Malaysia have been closer in export composition than South Korea and Japan. However, these four member states have still

⁵ This is the detailed result of similarity index calculation; the authors will provide the data upon request.

⁶ In the Ricardian model, countries will export goods that their labor produces relatively efficiently and will import goods that their labor produces relatively inefficiently. In other words, a country's production pattern is determined by comparative advantage. Krugman (2012)

shared the same bloc. Otherwise, in the recent years, Japan and South Korea have become more competitive, which has separated a small group before entering into the same community with Singapore and Malaysia.

The top five product groups, in which these four countries have important export SI, consist: (1) Transistors, valves, tubes, and so on (SITC-776), in which Singapore is leader with 50.36% of export within ASEAN+3 in 2014; (2) Telecommunications equipment (SITC-764) with the first position belonging to South Korea who increased its export intra-regional from 24% in 2005 to 37.88% in 2015; (3) Petroleum products (SITC-334), which is exported mostly intra-regional (i.e., Singapore 65%, Malaysia 77%, South Korea 62%, and Japan 48%); (4) Parts for office machines (SITC-759), in which Japan and Singapore are the main suppliers; (5) Parts of tractors, motor vehicles (SITC-784) with two big competitors South Korea and Japan whose export share of this product to ASEAN+3 market by these two countries is 38% and 29%, respectively⁷. Obviously, the developed member states concentrate in the technology intensive manufactures.

In the case of Indonesia, the export composition is different from that of other members in ASEAN-5⁸ but has a common export structure with Vietnam. In 2005 and 2010, these two member states were detected as a community. Crude materials (SITC-231: natural rubber, and so on) and mineral fuels (SITC-333: petroleum oils and SITC-231: coal but not agglomerated) are the products that Vietnam and Indonesia competes in the ASEAN+3 market (see further Appendix 1).

Regarding China, we observe that before 2005, this country joined in the same group with other members at the level of 6 or 7. Nevertheless, after 2005, Thailand and Vietnam seem to have more similar export commodity with China than others. For example, in 2010, China and Thailand was detected in one community, while China and Vietnam have been in the same group since 2013. Following the Appendix 1, China enters into the ASEAN+3 export market with a high similarity level in telecommunication equipment, and competes with South Korea and Vietnam basing on the cost advantage. Furthermore, the labor-intensive manufactures, such as transistors and article of apparel, of textile fabrics, have become the strength of China and allowed the country to compete directly with Thailand and Vietnam.

[Insert Figure 3]

⁷ The data of trade share by commodity will be provided upon request.

⁸ ASEAN-5 includes Indonesia, Malaysia, Philippines, Singapore and Thailand.

Together with the above result, we also point out the most common export product groups among eleven members in ASEAN+3 (Laos and Myanmar are excluded), which are reported in Table 3. First, there is a change in the common export composition over time among member states. However, the mineral fuels, including crude oils and petroleum products, have still remained the most similar export products in the region. . The share of these products within the ASEAN+3 market has proved this argument. For example, intra-regional exported crude oils exported account for around 60% of the total export. In 2013, the natural gas became the top products of all country members with the share of 88% to total intra-ASEAN+3 exports. This is possibly resulted from the sustainable development policy with the goal of environment protection, which requires all countries invest in the production to ensure the demand of the region. Second, in 2001 and 2006, the articles of apparel, of textile fabrics were the top three similar product that all countries export. In 2013, this light industry has lost its position into the heavy industry. Indeed, this change in export direction partly reveals the evolution of comparative advantage in the member states of ASEAN+3.

Following the above results, the similarity in trade structure reflects the degree of competition in export among member states of ASEAN+3. In other words, all ASEAN + 3 countries are not only competitive but also complementary in terms of intra-regional. In order to clarify this statement, we applied the *revealed comparative advantage index* for further analysis.

[Insert Table 3]

5. Comparative Advantage of ASEAN+3's exports

In this section, we analyze the export competence of each member states in ASEAN+3 market by employing the *revealed comparative advantage* (RCA) introduced by Balassa (1965). First, we look at the RCA across the countries by extracting the products with highest and smallest comparative advantage. Second, we take into consideration the individual country to study the stability of RCA, the relation between RCA and product's country market share in order to verify the Ricardo comparative advantage theory. Finally, we refer to the export similarity to evaluate the relation between SI and RCA, then compare the RCA of the most similar product groups among ASEAN+3.

Table 4 presents the changes of product groups with the highest and the smallest RCA by country in 1990, 2000 and 2014. On the one hand, there is a variation of products having comparative advantage among ASEAN+3 member states. For instance, Indonesia, Malaysia and Philippines have high RCA index in mineral products, while Thailand and Vietnam own export advantage in agricultural products. In Plus Three countries, Japan RCA is strong in vehicles and

parts of machine, while South Korea has high RCA in manufactured goods and leather goods. China owns the comparative advantage in uranium, thorium, un-milled maize and raw fur skin. Regarding the case of Brunei, natural gas has the dominance in its exports. However, this product is the most comparative disadvantage with bigger countries like Thailand, Singapore, Japan and Korea. On the other hand, each country member has experienced the important changes in its export advantages over time. Particularly, in 2000, synthetic rubber had the highest RCA index in Cambodia's exports, but in 2014, printed matter owned the first place.

[Insert Table 4]

When we look at Figure 4, it is clearly to see the difference in the mean value of RCA between among the member states. In Cambodia, this index significantly increased in 2004 and 2005, mainly due to the comparative advantage of the product group including works of art and antique. By contrast, Brunei has the lowest mean of RCA, which can be explained by the unique high value of RCA of the natural gas group. Over the observation period, some countries, such as Indonesia, China, Philippines, Thailand, Malaysia, Cambodia and Vietnam, have remained the mean RCA more than 1.0. . Otherwise, this value of

[Insert Figure 4]

In order to further analyze the stability of the RCA indices, we follow Hinloopen and Van Marrewijk (2001) in examining the changes in the original Balassa index's distribution over the period 1990-2014 shown in Figure 5 (see further Appendix 2 for detailed results). Our findings suggest that the revealed comparative advantage has strengthened in some countries, while in the others this index has weakened to an extent, resulting in a higher percentage of lower value indices ($RCA < 1$). For instance, before 1996, Brunei had around 20% of export products which have comparative advantage. After 1996, this country has witnessed a dramatic reduce in its export comparative advantage at the regional level. Moreover, the mean of RCA has significantly declined at the same period. This is mainly due to the limited export competence of Brunei, which only concentrates in natural gas. Indeed, the RCA of this product has increased from 15.29 to 28.68 over the observation period. Similarly, the mean of RCA of Singapore has a downward trend from 1.2 to 0.8. On the other hand, the share of Singapore products having comparative advantage has also reduced from 40% to 20%. These results show a slight weakening of comparative advantage of Singapore with respect to the regional level. By contrast, Thailand has remained the competence in export with the mean of RCA exceeding 1.0 over the observation period. Additionally, the ratio of products owning comparative advantage has gradually increased. Regarding the developing countries, Vietnam and Cambodia have

high value of RCA, particularly in labor-intensive product groups. For instance, Cambodia has remained mean of RCA around 2.0 and Vietnam has kept the RCA more than 1.5.. In the other words, export competence of developing countries is based on the labor cost advantage. Overall, the RCA index seems to be stable in China, Japan, Indonesia, Malaysia and Thailand, while this index is fluctuated in the case of Brunei, Philippines, Cambodia and Vietnam.

[Insert Figure 5]

Looking at both RCA index and country export share, we find that the products with high RCA are not always exported more than the others, and that the countries do not only export the products having comparative advantage. As highlighted in Figure 6, in the case of China, the transistor product group (S3-776) has higher export share in the total exports, but it does not have the revealed comparative advantage with RCA less than 1. Similarly, Figure 6 clearly shows that even if Vietnam does not have comparative advantage in telecommunication equipment (S3-764), its export share of this product is much higher than that of rice (S3-042) which has a high RCA value (more than 15). This result remind us to verify the law of comparative advantage of Ricardo⁹. This law postulates that, even if one nation is less efficient than other nation in the production of both commodities, there is still a basis for mutually beneficial trade (as long as the absolute disadvantage that the first nation has with respect to the second is not in the same proportion in both commodities). The less efficient nation should specialize in the production and export of the commodity in which its absolute disadvantage is smaller. Our results show that this hypothesis is not always true. In particular, the product group with transistor, valves, and so on (S3-776) is exported by most of the countries even if they do not have comparative advantage, like China and Vietnam. In addition, the petroleum products (S3-334) are not strong RCA for China, Japan or Vietnam, but they are still exported with higher country's export share than the other products. Our findings suggest that in the context of economic integration, every country wants to enlarge exports market by marking its name in the common market even though their products do not have comparative advantage. In the case of new entrants who want to enter to a market with more efficient competitors, the Ricardo's hypothesis will be applied because they should consider the comparative advantage of product with the others to decide the potential exports.

[Insert Figure 6]

We also verify the Ricardo's hypothesis by comparing the RCA index among countries having the most similar products with highest value of SI, as reported in Table 5. Although there is a big difference in RCA values among countries, they are still exporting the same products to a

⁹ In 1817, Ricardo published his *Principles of Political Economy and Taxation*, in which he presented the law of comparative advantage.

common market. For instance, regarding the telecommunication equipment sector, which is one of the most similar export products in ASEAN+3, while China has the most comparative advantage in telecommunication equipment (RCA is 2.1), Brunei has comparative disadvantage for this product (RCA is 0.019). In the other case, notably natural gas, except Brunei, Malaysia and Indonesia, which own the highest RCA index, the rest of member states, which almost have the zero RCA, still participate in the export market for this product.

From the other perspective, our results on the Balassa index can be partly explained by the New Trade Theory (NTT) initiated by Paul Krugman in the late 1970s, which bases the international trade on economies of scale, imperfect competition and differences in technological changes among nations. Following the theory, the countries producing similar goods and services continue to engage in trade with the other ones, although they do not benefit from international trade. Accordingly, the comparative advantage does not just come from the differences in resources; rather, the economies of scale and network effects that occur in key industries are also substantial determinants of international trade patterns.

Furthermore, Krugman's new trade theory claims that despite no disadvantage for a country to produce a certain good, it might be in their best interest to import same goods from another country in order to better specialize in other products and attain economies of scale. Because of less variety of goods at the national level, such a model then becomes an incentive to engage in trade with other countries in order to achieve variety at the consumer level.

[Insert Table 5]

Finally, we examine the relation between similarity index (SI) and revealed comparative advantage (RCA). We first set new formula of SI to define the relation between SI and RCA as follows:

$$SI_{ij} = \text{Min} \left\{ \frac{X_{ij}}{X_i}; \frac{X_{A-(i),j}}{X_{A-(i)}} \right\} \quad (4)$$

$$\frac{SI_{ij}}{MS_{Aj}} = \text{Min} \left\{ \frac{X_{ij}/X_{Aj}}{X_i/X_A}; \frac{X_{A-(i),j}/X_{Aj}}{X_{A-(i)}/X_A} \right\} \quad \text{with } MS_{Aj} = \frac{X_{Aj}}{X_A} \quad (5)$$

$$SI_{ij} = MS_{Aj} \times \text{Min} \{RCA_{ij}; RCA_{A-(i),j}\} \quad (6)$$

where:

SI_{ij} : similarity index of commodity j of country i

X_{ij} : export value of commodity j of country i

X_i : total exports of country i

$X_{A-(i),j}$: export value of commodity j of the other countries in ASEAN+3 except country i $X_{A-(i)}$

: total exports of the other countries in ASEAN+3 except country i

X_{Aj} : total exports of commodity i of ASEAN+3

X_A : total exports of ASEAN+3

MS_{Aj} : market share of commodity j in the ASEAN+3's exports

Following Equation (6), similarity index of one commodity is properly affected by three dimensions: (i) the market share of commodity j in the ASEAN+3's exports, (ii) RCA of commodity j of country i , (iii) RCA of commodity j of the other countries in ASEAN+3 except country i . In order to examine this relation, we calculated the correlation among SI_{ij} , MS_{Aj} , RCA_{ij} and $RCA_{A-(i),j}$. Due to the high volume of products, we only present in Table 6 the results of product groups having the highest value of similarity index.¹⁰,

[Insert Table 6]

The results show that the relation between SI_{ij} and MS_{Aj} , RCA_{ij} , $RCA_{A-(i),j}$ is significant. Indeed, the similarity index of a product of a country is positive with its market share in ASEAN+3's exports and its RCA index, but negative with the RCA of the same product of other member states. It means that the higher RCA of an exported commodity corresponds to the lower advantage of the same product of the rest of ASEAN + 3 member states, and vice versa. Accordingly, the SI of a product in a country with a small RCA of the same product seems to be small. In other words, RCA seems to be a key factor determining the similarity level of exports.

6. Conclusion

In this paper, we tend to investigate the similarity in exports of ASEAN + 3 and provide an exploratory study on the export community by applying a simple algorithm analysis, which is based on the similarity indices over the period 1990 - 2014. Moreover, to the best of our knowledge, this study is the first one to connect the comparative advantage approach with the similarity index approach to revisit the Ricardo's theory and New Trade theory. Accordingly, our empirical research provides a set of important findings.

First, the similarity in ASEAN + 3's export varies among the member states over the observation period. For example, over the last two decades, Malaysia, Singapore, Japan and Korea have remained a high similarity level in the region, while Brunei Darussalam and Cambodia have the lowest export similarity index. Second, the similarity index's ranking of each country does not seem to be sensitive to the changes in the commodity classification level. Third, the main export competitors are defined in pair and in bloc of countries. Such evidence shows that Japan and South Korea have the highest competition in ASEAN + 3 market, following by China, Thailand and Vietnam. In addition, the community including Singapore, Malaysia, Japan and South Korea has the highest export similarity with the common export products of transistor,

¹⁰ The calculation of the other products will be provided up on requests.

telecommunication equipment and petroleum products. Meanwhile, China provides similar exports with Thailand in automatic data processing machines, and with Vietnam in telecommunication equipment. Fourth, ASEAN + 3 has experienced such a different trend in comparative advantage among its member states. Indeed, China, Japan, Indonesia, Malaysia and Thailand have kept the stability in comparative advantage. By contrast, Brunei Darussalam, Philippines, Cambodia and Vietnam have witnessed the fluctuation over time. Finally, investigating the relation between revealed comparative advantage (RCA), country's export market share and similarity index (SI), we find that the Ricardo law of comparative advantage seems not to be applied in the context of ASEAN + 3 trade integration, on the one hand. On the other hand, as explained by New Trade theory, a country still export products without comparative advantage to obtain economies of scale and to achieve variety at the consumer level. Our empirical results also suggest that the export composition similarity among ASEAN + 3 member states is positively and significantly associated with the revealed comparative advantage for a given product. A set of policy implications can be obtained from our empirical findings. In terms of export similarity, the policy makers can determine the main competitors in ASEAN + 3 market to have more effective trading strategy. Regarding the comparative advantage, the export commodity structure of each country should be revisited in order to determine the potential products for export in ASEAN + 3.

In conclusion, the present paper seeks to contribute to the international trade literature through a community analysis focusing on the similarity index. Furthermore, by employing the revealed comparative advantage, our findings provide only partial supports to the international trade theories. However, this work has not attempted to test a theoretical model or addressed the specific sector to define the commodity-specific communities. To this end, two future researches should be required. First, a specific commodity and its export market issue will be explored fatherly. Second, formal economic modelling about ASEAN+3's export structure will be called for.

References

Balassa, B., 1965. "Trade Liberalisation and "Revealed" Comparative Advantage", *The Manchester School*, 33: 99-12

Baldwin, R.E., 1986. "Structural change and Patterns of international trade", NBER Working Paper, No. 2058.

Blondel, V.D., Guillaume, J.-L., Lambiotte, R., and Lefebvre, E., 2008. « Fast unfolding of communities in large networks", *Journal of Statistical Mechanics: Theory and Experiment*, 10, P1000.

David Dollar & Aart Kraay, 2004. "Trade, Growth, and Poverty," *Economic Journal*, Royal Economic Society, vol. 114(493), pages F22-F49.

De Benedictis, L., and Tajoli, L., 2006. "Economic Integration and Similarity in Trade structures", Nota Di Lavoro Paper, No.54.

De Benedictis, L., and Tajoli, L., 2008. "Similarity in trade structures, integration and catching-up", *Economics of Transition*, Vol 16(2), pp. 165 - 182.

Fagerberg Jan, Srholec Martin, 2004. «Structural Changes in International Trade. Cause, Impact and Response», *Revue économique*, 55, p. 1071-1097.

Fagerberg, J., and Srholec, M., 2004. «Structural Changes in International Trade. Cause, Impact and Response», *Revue économique*, 55, p. 1071-1097.

Finger, J.M., and Kreinin, M. E., 1979. "A Measure of 'Export Similarity' and Its Possible Uses", *Economic Journal*, Vol. 89 (356), pp. 905-912.

Frankel, Jeffrey A., and David Romer. 1999. "Does Trade Cause Growth?" *American Economic Review* 89(3): 379-399.

Fragkiskos D. Malliaros and Michalis Vazirgiannisa, (2013), "Clustering and Community Detection in Directed Networks: A Survey", *Journal Physics Reports*, 533(4), 95-142.

Grubel, H.G. and Lloyd, P.J., 1971. "The Empirical Measurement of Intra- Industry Trade », *Economic Record*, 47 (120), pp. 494-517.

Hinloopen, Jeroen, and Charles Van Marrewijk. 2016. "On the Empirical Distribution of the Balassa Index." *Weltwirtschaftliches Archiv* 137 (1): 1-35.

Krugman, P. R. (1980)., "Scale Economies, Product Differentiation, and the Pattern of Trade", *The American Economic Review*, 70(5), 950-959.

Kwan, Yum K., and Larry D. Qiu. 2010. "The ASEAN+3 Trading Bloc." *Journal of Economic Integration* 25 (1): 1-31.

Lejour, Arjan(2001), "China and the WTO: the Impact on China and the World Economy", paper presented in Greater China and the WTO Conference, held in Hong Kong, March 2001

Pons P. (2005), "Détection de structures de communautés dans les grands réseaux d'interactions". Septièmes Rencontres Francophones sur les aspects Algorithmiques des Télécommunications (AlgoTel'05), Giens, France.

Pons P. et Latapy M., (2006), "Computing communities in large networks using random walks", *Journal of Graph Algorithms and Applications*, 10(2), 191-218

Ravallion, Martin, (2004), "Looking beyond averages in the trade and poverty debate," *Policy Research Working Paper Series 3461*, The World Bank.

Rodrik, Dani, and Francisco Rodriguez, (2000), "Trade Policy and Economic Growth: A Skeptic's Guide to the Cross-National Evidence." In Ben Bernanke and Kenneth Rogoff, eds., NBER Macroeconomics Annual 2000. Cambridge, Mass.: MIT Press.

"Ricardo, On the Principles of Political Economy and Taxation | Library of Economics and Liberty." 2016. Accessed July 11. <http://www.econlib.org/library/Ricardo/ricP.html>.

Urata, S., (2007), "Competitive Regionalism in East Asia: An economic analysis", *GIARI Working Paper*, Vol.2, Waseda University.

Utkulu U., Seyman D., (2004), "Revealed Comparative Advantage and Competitiveness: Evidence for Turkey *vis-à-vis* the EU/15", presented paper at the European Trade Study Group 6th Annual Conference, Nottingham, September 2004

Waugh, M., (2010), "International trade and income differences", *The American Economic Review*, 100 (5), pp. 2093-2124.

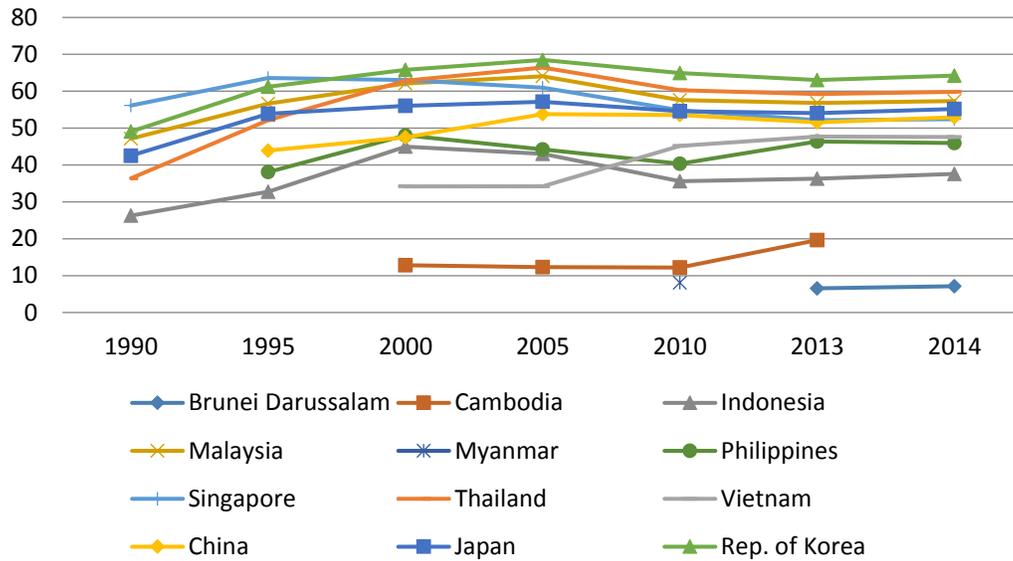
Table 1: Export similarity by country of ASEAN + 3

Country	1990		1995		2000		2005		2010		2014	
	SI	Rank										
SITC 3- 1 digit												
Brunei Darussalam	-	-	-	-	-	-	-	-	-	-	17.51	10
Cambodia	-	-	-	-	39.68	10	30.85	10	36.71	10	-	-
Indonesia	43.38	6	48.47	8	57.20	8	54.96	8	49.68	9	54.44	9
Malaysia	65.39	3	81.57	3	80.77	4	84.59	3	82.40	3	76.71	7
Philippines	-	-	54.98	7	68.69	6	64.23	7	63.15	8	77.77	6
Singapore	80.67	1	81.65	2	81.66	3	79.98	5	78.93	5	78.54	4
Thailand	59.44	4	73.95	4	86.22	1	87.49	2	84.42	2	81.29	2
Vietnam	-	-	-	-	48.08	9	51.65	9	68.31	7	78.21	5
China	-	-	62.15	6	66.80	7	77.01	6	79.40	4	75.81	8
Japan	55.60	5	71.51	5	75.69	5	80.56	4	78.20	6	79.72	3
Rep. of Korea	69.55	2	82.72	1	84.99	2	90.99	1	90.41	1	88.90	1
SITC 3- 2 digit												
Brunei Darussalam	-	-	-	-	-	-	-	-	-	-	16.64	10
Cambodia	-	-	-	-	21.06	10	19.17	10	18.27	10	-	-
Indonesia	29.41	6	37.00	8	48.58	8	47.41	8	42.68	9	48.48	9
Malaysia	57.38	2	62.63	3	67.01	4	72.03	3	67.13	3	66.10	3
Philippines	-	-	45.87	7	54.90	7	49.66	7	47.72	8	56.55	8
Singapore	69.94	1	70.51	1	71.34	3	69.91	4	64.01	4	62.96	5
Thailand	44.37	5	59.70	4	73.81	2	73.94	2	68.36	2	67.34	2
Vietnam	-	-	-	-	39.95	9	44.38	9	57.41	7	64.59	4
China	-	-	53.76	6	58.30	6	63.56	6	62.09	6	61.42	7
Japan	47.20	4	58.18	5	60.81	5	64.57	5	63.99	5	62.88	6
Rep. of Korea	57.29	3	69.67	2	77.80	1	78.71	1	74.65	1	72.84	1
SITC 3- 3 digit												
Brunei Darussalam	-	-	-	-	-	-	-	-	-	-	7.13	10
Cambodia	-	-	-	-	12.82	10	12.27	10	12.19	10	-	-
Indonesia	26.26	6	32.74	8	44.96	8	43.03	8	35.57	9	37.62	9
Malaysia	47.13	3	56.65	3	62.08	4	64.05	3	57.59	3	57.34	3
Philippines	-	-	38.08	7	48.04	6	44.20	7	40.32	8	45.95	8
Singapore	56.16	1	63.59	1	63.07	2	60.93	4	54.83	4	52.44	6
Thailand	36.40	5	52.13	5	62.87	3	66.43	2	60.27	2	59.86	2
Vietnam	-	-	-	-	34.20	9	34.23	9	45.16	7	47.57	7
China	-	-	43.92	6	47.51	7	53.79	6	53.50	6	52.94	5
Japan	42.54	4	53.87	4	56.00	5	57.14	5	54.60	5	55.18	4
Rep. of Korea	49.07	2	61.20	2	65.77	1	68.49	1	64.93	1	64.24	1

Note: Missing data of Lao PDR, Myanmar and Cambodia (2014)

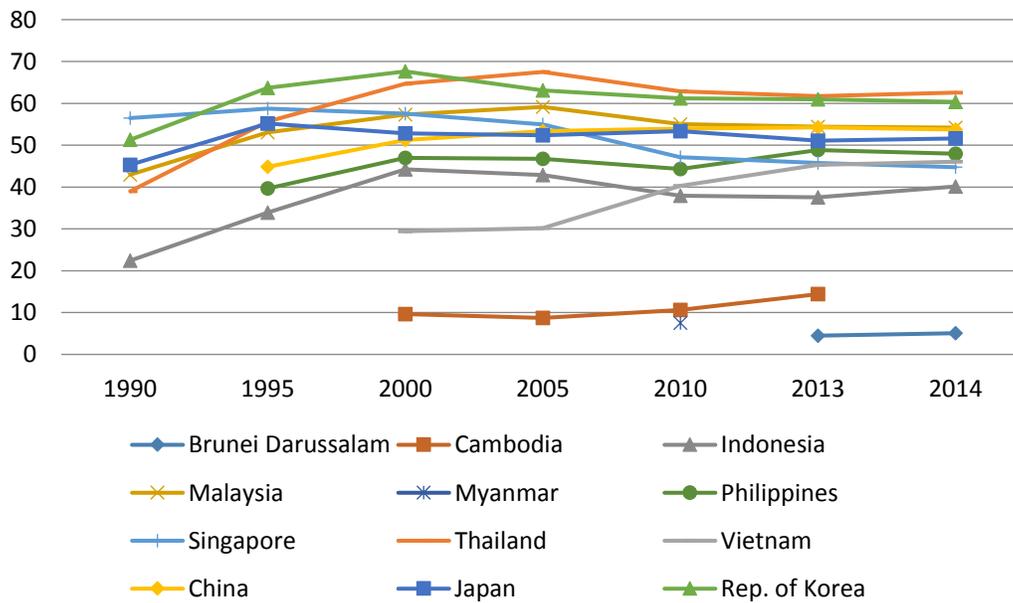
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Figure 2.1: Evolution of Export Similarity Intra-ASEAN+3



Source: Authors' creation

Figure 2.2: Evolution of Export Similarity of ASEAN+3 to World Market



Source: Authors' creation

Table2: Matrix of similarity

1990-2000												
	BRN	KHM	IDN	MYS	MMR	PHL	SGP	THA	VNM	CHN	JPN	KOR
BRN			37.26	17.96	0.10	4.24	4.65	3.28	32.81	9.38	2.66	4.41
KHM			-	-	-	-	-	-	-	-	-	-
IDN				42.89	11.03	25.70	25.09	30.34	40.57	36.45	19.97	28.52
MYS					15.36	43.27	55.36	46.82	28.10	37.81	37.81	44.84
MMR						12.54	6.10	22.91		16.39	2.97	6.03
PHL							43.97	40.96	23.86	28.41	32.91	38.76
SGP								48.77	22.02	35.45	60.11	54.04
THA									35.99	44.29	41.85	44.86
VNM										38.31	16.98	20.95
CHN											32.36	43.83
JPN												54.60

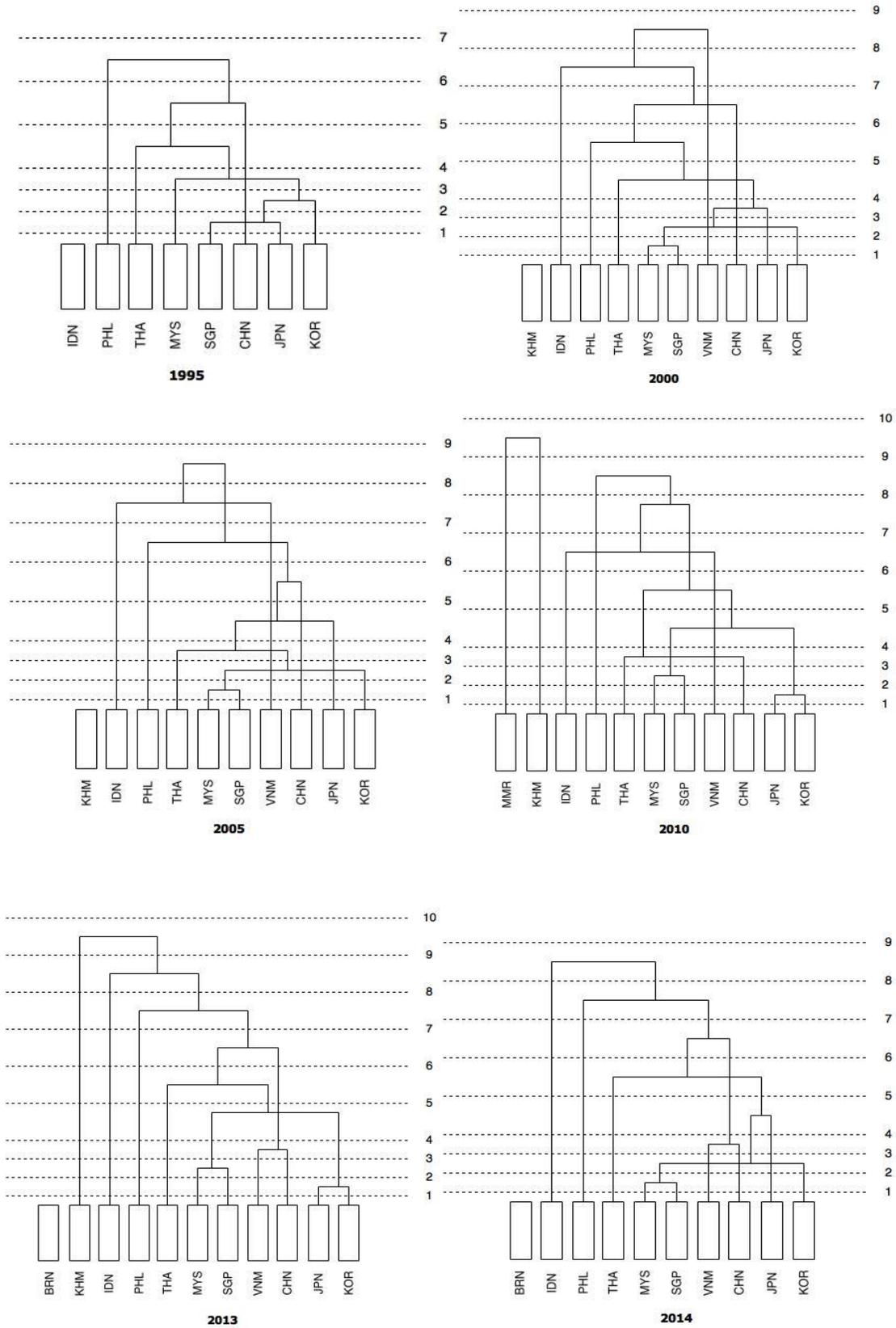
2000-2010												
	BRN	KHM	IDN	MYS	MMR	PHL	SGP	THA	VNM	CHN	JPN	KOR
BRN		3.60	32.61	14.83		2.93	3.61	5.06	32.81	6.07	3.54	4.44
KHM			13.25	9.39	14.29	6.14	8.17	16.70	16.66	15.61	10.41	12.25
IDN				50.79	21.39	32.50	29.85	40.06	43.97	36.11	30.05	38.41
MYS					14.26	47.70	74.03	54.85	32.74	43.14	43.14	52.23
MMR						3.02	1.86	9.28	15.55	7.79	2.20	2.77
PHL							52.78	41.84	23.62	34.67	37.20	40.60
SGP								53.38	24.22	42.75	54.23	61.98
THA									39.98	54.82	60.50	56.10
VNM										42.44	23.77	26.98
CHN											43.51	52.04
JPN												62.56

2011-2014												
	BRN	KHM	IDN	MYS	MMR	PHL	SGP	THA	VNM	CHN	JPN	KOR
BRN		1.87	27.92	19.94		5.63	3.94	4.15	13.22	2.97	3.12	3.25
KHM			13.23	8.71		9.03	8.28	19.25	24.78	17.82	8.77	9.52
IDN				49.22		29.93	23.54	35.73	41.22	29.48	26.72	26.92
MYS						46.90	58.78	50.62	34.67	40.78	40.78	51.89
MMR												
PHL							45.23	36.79	32.46	36.85	36.42	39.68
SGP								48.53	27.67	38.38	46.89	60.23
THA									44.87	50.89	47.99	52.01
VNM										53.71	29.66	33.91
CHN											47.33	48.74
JPN												59.95

Note: BRN = Brunei Darussalam, KHM = Cambodia, IDN = Indonesia, MYA = Malaysia, MMR = Myanmar, PHL = Philippines, SGP = Singapore, THA = Thailand, VNM = Vietnam, CHN = People Republic of China (China), JPN = Japan, KOR = Republic of Korea (South Korea)

Source: Authors' creation

Figure 3: Evolution of Community detection in exports of ASEAN+3



Source: Authors' creation

Table 3: Top 10 similar export product groups of ASEAN+3

2001				2006				2013			
SITC3 code	Commodity	Export Intra-ASEAN+3 (%)	Export Extra-ASEAN+3 (%)	SITC3 code	Commodity	Export Intra-ASEAN+3 (%)	Export Extra-ASEAN+3 (%)	SITC3 code	Commodity	Export Intra-ASEAN+3 (%)	Export Extra-ASEAN+3 (%)
333	Petroleum Oils, Crude	68.48	31.52	333	Petroleum Oils, Crude	59.43	40.57	343	Natural Gas	88.00	12.00
334	Petroleum Products	61.81	38.19	343	Natural Gas	92.72	7.28	333	Petroleum Oils, Crude	61.38	38.62
343	Natural Gas	87.05	12.95	845	Articles Of Apparel, Of Textile Fabrics, Whether Or Not Knitted Or Crocheted, N.E.S.	20.46	79.54	512	Alcohol, Phenol Etc. Derivatives	71.29	28.71
845	Articles Of Apparel, Of Textile Fabrics, Whether Or Not Knitted Or Crocheted, N.E.S.	31.25	68.75	731	Metal Removal Work Tools	39.90	60.10	874	Measure Control Instrument	40.78	59.22
652	Cotton Fabrics, Woven	31.00	69.00	792	Aircraft Associated Equipment	28.24	71.76	679	Tubes, Pipes, Etc. Iron, Steel	29.57	70.43
651	Textile Yarn	33.36	66.64	728	Other machinery and equipment specialized for particular industries	51.05	48.95	792	Aircraft Associated Equipment	25.10	74.90
793	Ship, Boat Float Structures	8.61	91.39	844	Women, Girls Clothing Knit	15.00	85.00	772	Electrical, Switching, ,Relay Circuit	42.88	57.12
655	Knit Crochet Fabric Nes	29.45	70.55	695	Tools	32.67	67.33	695	Tools	31.43	68.57
695	Tools	29.35	70.65	282	Ferrous Waste And Scrap	81.79	18.21	723	Civil Engineering Equipment	31.30	68.70
846	Clothing Accessories, Fabric	36.78	63.22	723	Civil Engineering Equipment	25.34	74.66	676	Iron, Steel. Bar Shapes Etc.	58.10	41.90

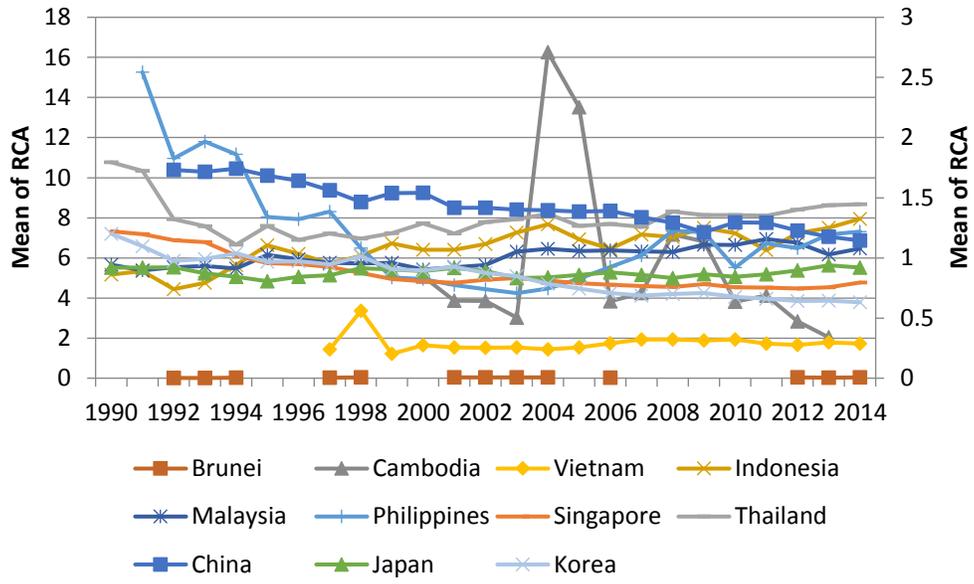
Note: Data exclude Laos and Myanmar due to the unavailability in UNCOMTRADE. Source: Authors' creation

Table 4: List product group of each country in ASEAN+3 by max and min value of RCA

Country	1990			2000			2014		
	SITC	Commodity	RCA	SITC	Commodity	RCA	SITC	Commodity	RCA
BRN				343	Natural Gas	23.65286	343	Natural Gas	28.68196
				251	Pulp And Waste Paper	0.00013	335	Residual Petrol. Products	0.00000
				232	Synthetic Rubber, Etc.	147.04061	892	Printed Matter	136.45444
KHM				759	Parts For Office Machines	0.00002	775	Dom. Electronic, Non-Elec. Equipment	0.00001
	351	Electric Current	8.43048	283	Copper Ores, Concentrates	13.24004	322	Briquettes, Lignite, Peat	18.25631
IDN	783	Road Motor Vehicles Nes	0.00004	344	Petroleum Gases, Nes	0.00005	344	Petroleum Gases, Nes	0.00000
	247	Wood Rough, Rough Squared	8.64031	247	Wood Rough, Rough Squared	8.94339	025	Eggs, Birds, Yolks, Albumin	9.99722
MYS	274	Sulphur, Unrstd. Iron Pyrs	0.00045	042	Rice	0.00068	251	Pulp And Waste Paper	0.00182
	281	Iron Ore, Concentrates	56.09978	281	Iron Ore, Concentrates	29.34678	635	Wood Manufactures, Nes	31.41537
PHL	674	Flat-Rolled Plated Iron	0.00003	333	Petroleum Oils, Crude	0.00000	344	Petroleum Gases, Nes	0.00000
	961	Coin Non-gold Noncurrent	7.27295	961	Coin Non-gold Noncurrent	6.99818	961	Coin Non-gold Noncurrent	6.86369
SGP	343	Natural Gas	0.00003	321	Coal, Not Agglomerated	0.00003	322	Briquettes, Lignite, Peat	0.00002
	042	Rice	17.97157	47	Other Cereal Meal, Flours	12.41441	016	Meat, Ed.Offl, Dry, Slt,Smk	13.67994
THA	343	Natural Gas	0.00002	321	Coal, Not Agglomerated	0.00000	343	Natural Gas	0.00002
				71	Coffee, Coffee Substitute	19.59136	286	Uranium, Thorium Ores, Etc	23.94431
VNM				431	Animal, Veg. Fats, Oils, Nes	0.00043	343	Natural Gas	0.00000
	286	Uranium, Thorium Ores, Etc	10.20172	044	Maize Un-milled	6.22533	212	Furskins, Raw	3.27328
CHN	231	Natural Rubber, Etc.	0.00000	231	Natural Rubber, Etc.	0.00040	283	Copper Ores, Concentrates	0.00004
	782	Goods, Spcl Transport Veh	2.25777	712	Steam Turbines	3.01263	282	Ferrous Waste And Scrap	4.71856
JPN	343	Natural Gas	0.00001	333	Petroleum Oils, Crude	0.00000	343	Natural Gas	0.00000
	896	Works Of Art, Antique Etc	6.35860	611	Leather	5.80705	891	Arms And Ammunition	4.89710
KOR	343	Natural Gas	0.00000	343	Natural Gas	0.00000	333	Petroleum Oils, Crude	0.00000

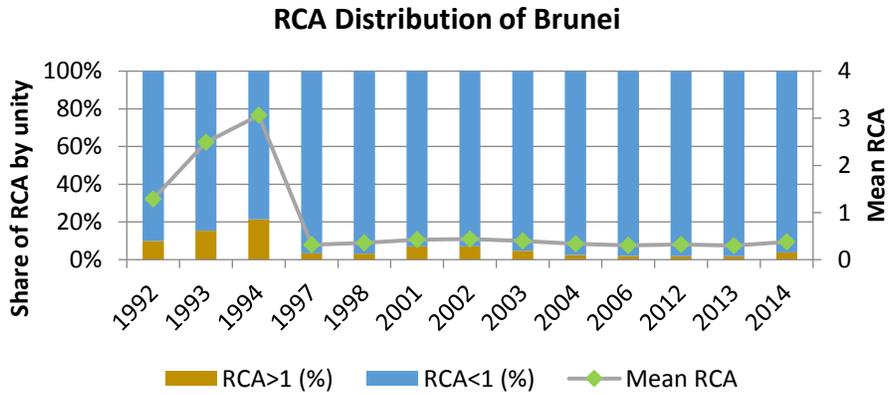
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Figure 4: Mean of RCA by country in ASEAN + 3

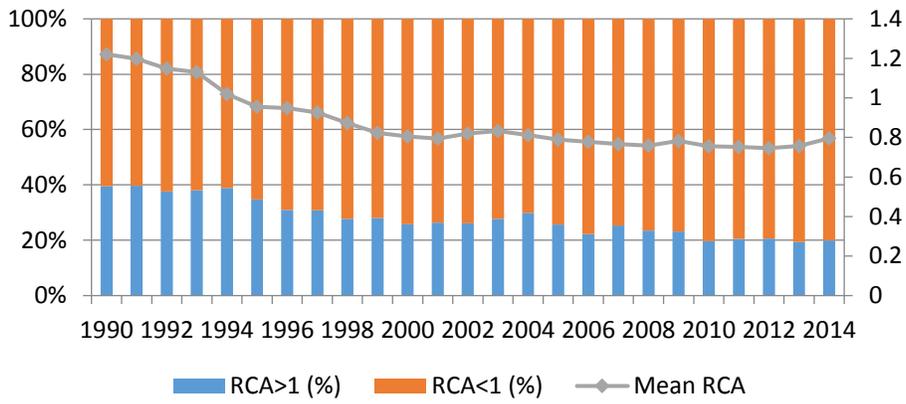


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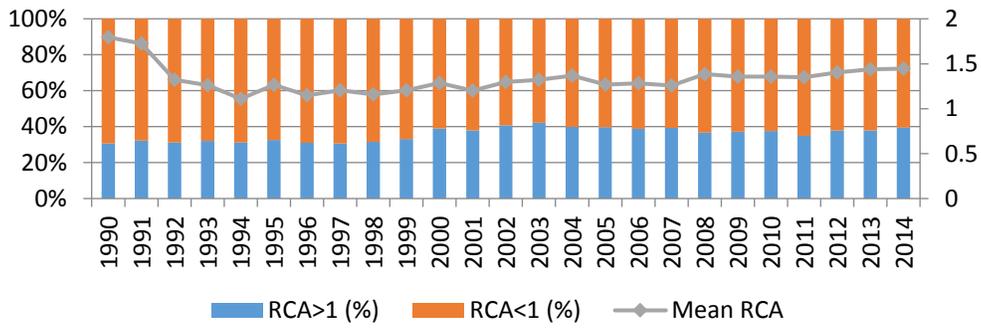
Figure 5: Distribution of RCA by selected countries



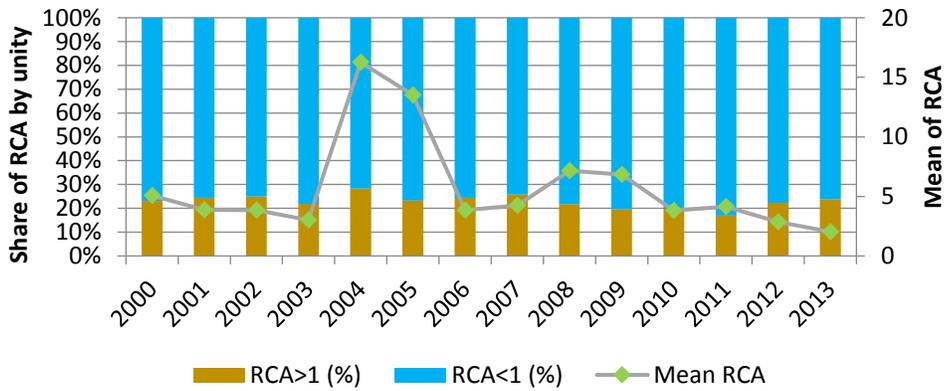
RCA Distribution in Singapore



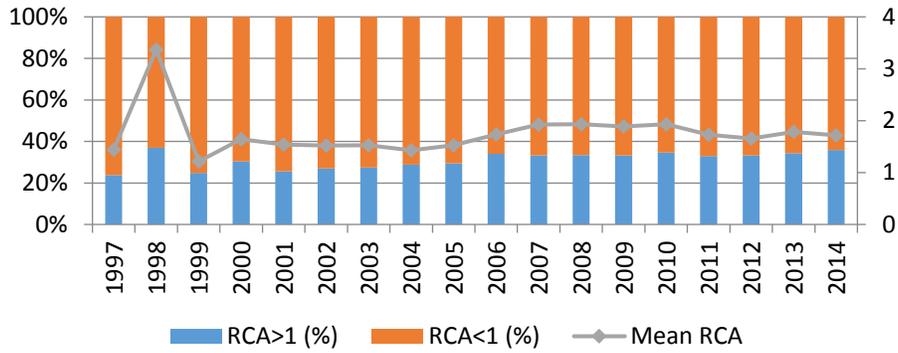
RCA Distribution in Thailand



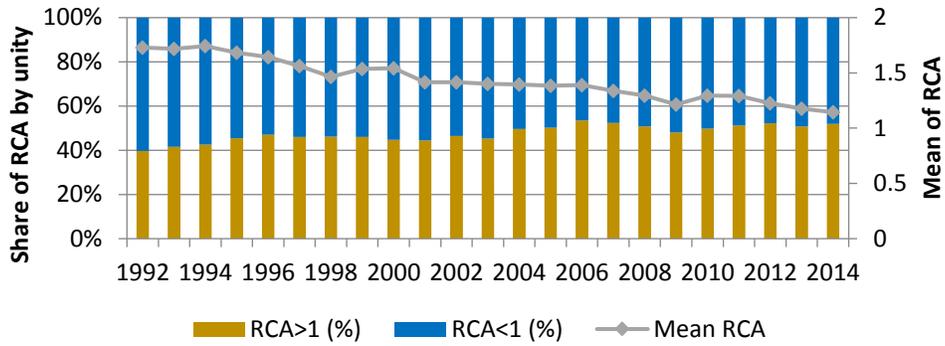
RCA Distribution of Cambodia



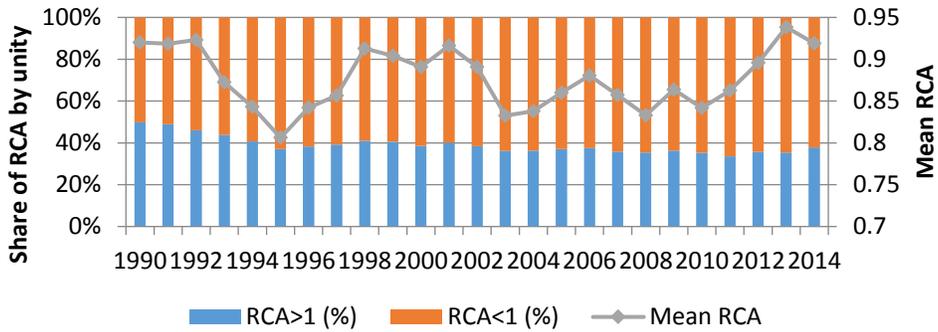
RCA Distribution in Vietnam



RCA Distribution of China



RCA Distribution in Japan



Source: Authors' creation

Table 5: SI and RCA by selected products(*) in ASEAN + 3, 2013

Country	S3-776		S3-334		S3-764		S3-778		S3-752	
	TRANSISTORS,VALVES,ETC.		PETROLEUM PRODUCTS		TELECOMM.EQUIP.PAR TS NES		ELECTRIC.MACH.APPART.N ES		AUTOMATC.DATA PROC.EQUIP	
	SI	RCA	SI	RCA	SI	RCA	SI	RCA	SI	RCA
BRN	0.000008	0.000084	0.000045	0.000628	0.000870	0.019333	0.000268	0.010989	0.000299	0.012960
KHM	0.000018	0.000196	0.000034	0.000479	0.044995	1.216400	0.000399	0.016348	0.000112	0.004849
IDN	0.006251	0.066994	0.014044	0.195340	0.008956	0.198990	0.010191	0.417510	0.002598	0.112710
MYS	0.087733	1.726800	0.068187	1.626800	0.011353	0.252260	0.011291	0.462590	0.022050	1.527100
PHL	0.090950	2.329400	0.022727	0.316120	0.008256	0.183430	0.024072	1.724400	0.022377	2.533000
SGP	0.075026	2.375300	0.052965	2.848000	0.027133	0.602870	0.018269	0.748470	0.021125	0.916550
THA	0.030946	0.331650	0.070638	1.249500	0.010366	0.230320	0.016626	0.681140	0.022752	1.183900
VNM	0.043180	0.462760	0.020296	0.282310	0.043874	1.789800	0.006589	0.269930	0.005996	0.260130
CHN	0.045056	0.482880	0.021984	0.305800	0.025141	2.107400	0.018076	0.740570	0.014350	1.946900
JPN	0.070106	0.751340	0.024474	0.340430	0.013705	0.304510	0.023515	1.170800	0.001555	0.067470
KOR	0.086348	1.403300	0.062525	1.704400	0.044580	1.051200	0.018983	2.201800	0.009367	0.406390

Country	S3-772		S3-784		S3-871		S3-343		S3-511	
	ELEC.SWITCH.RELAY.CIRC UT		PARTS,TRACTORS,MOT OR VEH		OPTICAL INSTRUMENTS,NES		NATURAL GAS		HYDROCARBONS,NES,DERIV TS	
	SI	RCA	SI	RCA	SI	RCA	SI	RCA	SI	RCA
BRN	0.001602	0.071769	0.000017	0.000827	0.000001	0.000051	0.019623	27.884100	0.000000	0.000007
KHM	0.000901	0.040360	0.000702	0.033478	0.000018	0.000888	0.000000	0.000000	0.000000	0.000000
IDN	0.008656	0.387830	0.009595	0.457910	0.000009	0.000455	0.014189	6.988000	0.006260	0.347320
MYS	0.019118	0.856540	0.003811	0.181850	0.001897	0.094787	0.014345	5.594300	0.009097	0.504740
PHL	0.021134	0.946870	0.020800	1.389300	0.000928	0.046361	0.000000	0.000000	0.002379	0.132010
SGP	0.017409	0.779970	0.006090	0.290610	0.001265	0.063204	0.000001	0.000053	0.011715	0.650000
THA	0.018192	0.815070	0.020418	1.366300	0.002140	0.106920	0.000000	0.000005	0.017570	1.359500
VNM	0.011129	0.498590	0.011954	0.570470	0.000013	0.000651	0.000049	0.002118	0.000132	0.007296
CHN	0.016856	0.755220	0.012212	0.582800	0.018900	0.944170	0.000000	0.000000	0.001878	0.104180
JPN	0.019724	1.543100	0.014377	2.465800	0.017539	0.876210	0.000000	0.000006	0.014059	2.027100
KOR	0.020097	1.538400	0.020151	1.207500	0.010593	3.545200	0.000000	0.000000	0.013221	2.440300

(*): Products are selected based on the highest SI indices. Source: Authors' creation

Table 6: Correlation between SI and RCA by selected products

SITC	Correlation results				
S3-776	SIij	RCAij	RCAaij	MSij	MSaj
	SIij	1.0000			
	RCAij	0.7805*	1.0000		
	RCAaij	-0.5136*	-0.6829*	1.0000	
	MSij	0.8198*	0.9575*	-0.6257*	1.0000
	MSaj	0.2609*	0.0220	0.0075	0.2361* 1.0000
S3-334	SIij	RCAij	RCAaij	MSij	MSaj
	SIij	1.0000			
	RCAij	0.4533*	1.0000		
	RCAaij	-0.3405*	-0.8118*	1.0000	
	MSij	0.5882*	0.9066*	-0.7375*	1.0000
	MSaj	0.3208*	-0.0688	-0.0008	0.2405* 1.0000
S3-764	SIij	RCAij	RCAaij	MSij	MSaj
	SIij	1.0000			
	RCAij	0.8238*	1.0000		
	RCAaij	-0.3131*	-0.7091*	1.0000	
	MSij	0.8436*	0.9727*	-0.7014*	1.0000
	MSaj	0.0934	-0.0926	0.0038	0.0987 1.0000
S3-778	SIij	RCAij	RCAaij	MSij	MSaj
	SIij	1.0000			
	RCAij	0.7528*	1.0000		
	RCAaij	-0.1982*	-0.5998*	1.0000	
	MSij	0.7665*	0.9799*	-0.5116*	1.0000
	MSaj	0.3159*	0.1068	0.0576	0.2462* 1.0000
S3-752	SIij	RCAij	RCAaij	MSij	MSaj
	SIij	1.0000			
	RCAij	0.6588*	1.0000		
	RCAaij	-0.3558*	-0.6576*	1.0000	
	MSij	0.7541*	0.9448*	-0.5657*	1.0000
	MSaj	0.4373*	0.0607	0.0231	0.2784* 1.0000

Source: Author's creation

Appendix 1: Top 3 similar export product group of ASEAN+3 by community detection, classified by SITC3-3 digit code

Year	Community	SITC-Rev3		
1995	JPN-SGP	776	764	772
	JPN-SGP-KOR	776	334	764
	JPN-SGP-KOR-MYS	776	764	334
	JPN-SGP-KOR-MYS - THA	776	764	759
	JPN-SGP-KOR-MYS - THA-CHN	764	673	752
	JPN-SGP-KOR-MYS - THA-CHN -PHL	776	334	764
	JPN-SGP-KOR-MYS - THA-CHN -PHL-IDN	334	333	764
2000	MYS-SGP	776	759	764
	MYS-SGP - KOR	776	334	759
	MYS-SGP - KOR-JPN	776	759	764
	MYS-SGP - KOR-JPN-THA	776	759	334
	MYS-SGP - KOR-JPN-THA-PHL	776	759	752
	MYS-SGP - KOR-JPN-THA-PHL-CHN	764	776	759
	MYS-SGP - KOR-JPN-THA-PHL-CHN-IDN	334	764	759
	MYS-SGP - KOR-JPN-THA-PHL-CHN-IDN-VNM	759	334	772
MYS-SGP - KOR-JPN-THA-PHL-CHN-IDN-VNM-KHM	845	653	036	
2005	MYS-SGP	776	759	334
	MYS-SGP-KOR	776	334	764
	MYS-SGP-KOR-THA	776	334	759
	MYS-SGP-KOR-THA-JPN	776	764	759
	MYS-SGP-KOR-THA-JPN-CHN	764	776	759
	MYS-SGP-KOR-THA-JPN-CHN-PHL	776	759	752
	IDN-VNM	333	321	759
	MYS-SGP-KOR-THA-JPN-CHN-PHL-IDN-VNM	334	759	772
MYS-SGP-KOR-THA-JPN-CHN-PHL-IDN-VNM-KHM	845	781	231	
2010	JPN-KOR	776	778	673
	MYS-SGP	776	334	759
	CHN-THA	752	776	334
	JPN-KOR-MYS-SGP	776	334	764
	JPN-KOR-MYS-SGP-CHN-THA	776	334	764
	IDN-VNM	333	321	231
	JPN-KOR-MYS-SGP-CHN-THA-IDN-VNM	334	764	778
	JPN-KOR-MYS-SGP-CHN-THA-IDN-VNM-PHL	776	752	759
	KHM-MMR	231	247	841
	JPN-KOR-MYS-SGP-CHN-THA-IDN-VNM-PHL-KHM-MMR	343	723	682
2013	JPN-KOR	776	511	772
	MYS-SGP	776	334	759
	CHN-VNM	764	776	845
	JPN-KOR-MYS-SGP	776	334	764

	JPN-KOR-MYS-SGP-THA	334	776	784
	JPN-KOR-MYS-SGP-THA-CHN-VNM	776	764	334
	JPN-KOR-MYS-SGP-THA-CHN-VNM-PHL	776	778	752
	JPN-KOR-MYS-SGP-THA-CHN-VNM-PHL-IDN	334	343	778
	JPN-KOR-MYS-SGP-THA-CHN-VNM-PHL-IDN-KHM	764	773	781
	JPN-KOR-MYS-SGP-THA-CHN-VNM-PHL-IDN-KHM-BRN	343	333	512
	MYS-SGP	776	334	759
	MYS-SGP-KOR	776	334	764
	CHN-VNM	764	776	845
	MYS-SGP-KOR-JPN	776	778	511
2014	MYS-SGP-KOR-JPN-THA	334	776	784
	MYS-SGP-KOR-JPN-THA-CHN-VNM	776	764	334
	MYS-SGP-KOR-JPN-THA-CHN-VNM-PHL	776	778	772
	MYS-SGP-KOR-JPN-THA-CHN-VNM-PHL-IDN	334	778	784
	MYS-SGP-KOR-JPN-THA-CHN-VNM-PHL-IDN-BRN	343	333	512

Note: BRN = Brunei Darussalam, KHM = Cambodia, IDN = Indonesia, MYS = Malaysia, MMR = Myanmar, PHL = Philippines, SGP = Singapore, THA = Thailand, VNM = Vietnam, CHN = People Republic of China (China), JPN = Japan, KOR = Republic of Korea (South Korea)

SITC Rev 3- 3 digit code

036: Crustaceans, molluscs and etc

231: Natural rubber, etc

247: Wood in the rough or roughly squared

321: Coal, whether or not pulverized, but not agglomerated

334: Petroleum products

511: Hydrocarbons, n.e.s., derivatives

512: Alcohols, phenols, phenol-alcohols, derivatives

653: Fabrics, woven, of man-made textile materials

682: Copper

673: Flat-rolled products of iron or non-alloy steel, not clad, plated or coated

764: Telecommunications equipment, n.e.s., and parts

752: Automatic data-processing machines and units thereof

759: Parts and accessories for office machines

772: Electrical apparatus for switching or protecting electrical circuits

773: Equipment for distributing electricity, n.e.s.

776: Transistors, valves and tubes

778: Electrical machinery and apparatus, n.e.s.

781: Motor cars and other motor vehicles principally designed for the transport of persons

841: Men's or boys' clothing, x-knit

845: Articles of apparel, of textile fabrics, whether or not knitted or crocheted, n.e.s.

Appendix 2: Distribution of RCA by country

Country	Year	Number of products	Mean	Max	Min	RCA>1 (%)	RCA<1 (%)	Country Market share >0.5% (%)	Country Market share <0.5% (%)
Brunei Darussalam	1992	20	1.29095	15.2922	9.90E-05	10%	90%	15.0%	85.0%
	1997	184	0.317034	25.29052	6.79E-05	3%	97%	2.7%	97.3%
	2002	186	0.440169	25.82325	7.73E-05	7%	93%	2.7%	97.3%
	2006	199	0.301086	25.38419	7.16E-08	2%	98%	1.0%	99.0%
	2014	208	0.378752	28.68196	7.54E-08	4%	96%	1.4%	98.6%
Cambodia	2000	121	5.064614	147.0406	1.66E-05	23%	77%	17.4%	82.6%
	2005	151	13.50922	1478.943	2.31E-06	23%	77%	15.2%	84.8%
	2010	161	3.814651	279.4655	1.01E-05	20%	80%	7.5%	92.5%
	2013	164	2.032999	136.4544	8.94E-06	24%	76%	11.6%	88.4%
Indonesia	1990	242	0.860632	8.430485	4.46E-05	21%	79%	9.1%	90.9%
	1995	240	1.104218	15.27985	1.06E-04	23%	77%	14.2%	85.8%
	2000	253	1.068259	13.24004	5.45E-05	24%	76%	14.2%	85.8%
	2005	259	1.154331	16.36957	1.63E-05	28%	72%	12.7%	87.3%
	2010	253	1.205808	14.78012	2.53E-06	24%	76%	12.3%	87.7%
	2014	252	1.325226	18.25631	6.10E-07	28%	72%	15.1%	84.9%
Malaysia	1990	253	0.942742	8.640306	4.53E-04	26%	74%	10.3%	89.7%
	1995	253	1.024513	9.967879	4.64E-03	28%	72%	13.0%	87.0%
	2000	255	0.903231	8.943391	6.85E-04	25%	75%	11.8%	88.2%
	2005	256	1.056673	12.35477	2.82E-04	27%	73%	14.8%	85.2%
	2010	259	1.107912	10.07174	1.43E-03	30%	70%	13.5%	86.5%
	2014	258	1.078139	9.997222	1.82E-03	31%	69%	14.0%	86.0%
Philippines	1991	220	2.544004	56.09978	2.62E-05	27%	73%	13.2%	86.8%
	1995	225	1.340042	58.49326	2.78E-05	19%	81%	12.0%	88.0%
	2000	238	0.82504	29.34678	1.58E-07	14%	86%	7.6%	92.4%
	2005	243	0.827158	29.8305	3.98E-05	19%	81%	7.4%	92.6%
	2010	238	0.920569	22.19122	1.41E-04	19%	81%	9.2%	90.8%
	2014	244	1.219387	31.41537	3.47E-06	27%	73%	12.3%	87.7%
Singapore	1990	258	1.220809	7.27295	2.86E-05	40%	60%	16.7%	83.3%
	1995	259	0.955647	6.082952	4.98E-05	35%	65%	14.3%	85.7%
	2000	256	0.805519	6.998184	2.73E-05	26%	74%	9.0%	91.0%
	2005	257	0.788931	7.091226	4.55E-06	26%	74%	11.7%	88.3%
	2010	254	0.755496	6.783506	4.05E-05	20%	80%	13.4%	86.6%
	2014	256	0.795303	6.863692	2.18E-05	20%	80%	12.5%	87.5%
Thailand	1990	244	1.794996	17.97157	1.68E-05	31%	69%	16.4%	83.6%
	1995	248	1.264934	14.84804	2.93E-04	33%	67%	17.3%	82.7%
	2000	252	1.286878	12.41441	6.45E-08	39%	61%	16.7%	83.3%
	2005	254	1.266516	12.15127	2.72E-07	40%	60%	19.7%	80.3%
	2010	256	1.356381	14.98874	3.01E-06	38%	63%	19.1%	80.9%

Vietnam	2014	258	1.446186	13.67994	1.68E-05	40%	60%	20.2%	79.8%
	2000	175	1.644832	19.59136	4.33E-04	30%	70%	17.1%	82.9%
	2005	241	1.525612	29.06593	1.20E-05	29%	71%	13.7%	86.3%
	2010	245	1.930999	39.65492	2.44E-04	35%	65%	16.7%	83.3%
China	2014	251	1.7188	23.94431	2.83E-06	36%	64%	17.9%	82.1%
	1992	252	1.73064	10.20172	3.51E-06	40%	60%	19.0%	81.0%
	1995	255	1.68276	7.28773	8.05E-04	45%	55%	22.4%	77.6%
	2000	255	1.540919	6.225329	4.03E-04	45%	55%	21.6%	78.4%
	2005	257	1.384863	4.574434	1.82E-06	50%	50%	21.8%	78.2%
	2010	255	1.294906	4.111647	1.35E-06	50%	50%	23.1%	76.9%
Japan	2014	254	1.144203	3.273283	3.94E-05	52%	48%	22.8%	77.2%
	1990	249	0.920163	2.257775	6.17E-06	50%	50%	23.3%	76.7%
	1995	251	0.806154	2.380381	1.11E-05	37%	63%	22.3%	77.7%
	2000	254	0.890928	3.012627	2.26E-06	39%	61%	20.9%	79.1%
	2005	254	0.85989	3.217	9.21E-07	37%	63%	21.7%	78.3%
	2010	253	0.841836	3.173936	1.91E-05	35%	65%	19.0%	81.0%
South Korea	2014	251	0.918804	4.718561	2.98E-06	38%	62%	21.1%	78.9%
	1990	242	1.200837	6.358596	3.89E-06	39%	61%	21.5%	78.5%
	1995	245	0.966269	6.033342	3.36E-05	32%	68%	23.3%	76.7%
	2000	254	0.89527	5.807046	4.56E-06	33%	67%	16.9%	83.1%
	2005	252	0.745693	4.189848	1.56E-05	25%	75%	15.9%	84.1%
	2010	254	0.676881	4.916795	7.40E-07	20%	80%	15.7%	84.3%
	2014	254	0.630911	4.897103	1.93E-06	19%	81%	15.7%	84.3%

Source: Authors' creation

Appendix 3: Standard International Trade Classification SITC (rev.3)

<p>0 Food and live animals</p> <p>[001] Live animals other than animals of division 03 [011] Meat of bovine animals, fresh, chilled or frozen [012] Other meat and edible meat offal [016] Meat, edible meat offal, salted, dried; flours, meals [017] Meat, edible meat offal, prepared, preserved, n.e.s. [022] Milk, cream and milk products (excluding butter, cheese) [023] Butter and other fats and oils derived from milk [024] Cheese and curd [025] Birds' eggs, and eggs' yolks; egg albumin [034] Fish, fresh (live or dead), chilled or frozen [035] Fish, dried, salted or in brine; smoked fish [036] Crustaceans, mollusks and aquatic invertebrates [037] Fish, aqua. invertebrates, prepared, preserved, n.e.s. [041] Wheat (including spelt) and meslin, unmilled [042] Rice [043] Barley, unmilled [044] Maize (not including sweet corn), unmilled [045] Cereals, unmilled (excluding wheat, rice, barley, maize) [046] Meal and flour of wheat and flour of meslin [047] Other cereal meals and flour [048] Cereal preparations, flour of fruits or vegetables [054] Vegetables [056] Vegetables, roots, tubers, prepared, preserved, n.e.s. [057] Fruits and nuts (excluding oil nuts), fresh or dried [058] Fruit, preserved, and fruit preparations (no juice) [059] Fruit and vegetable juices, unfermented, no spirit [061] Sugar, molasses and honey [062] Sugar confectionery [071] Coffee and coffee substitutes [072] Cocoa [073] Chocolate, food preparations with cocoa, n.e.s. [074] Tea and mate [075] Spices [081] Feeding stuff for animals (no unmilled cereals) [091] Margarine and shortening [098] Edible products and preparations, n.e.s.</p>	<p>3 Mineral fuels, lubricants and related materials</p> <p>[321] Coal, whether or not pulverized, not agglomerated [322] Briquettes, lignites and peat [325] Coke & semi-cokes of coal, lign., peat; retort carbon [333] Petroleum oils, oils from bitumin. materials, crude [334] Petroleum oils or bituminous minerals > 70 % oil [335] Residual petroleum products, n.e.s., related mater. [342] Liquefied propane and butane [343] Natural gas, whether or not liquefied [344] Petroleum gases, other gaseous hydrocarbons, n.e.s. [351] Electric current</p>	<p>[642] Paper & paperboard, cut to shape or size, articles [651] Textile yarn [652] Cotton fabrics, woven [653] Fabrics, woven, of man-made fabrics [654] Other textile fabrics, woven [655] Knitted or crocheted fabrics, n.e.s. [656] Tulles, trimmings, lace, ribbons & other small wares [657] Special yarn, special textile fabrics & related [658] Made-up articles, of textile materials, n.e.s. [659] Floor coverings, etc. [661] Lime, cement, fabrica. constr. mat. (excluding glass, clay) [662] Clay construction, refracto. construction materials [663] Mineral manufactures, n.e.s. [664] Glass [665] Glassware [666] Pottery [667] Pearls, precious & semi-precious stones [671] Pig iron & spiegeleisen, sponge iron, powder & granu [672] Ingots, primary forms, of iron or steel; semi-finis. [673] Flat-rolled prod., iron, non-alloy steel, not coated [674] Flat-rolled prod., iron, non-alloy steel, coated, clad [675] Flat-rolled products of alloy steel [676] Iron & steel bars, rods, angles, shapes & sections [677] Rails & railway track construction mat., iron, steel [678] Wire of iron or steel [679] Tubes, pipes & hollow profiles, fittings, iron, steel [681] Silver, platinum, other metals of the platinum group [682] Copper [683] Nickel [684] Aluminium [685] Lead [686] Zinc [687] Tin [689] Miscellaneous no-ferrous base metals for metallur. [691] Structures & parts, n.e.s., of iron, steel, aluminium [692] Metal containers for storage or transport [693] Wire products (excluding electrical) and fencing grills [694] Nails, screws, nuts, bolts, rivets & the like, of metal [695] Tools for use in the hand or in machine [696] Cutlery [697] Household equipment of base metal, n.e.s. [699] Manufactures of base metal, n.e.s.</p>	<p>[743] Pumps (excluding liquid), gas compressors & fans; centr. [744] Mechanical handling equipment, & parts, n.e.s. [745] Other non-electr. machinery, tools & mechan. appar. [746] Ball or roller bearings [747] Appliances for pipes, boiler shells, tanks, vats, etc. [748] Transmis. shafts [749] Non-electric parts & accessor. of machinery, n.e.s. [751] Office machines [752] Automatic data processing machines, n.e.s. [759] Parts, accessories for machines of groups 751, 752 [761] Television receivers, whether or not combined [762] Radio-broadcast receivers, whether or not combined [763] Sound recorders or reproducers [764] Telecommunication equipment, n.e.s.; & parts, n.e.s. [771] Electric power machinery, and parts thereof [772] Apparatus for electrical circuits; board, panels [773] Equipment for distributing electricity, n.e.s. [774] Electro-diagnostic appa. for medical sciences, etc. [775] Household type equipment, electrical or not, n.e.s. [776] Cathode valves & tubes [778] Electrical machinery & apparatus, n.e.s. [781] Motor vehicles for the transport of persons [782] Motor vehic. for transport of goods, special purpo. [783] Road motor vehicles, n.e.s. [784] Parts & accessories of vehicles of 722, 781, 782, 783 [785] Motorcycles & cycles [786] Trailers & semi-trailers [791] Railway vehicles & associated equipment [792] Aircraft & associated equipment; spacecraft, etc. [793] Ships, boats & floating structures</p>
<p>1 Beverages and tobacco</p> <p>[111] Non-alcoholic beverages, n.e.s. [112] Alcoholic beverages [121] Tobacco, unmanufactured; tobacco refuse [122] Tobacco, manufactured</p>	<p>[511] Hydrocarbons, n.e.s., & halogenated, nitr. derivative [512] Alcohols, phenols, halogenat., sulfonat., nitrat. der. [513] Carboxylic acids, anhydrides, halides, per.; derivati. [514] Nitrogen-function compounds [515] Organo-inorganic, heterocycl. compounds, nucl. acids [516] Other organic chemicals [522] Inorganic chemical elements, oxides & halogen salts [523] Metallic salts & peroxysalts, of inorganic acids [524] Other inorganic chemicals [525] Radio-actives and associated materials [531] Synth. organic colouring matter & colouring lakes [532] Dyeing & tanning extracts, synth. tanning materials [533] Pigments, paints, varnishes and related materials [541] Medicinal and pharmaceutical products, excluding 542 [542] Medicaments (incl. veterinary medicaments) [551] Essential oils, perfume & flavour materials [553] Perfumery, cosmetics or toilet prepar. (excluding soaps) [554] Soaps, cleansing and polishing preparations [562] Fertilizers (other than those of group 272) [571] Polymers of ethylene, in primary forms [572] Polymers of styrene, in primary forms [573] Polymers of vinyl chloride or halogenated olefins [574] Polyethers, epoxide resins; polycarbonat., polyesters [575] Other plastics, in primary forms [579] Waste, parings and scrap, of plastics [581] Tubes, pipes and hoses of plastics</p>	<p>[723] Pumps (excluding liquid), gas compressors & fans; centr. [724] Mechanical handling equipment, & parts, n.e.s. [725] Other non-electr. machinery, tools & mechan. appar. [726] Ball or roller bearings [727] Appliances for pipes, boiler shells, tanks, vats, etc. [728] Transmis. shafts [729] Non-electric parts & accessor. of machinery, n.e.s. [731] Office machines [732] Automatic data processing machines, n.e.s. [739] Parts, accessories for machines of groups 731, 732 [741] Television receivers, whether or not combined [742] Radio-broadcast receivers, whether or not combined [743] Sound recorders or reproducers [744] Telecommunication equipment, n.e.s.; & parts, n.e.s. [751] Electric power machinery, and parts thereof [752] Apparatus for electrical circuits; board, panels [753] Equipment for distributing electricity, n.e.s. [754] Electro-diagnostic appa. for medical sciences, etc. [755] Household type equipment, electrical or not, n.e.s. [756] Cathode valves & tubes [758] Electrical machinery & apparatus, n.e.s. [761] Motor vehicles for the transport of persons [762] Motor vehic. for transport of goods, special purpo. [763] Road motor vehicles, n.e.s. [764] Parts & accessories of vehicles of 722, 761, 762, 763 [765] Motorcycles & cycles [766] Trailers & semi-trailers [771] Railway vehicles & associated equipment [772] Aircraft & associated equipment; spacecraft, etc. [773] Ships, boats & floating structures</p>	<p>8 Miscellaneous manufactured articles</p> <p>[811] Prefabricated buildings [812] Sanitary, plumbing, heating fixtures, fittings, n.e.s. [813] Lighting fixtures & fittings, n.e.s. [821] Furniture & parts [831] Travel goods, handbags & similar containers [841] Men's clothing of textile fabrics, not knitted [842] Women's clothing, of textile fabrics [843] Men's or boy's clothing, of textile, knitted, croche. [844] Women's clothing, of textile, knitted or crocheted [845] Articles of apparel, of textile fabrics, n.e.s. [846] Clothing accessories, of textile fabrics [848] Articles of apparel, clothing access., excluding textile [851] Footwear [871] Optical instruments & apparatus, n.e.s. [872] Instruments & appliances, n.e.s.,</p>
<p>2 Crude materials, inedible, except fuels</p> <p>[211] Hides and skins (except furskins), raw [212] Furskins, raw, other than hides & skins of group 211 [222] Oil seeds and oleaginous fruits (excluding flour) [223] Oil seeds & oleaginous fruits (incl. flour, n.e.s.) [231] Natural rubber & similar gums, in primary forms [232] Synthetic rubber [245] Fuel wood (excluding wood waste) and wood charcoal [246] Wood in chips or particles and wood waste</p>	<p>[511] Hydrocarbons, n.e.s., & halogenated, nitr. derivative [512] Alcohols, phenols, halogenat., sulfonat., nitrat. der. [513] Carboxylic acids, anhydrides, halides, per.; derivati. [514] Nitrogen-function compounds [515] Organo-inorganic, heterocycl. compounds, nucl. acids [516] Other organic chemicals [522] Inorganic chemical elements, oxides & halogen salts [523] Metallic salts & peroxysalts, of inorganic acids [524] Other inorganic chemicals [525] Radio-actives and associated materials [531] Synth. organic colouring matter & colouring lakes [532] Dyeing & tanning extracts, synth. tanning materials [533] Pigments, paints, varnishes and related materials [541] Medicinal and pharmaceutical products, excluding 542 [542] Medicaments (incl. veterinary medicaments) [551] Essential oils, perfume & flavour materials [553] Perfumery, cosmetics or toilet prepar. (excluding soaps) [554] Soaps, cleansing and polishing preparations [562] Fertilizers (other than those of group 272) [571] Polymers of ethylene, in primary forms [572] Polymers of styrene, in primary forms [573] Polymers of vinyl chloride or halogenated olefins [574] Polyethers, epoxide resins; polycarbonat., polyesters [575] Other plastics, in primary forms [579] Waste, parings and scrap, of plastics [581] Tubes, pipes and hoses of plastics</p>	<p>[642] Paper & paperboard, cut to shape or size, articles [651] Textile yarn [652] Cotton fabrics, woven [653] Fabrics, woven, of man-made fabrics [654] Other textile fabrics, woven [655] Knitted or crocheted fabrics, n.e.s. [656] Tulles, trimmings, lace, ribbons & other small wares [657] Special yarn, special textile fabrics & related [658] Made-up articles, of textile materials, n.e.s. [659] Floor coverings, etc. [661] Lime, cement, fabrica. constr. mat. (excluding glass, clay) [662] Clay construction, refracto. construction materials [663] Mineral manufactures, n.e.s. [664] Glass [665] Glassware [666] Pottery [667] Pearls, precious & semi-precious stones [671] Pig iron & spiegeleisen, sponge iron, powder & granu [672] Ingots, primary forms, of iron or steel; semi-finis. [673] Flat-rolled prod., iron, non-alloy steel, not coated [674] Flat-rolled prod., iron, non-alloy steel, coated, clad [675] Flat-rolled products of alloy steel [676] Iron & steel bars, rods, angles, shapes & sections [677] Rails & railway track construction mat., iron, steel [678] Wire of iron or steel [679] Tubes, pipes & hollow profiles, fittings, iron, steel [681] Silver, platinum, other metals of the platinum group [682] Copper [683] Nickel [684] Aluminium [685] Lead [686] Zinc [687] Tin [689] Miscellaneous no-ferrous base metals for metallur. [691] Structures & parts, n.e.s., of iron, steel, aluminium [692] Metal containers for storage or transport [693] Wire products (excluding electrical) and fencing grills [694] Nails, screws, nuts, bolts, rivets & the like, of metal [695] Tools for use in the hand or in machine [696] Cutlery [697] Household equipment of base metal, n.e.s. [699] Manufactures of base metal, n.e.s.</p>	<p>[811] Prefabricated buildings [812] Sanitary, plumbing, heating fixtures, fittings, n.e.s. [813] Lighting fixtures & fittings, n.e.s. [821] Furniture & parts [831] Travel goods, handbags & similar containers [841] Men's clothing of textile fabrics, not knitted [842] Women's clothing, of textile fabrics [843] Men's or boy's clothing, of textile, knitted, croche. [844] Women's clothing, of textile, knitted or crocheted [845] Articles of apparel, of textile fabrics, n.e.s. [846] Clothing accessories, of textile fabrics [848] Articles of apparel, clothing access., excluding textile [851] Footwear [871] Optical instruments & apparatus, n.e.s. [872] Instruments & appliances, n.e.s.,</p>

<p>[247] Wood in the rough or roughly squared [248] Wood simply worked, and railway sleepers of wood [251] Pulp and waste paper [261] Silk [263] Cotton [265] Vegetable textile fibres, not spun; waste of them [266] Synthetic fibres suitable for spinning [267] Other man-made fibres suitable for spinning [268] Wool and other animal hair (incl. wool tops) [269] Worn clothing and other worn textile articles [272] Crude fertilizers (excluding those of division 56) [273] Stone, sand and gravel [274] Sulphur and unroasted iron pyrites [277] Natural abrasives, n.e.s. (incl. industri. diamonds) [278] Other crude minerals [281] Iron ore and concentrates [282] Ferrous waste, scrape; remelting ingots, iron, steel [283] Copper ores and concentrates; copper mattes, cemen [284] Nickel ores & concentrates; nickel mattes, etc. [285] Aluminium ores and concentrates (incl. alumina) [286] Ores and concentrates of uranium or thorium [287] Ores and concentrates of base metals, n.e.s. [288] Non-ferrous base metal waste and scrap, n.e.s. [289] Ores & concentrates of precious metals; waste, scrap [291] Crude animal materials, n.e.s. [292] Crude vegetable materials, n.e.s</p>	<p>[582] Plates, sheets, films, foil & strip, of plastics [583] Monofilaments, of plastics, cross-section > 1mm [591] Insecticides & similar products, for retail sale [592] Starche, wheat gluten; albuminoidal substances; glues [593] Explosives and pyrotechnic products [597] Prepared addit. for miner. oils; lubricat., de-icing [598] Miscellaneous chemical products, n.e.s.</p>	<p>7 Machinery and transport equipment</p> <p>[711] Vapour generating boilers, auxiliary plant; parts [712] Steam turbines & other vapour turbin., parts, n.e.s. [713] Internal combustion piston engines, parts, n.e.s. [714] Engines & motors, non-electric; parts, n.e.s. [716] Rotating electric plant & parts thereof, n.e.s. [718] Other power generating machinery & parts, n.e.s. [721] Agricultural machinery (excluding tractors) & parts [722] Tractors (excluding those of 71414 & 74415) [723] Civil engineering & contractors' plant & equipment [724] Textile & leather machinery, & parts thereof, n.e.s. [725] Paper mill, pulp mill machinery; paper articles man. [726] Printing & bookbinding machinery, & parts thereof [727] Food-processing machines (excluding domestic) [728] Other machinery for particular industries, n.e.s. [731] Machine-tools working by removing material [733] Mach.-tools for working metal, excluding removing mate. [735] Parts, n.e.s., & accessories for machines of 731, 733 [737] Metalworking machinery (excluding machine-tools) & parts [741] Heating & cooling equipment & parts thereof, n.e.s. [742] Pumps for liquids</p>	<p>for medical, etc. [873] Meters & counters, n.e.s. [874] Measuring, analysing & controlling apparatus, n.e.s. [881] Photographic apparatus & equipment, n.e.s. [882] Cinematographic & photographic supplies [883] Cinematograph films, exposed & developed [884] Optical goods, n.e.s. [885] Watches & clocks [891] Arms & ammunition [892] Printed matter [893] Articles, n.e.s., of plastics [894] Baby carriages, toys, games & sporting goods [895] Office & stationery supplies, n.e.s. [896] Works of art, collectors' pieces & antiques [897] Jewellery & articles of precious materia., n.e.s. [898] Musical instruments, parts; records, tapes & similar [899] Miscellaneous manufactured articles, n.e.s.</p>
	<p>6 Manufactured goods classified chiefly by material</p> <p>[611] Leather [612] Manufactures of leather, n.e.s.; saddlery & harness [613] Furskins, tanned or dressed, excluding those of 8483 [621] Materials of rubber (pastes, plates, sheets, etc.) [625] Rubber tyres, tyre treads or flaps & inner tubes [629] Articles of rubber, n.e.s. [633] Cork manufactures [634] Veneers, plywood and other wood, worked, n.e.s [635] Wood manufacture, n.e.s [641] Paper and paperboard</p>		<p>9 Commodities and transactions n.e.s. in the SITC</p> <p>[971] Gold, non-monetary (excluding gold ores and concentrates)</p>

Source: Kocourek (2015), "Structural changes in comparative advantages of BRICS", *Procedia- Social and Behavioral Sciences*, 172, pp:10-17