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Intra-industry trade: A portrait of global patterns during 2000-2022

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ABSTRACT

Objective: The article aims to identify patterns of world intra-industry trade (IIT) during the turbulent period 2000-2022. This period includes global slowdown after attack on World Trade Centre (2001-2002), global prosperity and intensive internationalisation known as 'hyper-globalisation' (2002-2008), global financial (2008) and economic (2009) crisis, post-crisis economic rebound (2010), stagnation or moderate growth period (2010-2019), pandemic (2020-2021), and escalation of war in Ukraine (2022). The article includes studies on intra-industry trade of selected countries and groups of countries, as well as an analysis of the world and the European Union average of two-way trade.

Research Design & Methods: We analysed IIT disaggregated into six-digit Harmonized System codes using the United Nations Comtrade database. We employed Grubel-Lloyd indices.

Findings: Our results confirmed that world trade is still mainly inter-industry and that the developed countries conduct much more intensive IIT than the rest of the world. The slight decline between years 2000 and 2022 in global intra-industry's share has been accompanied by the increasing role of developing countries in international trade flows. We proved that some developing countries are, with time, more intensive IIT participants. It holds especially for members of RTAs with developed countries and participants in international production.

Implications & Recommendations: We examined IIT of about 150 countries over more than the last two decades and found that, as expected, in many developing countries the share of IIT was still low. Despite the much bigger engagement of developing countries in global value chains and global production networks, their trade remains mainly inter-industry. Thus, there is a space for industrial policies in developing countries. We recommend more intensive capital inflows into these countries and intensification of their manufacturing production, e.g., in the framework of global value chains. Moreover, to address low levels of IIT in some developing countries, international policy should focus on reducing trade barriers, promoting product differentiation, and encouraging economies of scale. Specifically, trade liberalisation, investments in research and development, and policies that foster competition can help boost IIT.

Contribution & Value Added: IIT is still a hotly debated issue. We calculated Grubel-Lloyd indices for country-pairs from the whole world (bilateral trade), for selected countries with all partners and also the world average for more than twenty years. To our best knowledge, there has been no such analysis of world IIT during the period 2000-2022 thus far. Moreover, our study brings valuable conclusions, recommendations and research future directions which are crucial for the growing role of International Economics (and International Business) in social sciences.

Article type:	research article
Keywords:	intra-industry trade; world trade; Grubel-Lloyd index; G7 countries; BRICS countries; EU trade
JEL codes:	F10, F14

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INTRODUCTION

International trade is more and more intensive despite the progressing mobility of production factors, pandemics as well as conflicts destroying traditional ties and transportation roads. However, trade's characteristics, especially its material structure and geographic pattern, have changed. Nowadays, trade includes not only the exchange of goods differing by their material characteristics and purpose (compliments) but also similar goods (substitutes). Simultaneous exports and imports of goods stemming from the same industry in bilateral trade is called intra-industry trade (IIT).

Countries conducting IIT are usually developed and have similar economic structures with expanded manufacturing industries producing a big array of goods that are imperfect substitutes. Citizens of these countries have a similar level of wealth. However, with the continuing process of catching up, more and more new industrialised countries begin to participate in this type of trade.

The main research objective was to identify patterns of world IIT during the turbulent period 2000-2022. This period includes global slowdown after attack on World Trade Centre (2001-2002), global prosperity and intensive internationalisation known as 'hyper-globalisation' (2002-2008), global financial (2008) and economic (2009) crisis, post-crisis economic rebound (2010), stagnation or moderate growth period (2010-2019), pandemic (2020-2021), and escalation of war in Ukraine (2022). The article includes studies on intra-industry trade of selected countries and groups of countries, as well as an analysis of the world and the EU average of two-way trade. In general, the large geographical coverage limits the detail of our research, and this is why we did not analyse IIT in individual industries. We realise that our study does not answer the questions concerning factors shaping IIT or detailed tendencies in IIT. However, it gives a worldwide view of IIT. We intentionally accepted this trade-off.

We considered IIT of the main participants of world trade, especially the biggest and intensively trading developed countries from the group G7 (the United States, Canada, France, Germany, Italy, the United Kingdom, Japan), as well as the EU members from outside of the G7 differing in respect of economic advancement, potential and level of citizens' welfare. We looked at IIT of important developing challengers gathered in BRICS (Brazil, China, India, Russia, South Africa). To give a picture of global IIT, we supplemented our analysis with information about the IIT of countries representing all inhabited continents and having different characteristics.

Our research covers a relatively long period of 23 years (2000-2022). In our opinion, it is enough to show the tendency of IIT development. We expect the most developed countries to be especially intensive IIT participants, whereas the developing countries are generally expected to have IIT below the world average. However, we believe that some developing countries show a tendency to increase their IIT shares over time.

The novelty of this article is to analyse the intensity of IIT for selected country-pairs (bilateral trade) from the whole world and also the world as well as the EU average, for more than twenty years. To our best knowledge, there has been no such extended analysis of the world IIT conducted for so long and eventful period so far. To fill this gap, our research focuses on seeking answers to the following research questions:

RQ1: What were the patterns of world intra-industry trade in the turbulent period 2000-2022?

RQ2: What are the differences between the intensity of IIT of developed countries with various characteristics, and how have they changed over time?

RQ3: What were the differences between the intensity of IIT of developed and developing countries?

RQ4: What are the recommendations for the industrial policy of developing countries in the context of their IIT?

Moreover, we selected groups of countries differently from the major authors. We based our selection not only on economic but also political criteria. Specifically, we compared IIT shares of G7 and BRICS countries as well as respective shares of selected countries from all inhabited continents. The only traditional group in our research was the EU. We juxtaposed the IIT shares of all the mentioned countries and groups of countries with the world average IIT shares.

This article proceeds as follows. Section 2 reviews the literature on intra-industry trade. We pay a lot of attention to the most complex analyses and to the newest ones. We also discuss the pioneering works as well as unusual results and settings. We stress the limited research framework of the majority of analyses. Section 3 describes our research methodology. Section 4 presents and discusses the study's results. We compare and discuss the IIT shares of countries and groups of countries with the world or the EU average. We separately analyse the IIT shares of G7 and BRICS countries. We supplement this research with an analysis of the EU members' IIT as well as with an analysis of the IIT of selected countries from all inhabited continents. This section is followed by conclusions.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

There are plenty of studies on intra-industry trade in the literature, both theoretical and empirical. For a review of the extensive literature on intra-industry trade in four distinct areas: theory, measurement, empirical evidence and policy aspects, see Aggarwal (2023). For new theoretical models, see, *e.g.*, Afonso *et al.* (2021).

Most empirical studies examine intra-industry trade for a selected industry (*e.g.*, Hoang, 2019; Leitão & Faustino, 2008; Łapińska *et al.*, 2019; Marius-Răzvan & Camelia, 2015; Szczepaniak, 2013; Tayyar, 2024; Türkcan, 2011), several industries (*e.g.*, Brkić, 2018; Brülhart & Elliott, 1999; Globerman & Dean, 1990; Globerman, 1992; Islam, 2018; Khalid, 2023; Kılavuz *et al.*, 2013; Kumar & Ahmed, 2015; Lyu & Blandford, 2019; Molendowski, 2006; Porto & Costa, 1999; Rossini & Burattoni, 1999; Zapata *et al.*, 2023), or all industries (*e.g.*, ten main sections of SITC classification: Harfi & Montet, 1999; Kol & Kuijpers, 1999; Kumar & Ahmed, 2015; Özçalık *et al.*, 2021; Sarris *et al.*, 1999; Smeets, 1999; Souguir, 2024; Yong & others, 2015) in different periods. Industry indicators are usually calculated for the total trade of a country or of a group of countries (Brülhart & Elliott, 1999; Globerman & Dean, 1990; Harfi & Montet, 1999; Hoang, 2019; Kılavuz *et al.*, 2013; Kol & Kuijpers, 1999; Leitão & Faustino, 2008; Lyu & Blandford, 2019; Łapińska *et al.*, 2019; Özçalık *et al.*, 2021; Porto & Costa, 1999; Rossini & Burattoni, 1999; Sarris *et al.*, 1999; Smeets, 1999; Souguir, 2024; Szczepaniak, 2013; Tayyar, 2024; Türkcan, 2011) or for bilateral trade of selected countries (Brkić, 2018; Globerman, 1992; Islam, 2018; Khalid, 2023; Kılavuz *et al.*, 2013; Kumar & Ahmed, 2015; Łapińska *et al.*, 2019; Marius-Răzvan & Camelia, 2015; Türkcan, 2011; Yong & others, 2015; Zapata *et al.*, 2023).

There are far fewer studies that analyse total intra-industry trade. In this case, scholars most often calculate the Grubel-Lloyd index for bilateral trade between selected countries (*e.g.*, China with 50 countries: Zhang *et al.*, 2005; EU with its main partners: Bernatonytė & Normantienė, 2007; United States with Canada and Mexico: Ekanayake *et al.*, 2009; Germany and France with ten largest trade partners, China and seven Eastern European countries: Ito & Okubo, 2011; Bosnia and Herzegovina with Croatia: Brkić, 2018; Indonesia with RCEP countries: Handoyo & Syahnie, 2020; China with the top ten EU 28 members: Souguir, 2024), or between a country and an integration grouping or a group of countries (*e.g.*, the Netherlands with EC6: Kol & Kuijpers, 1999; Greece with EU12 and non-EU12: Sarris *et al.*, 1999; Germany with EU12, EU6, the rest of Europe and the rest of world: Smeets, 1999; CEFTA countries with the EU: Molendowski, 2006; Portugal with the EU15: Leitão & Faustino, 2008; United States with NAFTA: Ekanayake *et al.*, 2009; an intraregional trade of EU15 countries and 13 East Asian countries: Kang, 2011; new member states of the EU with EU15 and EU10: Molendowski & Polan, 2013; 55 countries with developed and developing economies: WTO, 2013; new member states with EU15 and among new member states: Czarny & Śledziewska, 2016; V4 countries with EU12, EU14 and the 26 biggest non-EU partners: Toporowski, 2017; Croatia with the 24 most important trade partners: Jošić & Žmuk, 2020; 8 CEEC with the EU, CEFTA and other RTAs: Zaninović, 2022; China with the EU28: Souguir, 2024). There are fewer works containing an analysis of total intra-industry trade of selected countries with all their trading partners (*e.g.*, 11 EU trading entities: Brülhart & Elliott, 1999; France: Harfi & Montet, 1999; Portugal: Porto & Costa, 1999; Greece: Sarris *et al.*, 1999; Germany: Smeets, 1999; China: Deese, 2017; Zhang *et al.*, 2005; Lithuania: Bernatonytė & Normantienė, 2007; 214 countries in 2006: Brülhart, 2008; 55 countries: WTO, 2013; 5 countries with the largest and smallest values for IIT index: Soo, 2016). In the last

years, there have appeared more and more articles on the IIT of developing countries. Besides the works mentioned before, let us also note the article by Saparamadu and Weerasinghe (2021) studying Sri Lanka's IIT with 3 South Asian countries (India, Pakistan, Bangladesh), as well as Agarwal and Betai (2021) discussing India's IIT with 15 most significant trade partners. These articles bring valuable development policy recommendations. In turn, there are only a few articles in the literature on intra-industry concerning world trade flows.

Brülhart (2008) conducted a study of global intra-industry trade for the longest time period. He calculated the Grubel-Lloyd index for the period 1962-2006 and based on trade data from the WITS database and the COMTRADE database. Because the range of countries was not uniform from 1962 to 2006, he established a list of 56 countries that have reported trade data in at least 40 of the 45 sample years. For this dataset, he retained only data reported by importing countries. Furthermore, he established a second dataset using data from exporters to fill in as many gaps as possible in the import data for the four sample years: 1962, 1975, 1990 and 2006. Consequently, a dataset for 1962 covered trade flows for 177 countries and for 2006 – for 214 countries. In this way, Brülhart incorporated many low-income countries into the analysis. Brülhart conducted his calculations mainly at the 5-digit level of the SITC classification, and for comparison, some IIT calculations at the SITC 3-digit level. His research illustrates that, regardless of the level of categorical aggregation, global IIT showed a secular upward trend that stabilised in the mid-1990s. Based on the smaller countries sample, he calculated that in 1962, intra-industry trade accounted for only about 10% of world trade at the 5-digit level of the SITC classification and about 25% at the SITC 3-digit level. The results obtained for the second dataset were lower – in the last analysed year, 27% of world trade flows were intra-industry at the 5-digit level (44% at the 3-digit level). The reason for this discrepancy is that the first dataset did not include the lowest-income countries. Brülhart also calculated IIT, *e.g.*, by income group, by product group, by SITC sector, by countries, with world regions, etc. He concluded that the upward trend in IIT suggests a process of world-wide structural convergence: economies are becoming more similar over time in terms of their sectoral compositions.

Brülhart's work (2008) is a background contribution to the World Bank's World Development Report (2009). The report focuses on IIT by world region and by product group, both at the 3-digit level, and by income group (at the 5-digit level). It indicates that in 2006, within-region, intra-industry trade was low in most regions and high in a few (North America, Australia and New Zealand, Western Europe and East Asia). The IIT trade consisted of primary, intermediate, and final goods, with all having increased considerably in the years 1962-2006. Throughout the period analysed, the highest share of intra-industry trade occurred for intermediate products. The second place went to intra-industry trade in final products, and the last one to primary products. The report highlights that global IIT is no longer confined to rich countries. In the 1960s and 1970s, intra-industry trade surged between high-income countries. However, in the beginning of the 1980s, IIT between medium- and high-income countries expanded and later the same process was visible between other categories of countries. This was due to lower transport and communication costs, changes in the composition of goods traded, as well as the love of variety by consumers (users).

Global intra-industry trade in the twenty-first century was analysed by Czarny and Śledziewska (2012) as well as by Emlinger and Piton (2014). The first study deals with intra-industry trade during the 2008-2010 crisis, with the year 2000 as a reference point. The authors conducted the analysis using COMTRADE data at the 6-digit HS code level. Czarny and Śledziewska pointed out that in 2000, IIT accounted for more than a third of world trade (the share was even higher among developed countries, but lower among developing and transformation countries). In 2008, the share of IIT in world trade and in all three groups of countries decreased compared to their values in 2000. The global IIT shares declined by more than 4 percentage points (p.p.) during the period specified. In the following two years, declines in the share of intra-industry trade in world trade did not exceed 1 p.p. compared to the year in which the crisis began. In addition to global intra-industry trade, Czarny and Śledziewska (2012) analysed the IIT shares in the commodity exchange of groups of countries with different levels of development with particular groups of partners, as well as the IIT of the EU, the euro area and

Poland with the world and with different partner groups. The analysis was not limited to total intra-industry trade, but it was conducted for horizontal and vertical trade as well.

The article by Emlinger and Piton (2014) covers a greater number of years than the book of Czarny and Śledziewska (2012). Emlinger and Piton (2014) studied world trade using a new database built on a harmonised version of Trade Unit Values, CEPII's database providing a world trade matrix of unit values for more than 230 countries and 5 100 products over the period 2000-2012. In their database, each flow was associated with a trade type (one-way trade, intra-industry trade in similar products or in differentiated products). The article shows that world trade is still mainly inter-industry. Over the period 2000-2012, along with the increasing role of developing countries in international trade, the share of intra-industry trade in global turnover decreased from approximately 30% to 23%. During the analysed period, there was also a decline in the share of IIT in vertically differentiated products. Moreover, their article indicates that intra-industry trade took place mainly between countries that were generally close, either economically or geographically (*e.g.*, France and Germany), and inter-industry trade was typical for remote trading partners or partners characterised by large differences in factor endowments (*e.g.*, the United States and China).

However, the literature lacks an analysis of global intra-industry trade in the second and early third decades of the twenty-first century, a period of many changes in the global economy such as growing protectionist tendencies in trade, epitomised, among others, by the trade war between the US and China under the first Trump presidency, the COVID-19 pandemic, Brexit, or Russia's armed attack on Ukraine. Global financial and economic crisis, coronacrisis (2020), rising protectionism, geopolitical tensions, and anti-globalisation sentiment contributed to the slowdown of globalisation ('slowbalisation'), which can hamper the IIT's development. Thus, it is justified to check whether it is true or false.

Studies of global intra-industry trade in the literature end in 2012. The same is true for analyses of individual countries' intra-industry trade with all trading partners, which were conducted until around the middle of the second decade of the twenty-first century. More recent studies of intra-industry trade are limited to the analysis of the intra-industry trade of individual countries with selected trading partners or for selected industries.

Based on the literature review, we formulated the following hypotheses:

H1: In a period of many changes in the global economy world intra-industry trade is subject to fluctuations.

H2: The most developed countries are intensive IIT participants.

H3: The developing countries have IIT intensity below the world average, but some developing countries show a tendency to increase their IIT shares over time.

RESEARCH METHODOLOGY

We calculated Grubel-Lloyd (GL) indices based on values of exports and imports derived from the WITS-COMTRADE database. We chose the COMTRADE database because it covers the whole world. We realise that sometimes the data presented there are less accurate than in the Comext databases (there are more gaps in the COMTRADE database than in the Comext dataset), which in turn are limited by the number of countries for which data are available. Furthermore, the COMTRADE database is one of the most prestigious and reliable sources of statistics, which confirms the right of our choice. As statistics for the quantity of exports (imports) are shaky and the problem of missing data is more serious than in the case of statistics measuring the value of trade, especially for developing countries, we computed only GL indices for total IIT, and we refrain from calculating GL indices for horizontal and vertical IIT. For the same reasons, we did not count GL indices for particular industries. Moreover, we assumed that a proper approximation of industry is a group of products meant as the 6-digit HS code level (WITS-COMTRADE database does not include more disaggregated statistics).

We calculated three types of GL indices. The first one was GL index in bilateral trade (for a selected country-pair) – see formula (1).

$$GL_{ij} = 1 - \frac{\sum_{b=1}^{k} |X_{ijb} - M_{ijb}|}{\sum_{b=1}^{k} (X_{ijb} + M_{ijb})} \quad (1)$$

in which:

i - reporter (reporting country);
j - partner (trading partner);
b - industry (6-digit HS code level);
k - number of industries in total trade (trade of all products);
GL_{ij} - Grubel-Lloyd index in bilateral trade between country i and country j;
X_{ijb} - exports from country i to country j of products from industry b;
M_{ijb} - imports to country i from country j of products from industry b.

The second one is GL index for a selected country, see equation (2).

$$GL_i = 1 - \frac{\sum_{j=1}^{n} \sum_{b=1}^{k} |X_{ijb} - M_{ijb}|}{\sum_{j=1}^{n} \sum_{b=1}^{k} (X_{ijb} + M_{ijb})} \quad (2)$$

in which:

i - reporter (trading country);
j - partner (trading partner);
n - number of trading partners;
b - industry (6-digit HS code level);
k - number of industries in total trade (trade of all products);
GL_i - Grubel-Lloyd index for country i;
X_{ijb} - exports from country i to country j of products belonging to industry b;
M_{ijb} - imports to country i from country j of products belonging to industry b.

The third one is GL index for the world – see formula (3). Using the corresponding formula, we also calculated GL index for the EU (the reporters are limited to the EU member states). Table 1 presents the number of reporters (m) used in calculating GL_{world}.

$$GL_{world} = 1 - \frac{\sum_{i=1}^{m} \sum_{j=1}^{n} \sum_{b=1}^{k} |X_{ijb} - M_{ijb}|}{\sum_{i=1}^{m} \sum_{j=1}^{n} \sum_{b=1}^{k} (X_{ijb} + M_{ijb})} \quad (3)$$

in which:

i - reporter (trading country);
m - number of reporters (trading countries);
j - partner (trading partner);
n - number of partners (trading partners);
b - industry (6-digit HS code level);
k - number of industries in total trade (trade of all products);
GL_{world} - Grubel-Lloyd index for the world;
X_{ijb} - exports from country i to country j of products belonging to industry b;
M_{ijb} - imports to country i from country j of products belonging to industry b.

Table 1. Number of reporters during 2000-2022

Year	m	Year	m	Year	m	Year	m
2000	137	2006	158	2012	170	2018	171
2001	142	2007	165	2013	170	2019	166
2002	147	2008	164	2014	157	2020	163
2003	153	2009	168	2015	167	2021	162
2004	152	2010	170	2016	172	2022	143
2005	159	2011	167	2017	173		

Source: own study based on Comtrade database https://wits.worldbank.org/WITS/WITS/Restricted/Login.aspx accessed on 15 May 2024.

The number of reporters varies over time, but in all years, all developed countries and the majority of developing countries are included. Gaps in statistics usually refer to island countries in the Pacific or in the Caribbean Sea, and also to some African countries, especially those touched by war. There is also missing data from countries with dictatorial rules.

RESULTS AND DISCUSSION

World Intra-industry Trade

World trade is still mainly inter-industry. In 2000, intra-industry trade accounted for about 32% of world trade and in 2022 for about 29% (Figure 1). Our results are compatible with the results of Emlinger and Piton (2014) and with the outcomes presented by Czarny and Śledziewska (2012).

Despite the turbulent changes occurring in the analysed period, including 'hyper-globalisation,' global financial and economic crisis, 'slowbalisation' and pandemic, the share of intra-industry trade remained quite stable (3 p.p. decrease over more than two decades). The IIT has reached its peak in the year 2001 (33%) and further decreased till 2012-2013 (26%), which we can see as a result of smaller purchases, especially in international space during and after the economic crisis. Next, it has increased to 30% in the years 2017-2020 and finally declined by 1 p.p.

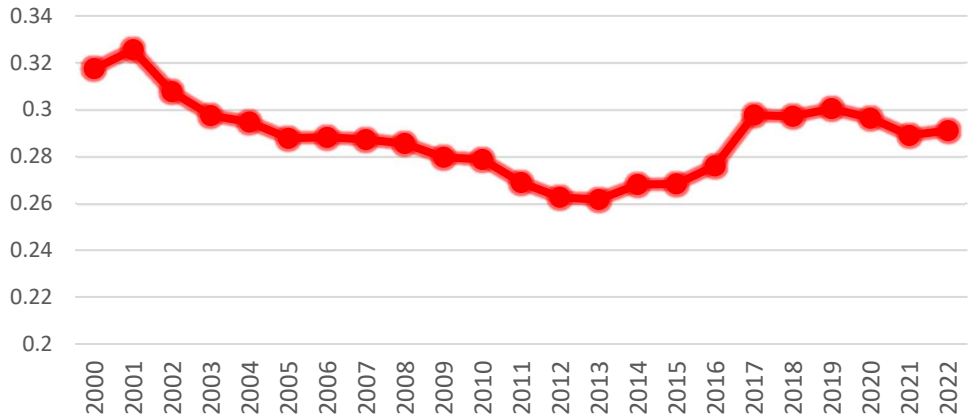

Figure 1. Intra-industry trade: World average
Source: own elaboration based on Comtrade database, https://wits.worldbank.org/WITS/WITS/Restricted/Login.aspx accessed on 15 May 2024.

Intra-industry Trade of The G7 Members

Nowadays, the G7 countries account for about 28% of global exports and for ca. 34% of imports of goods, which confirms that this bloc plays a significant role in the world trade. Thus, it was worth examining the total IIT of G7 countries and bilateral IIT between pair of group members. We were especially interested in this group as researchers overlook IIT of its members.

As expected, the majority of G7 members reveals very intensive IIT with the maximal value of 43% (Canada, 2002) and the minimal one of 24% (2012, Japan – see Figure 2). In the years 2004-2013, France had the highest IIT shares. In the years 2014-2015, Canada reached the same shares as France. In 2015, Germany also reached France's level. Before 2004, the leader was Canada (in 2001 with the same share as France), and since 2016, it has been Germany. Generally, during the analysed period three mentioned states (Canada, France, Germany) had significantly more intensive IIT than any other country from this group. It is understandable as they are industrialised, rich, and integrated in RTAs (Germany and France in the EU, Canada in USMCA), which helped them to freely trade with the groupings' partners. At the same time, they have big economic potential, which, however, is not so huge as to make them self-sufficient, as, *e.g.*, the United States.

The case of the United Kingdom is interesting. Until 2009, it was the fourth biggest IIT participant among the G7 members. Referendum on leaving the EU in 2016 has led to only a small decrease in its IIT share: yearly decrease in 2017 was 1 p.p. Deep breakdown (-5 p.p. yearly) came in 2022, which was

the second year of real trade disintegration with the other EU members. This fall in the British IIT share caused the biggest decrease in the whole sample during the analysed period (2000-2022: -10 p.p.). We observed the second biggest drop in the U.S. IIT share (-8 p.p.).

U.S. IIT shares achieved in the years 2001-2004, 2006, 2008-2009, 2011, 2015 the levels equal to the world average. In 2000, American IIT share was by 2 p.p. higher (34%), and after 2015 constantly lower than the global shares, which confirms a high extent of self-sufficiency of the USA. After 2015, the USA remained the G7 member with the lowest IIT share, replacing Japan in this position.

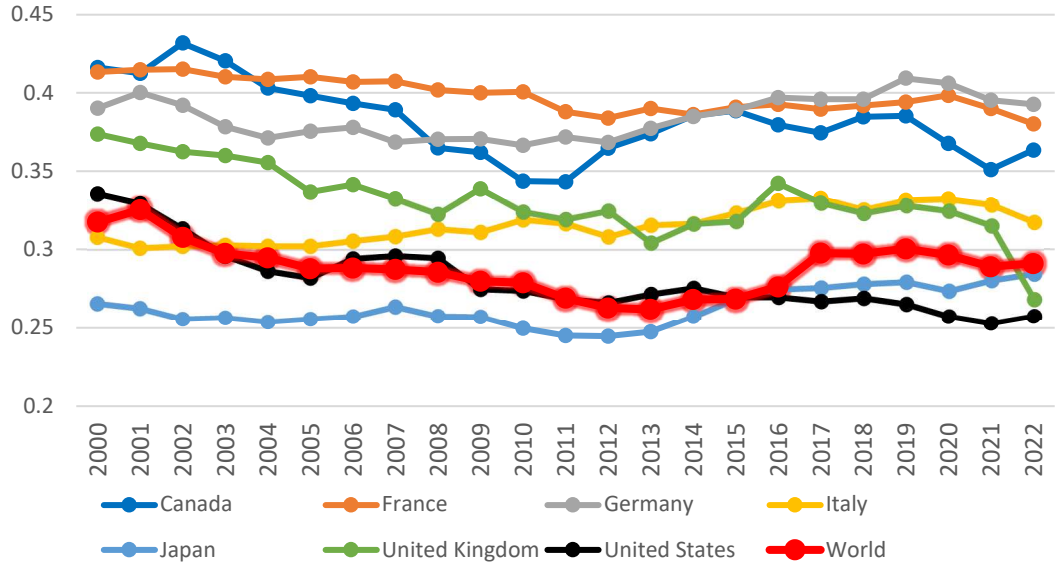

Figure 2. Intra-industry trade of G7 states
Source: own elaboration based on Comtrade database, https://wits.worldbank.org/WITS/WITS/Restricted/Login.aspx accessed on 15 May 2024

We attribute relatively low IIT shares of Japan to loose links to RTAs with similar economic potential and its specialisation in technologically advanced goods (mainly electric and electronic devices, pharmaceuticals, (Czarny *et al*., 2023, pp. 30-31)) sold abroad in exchange for less technologically advanced goods. Interestingly, only Japan and Italy had higher IIT shares in the last year of research than in the first one, even if they are among G7 members with rather low IIT shares. It means that they have intensified their IIT. In the case of Japan, IIT intensification is probably going hand in hand with involvement in RTAs.

As far as bilateral IIT between G7 members is concerned (Table 1), unsurprisingly, we observed the highest shares in trade of the EU members (France, Germany, Italy). They reached or exceeded 50% of their total bilateral turnover. Surprisingly, bilateral IIT between Canada and the USA, representing USMCA was not much lower. In both years of research (2000, 2022), its shares were equal 46% despite the fact that USMCA was less deeply integrated than the EU.

The United Kingdom has lost a lot of its IIT intensity after the EU exit. Its IIT shares in trade with all G7 members but Japan were in 2022 noticeably lower than in 2000. In the case of IIT, the UK's expectations of a trade boom in the transatlantic area have failed. Simultaneously, it has lost part of its IIT connections with the main EU partners. In our opinion, this decrease in IIT intensity will probably continue as traditional trade ties with the EU members will weaken.

Intra-industry Trade of Selected EU Member States

The next analysed group were the EU members. We chose countries with the highest trade potential (France, Germany, Italy) as well as three countries joining the EU in 2004 (Czechia, Poland, Slovakia). We completed the sample with Sweden – a rich and developed EU member with a peripheral location. These seven EU members are important for world trade. Their joint share in global exports and imports reached almost 16%. We compared their IIT shares with the EU average (Figure 3). Interestingly, the EU average stays stable throughout the whole analysed period.

Table 2. Bilateral intra-industry trade between G7 countries

Reporter	Partner	2000	2022	Reporter	Partner	2000	2022
Canada	France	0.23	0.25	Japan	Canada	0.14	0.10
	Germany	0.18	0.14		France	0.21	0.23
	Italy	0.13	0.12		Germany	0.29	0.37
	Japan	0.06	0.08		Italy	0.19	0.21
	UK	0.26	0.11		UK	0.23	0.31
	US	0.46	0.46		US	0.32	0.29
France	Canada	0.26	0.29	UK	Canada	0.30	0.17
	Germany	0.56	0.55		France	0.46	0.41
	Italy	0.44	0.45		Germany	0.53	0.40
	Japan	0.18	0.26		Italy	0.37	0.29
	UK	0.50	0.44		Japan	0.17	0.29
	US	0.44	0.43		US	0.50	0.47
Germany	Canada	0.24	0.28	US	Canada	0.46	0.45
	France	0.57	0.50		France	0.42	0.32
	Italy	0.38	0.47		Germany	0.41	0.37
	Japan	0.30	0.42		Italy	0.27	0.19
	UK	0.49	0.42		Japan	0.28	0.26
	US	0.45	0.45		UK	0.49	0.44
Italy	Canada	0.12	0.10				
	France	0.44	0.41				
	Germany	0.40	0.45				
	Japan	0.18	0.23				
	UK	0.36	0.27				
	US	0.26	0.21				

Source: own study based on Comtrade database, https://wits.worldbank.org/WITS/WITS/Restricted/Login.aspx accessed on 15 May 2024.

France and Germany had the highest IIT-levels, which have swapped places during the analysed period: the leader, France, has given way to runner-up Germany to take the runner-up position behind them. Only these two countries constantly reach IIT shares exceeding the EU average, which proves their significant position in the EU IIT. Moreover, these countries display the highest shares in global exports and imports in the sample (Germany about 6% and France ca. 3%).

Czechia had the third-highest IIT share, with stable shares ranging from 36% (2000-2009, 2015-2019) to 34% (2022). It makes Czechia the most successful new EU member in respect of IIT development. It also proves Czechia's advancement in the production of manufactures, which are differentiated goods, some of them technologically advanced.

The remaining four countries (Italy, Poland, Slovakia, and Sweden) had considerably lower IIT shares. All of them were far below the EU average. Italy's IIT shares were relatively stable, whereas the Polish ones showed the most fluctuations. One can explain Poland's and Slovakia's low IIT shares with their relatively lower level of development and smaller potential to exchange substitutes with the highly developed partners (especially those gathered in the EU). Regarding Sweden, the reason for its poor IIT participation might be its peripheral location.

The next part of our analysis compares IIT shares of the selected EU members with IIT shares of the United Kingdom (Figure 4). We checked whether the decision about leaving the EU and then the actual exit from the grouping influenced British IIT shares in trade with the EU members. We expected that it had as the EU is deeply integrated and developed. Its members are intensively trading with substitutes, and IIT is especially sensitive to trade barriers.

In the first year of research (2000), the UK achieved the third-highest IIT share in the EU (37%), placing it behind France and Germany. This share went continuously down till 2008 (32%) and then

fluctuated between 30% (2013) and 34% (2016) before dropping to 27% in 2022. We attributed this last decline to a real change in the rules of trade between the EU and the UK.

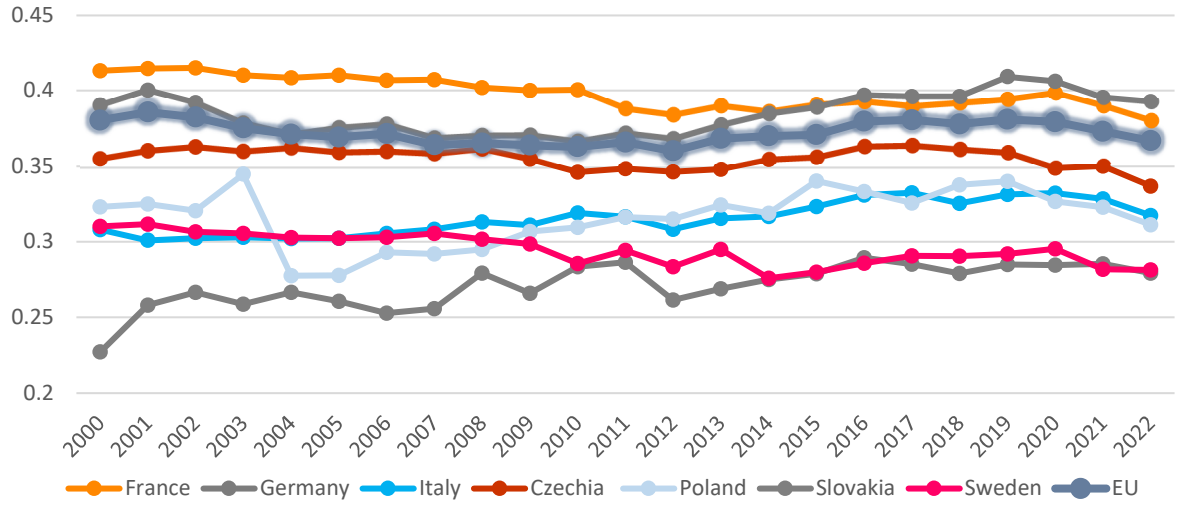

Figure 3. Intra-industry trade of selected EU Member States
Source: own elaboration based on Comtrade database,
https://wits.worldbank.org/WITS/WITS/Restricted/Login.aspx accessed on 15 May 2024.

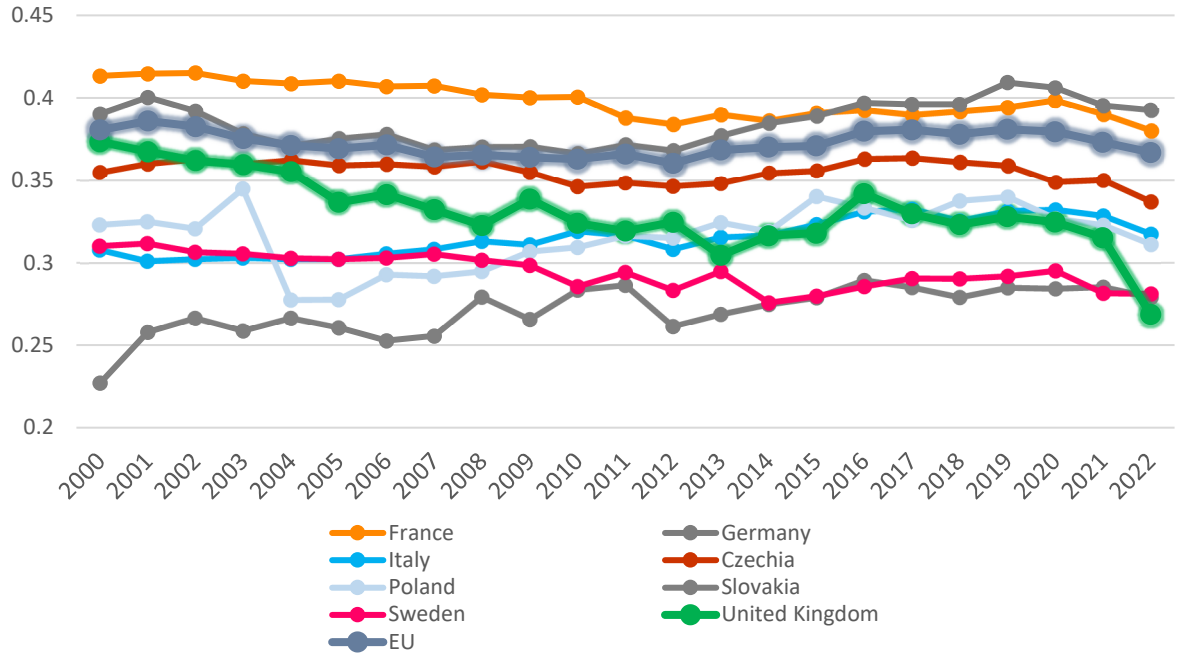

Figure 4. Intra-industry trade of selected EU Member States with reference to the United Kingdom and the EU average
Source: own elaboration based on WITS-COMTRADE database,
https://wits.worldbank.org/WITS/WITS/Restricted/Login.aspx accessed on 15 May 2024.

Intra-industry Trade of the BRICS Countries

Let us now look at IIT of the BRICS members. They are still developing countries, but they have big economic, political, and population potential as mirrored in more and more active participation in global trade. They account for 20% of global exports and for 16% of global imports of goods.

The BRICS countries constantly reveal much lower IIT shares than the world average and all the more lower than the EU average (Figure 5). Brazil had the highest share in the dominant part of the analysed period, with the peak value of 22% in the crisis year 2008, which seems to be connected with its intensive trade in the framework of MERCOSUR. In the years 2003-2017, its shares were higher than those of China (in 2014, the respective shares of both countries were equal). However, at the beginning of the analysed period (2000-2002) and in the last years (2019-2022), China had the highest shares in the group. It might be the result of an increase in its participation in global exports of the most technologically advanced goods. For example, in 2021, telecommunication equipment and parts thereof constituted over 20% of global exports of these goods, cathode valves and tubes over 19%, and automatic data processing machines also over 19% (Czarny *et al*., 2023, pp. 30-31). GL indices for China were higher than those presented by Deese (2017) who calculated them at the HS8 level. However, the general tendency as the same, decrease in years 2000-2013 and slight increase after 2013.

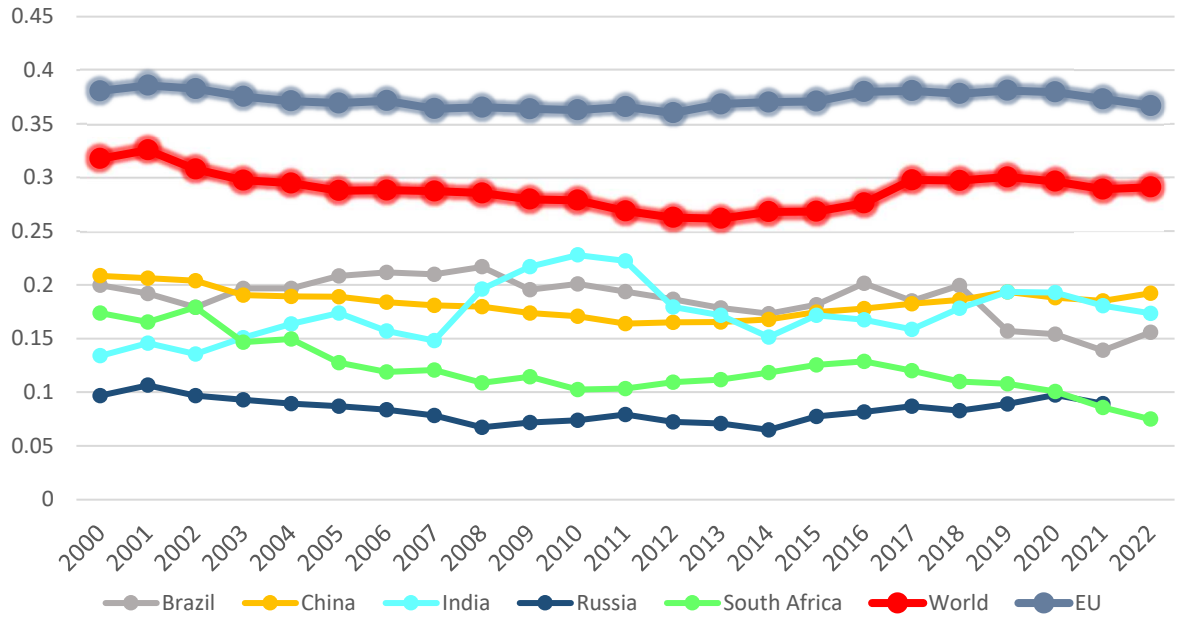

Figure 5. Intra-industry trade of BRICS-countries
Note: In the case of Russia, there was no data for 2022. Thus, we did not calculate the indicator of IIT.
Source: own elaboration based on Comtrade database,
https://wits.worldbank.org/WITS/WITS/Restricted/Login.aspx accessed on 5 May 2024.

Increase in IIT shares of the BRICS members found confirmation only in the case of India: its IIT share increased during the years 2000-2022 by 4 p.p. from 13% to 17%. India had also reached the highest overall IIT share in the group: 23% in 2010. Moreover, it recorded an increase in IIT shares during the economic crisis and immediately afterwards (2008-2010). India's current improvement in IIT might be a consequence of its participation in GVCs and an increase in exports of the most technologically advanced products.

In the case of Brazil, we noticed a visible drop in IIT shares during and after the pandemic. South Africa experienced a constant decrease in IIT shares since 2016. In the years 2016-2022, its shares dropped by 6 p.p. from 13% to 7%.

Generally, BRICS countries remain masters of inter-industry trade, mainly specialised in the production of raw-material and labour-intensive goods. IIT shares have exceeded 20% only in the case of Brazil (2000, 2003-2010, 2016, 2018) and India (2008-2011). As mentioned, it was probably due to their participation in trade with developed countries and in international production. Let us also note the relatively big IIT shares of both mentioned countries during the financial crisis (2008) and the global trade collapse (2009). It looks like they became more attractive partners than in good times. Russia had the lowest IIT shares in the sample, with the highest value of 11% achieved in the

year 2001 and the lowest value of 7% in the years of crisis (2008-2010). It is not surprising, given that its exports consist mainly of fuel and raw materials. Since the start of the war with Ukraine (2022), Russia's data concerning IIT has been missing.

Intra-industry Trade of Selected Developing Countries from Latin America, Asia, and Africa

For further investigation, we chose a few economically and politically significant developing countries from all inhabited continents. We discuss their IIT shares and make comparisons with the world and the EU average, as well as with the results of selected G7 or BRICS members.

Latin American countries whose IIT shares we investigated were Argentina, Chile, Cuba, Mexico, Uruguay, and Venezuela (Figure 6). We compared their IIT shares with the respective shares of Brazil, which is a member of BRICS. The analysed countries did not participate in the IIT intensively. The exception was Mexico. Its IIT shares were in the first years of investigation comparable with the EU average and in the year 2000 even by 2 p.p. higher. Afterwards, these shares decreased considerably and by the end of the analysed period reached a value of 29%. It was by 11 p.p. lower than in 2000.

For most of the time, Argentina had the second-highest IIT shares, which Uruguay overtook only in the years 2000-2001. Argentina's IIT was generally more intensive than that of Brazil and, in many years, comparable with the world average but significantly lower than the Mexican one. In the years 2012-2013, it was even slightly above the world average. It means that Mexico and Argentina were relatively nearer in respect of IIT to the developed countries than any other country from this sample. For Mexico, its free trade and international production cooperation in the USMCA are important. Argentina enjoys free trade in MERCOSUR.

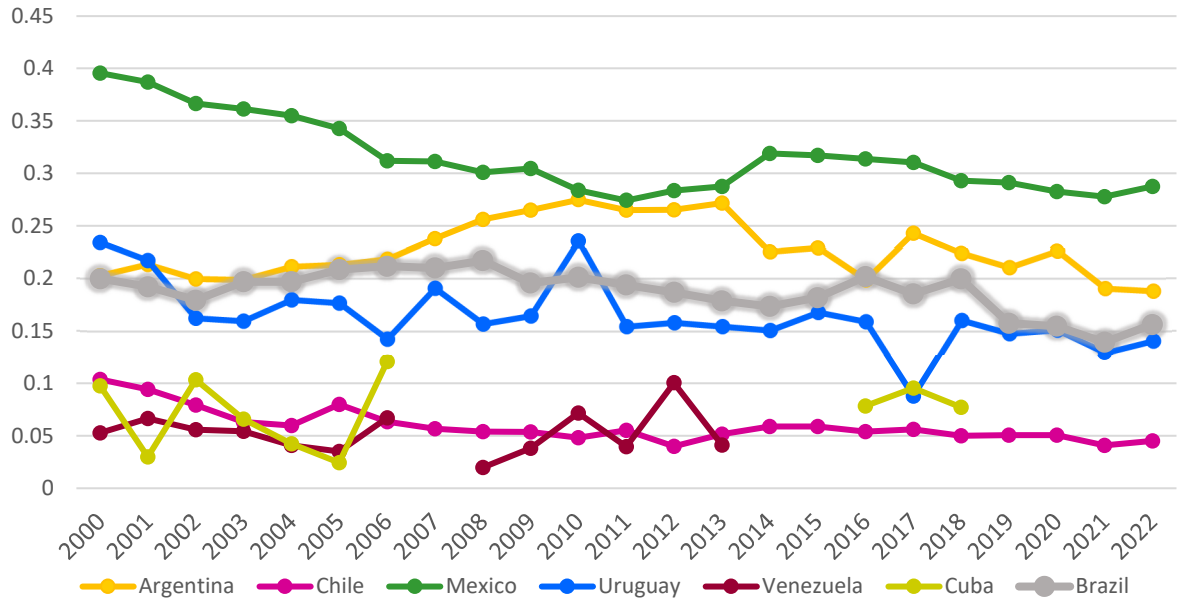

Figure 6. Intra-industry trade of selected developing countries from Latin America
Note: For Cuba and Venezuela, data were available only for selected years.
Source: own elaboration based on Comtrade database,
https://wits.worldbank.org/WITS/WITS/Restricted/Login.aspx accessed on 15 May 2024

The cases of Cuba and Venezuela are interesting. They had very low IIT shares. Cuba achieved the highest value of 12% in 2006, and Venezuela 10% in 2012 (the lowest values were in both countries 2% – for Cuba in 2005 and for Venezuela in 2008). Both countries have incomplete data about IIT in the analysed period, visible as discontinuous lines in Figure 6. The dictatorship in political life goes in their case together with limping cooperation with international statistical agencies.

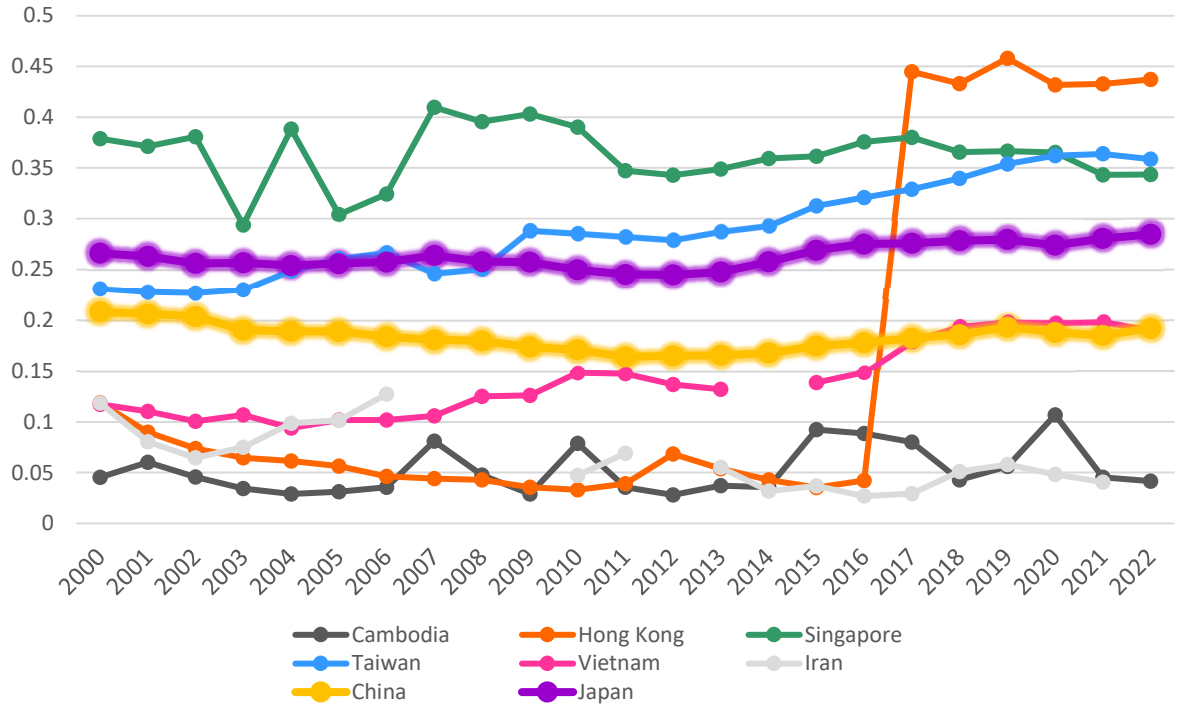

Figure 7. Intra-industry trade of selected developing countries from Asia
Note: In the case of Iran, data was available only for selected years, and for Vietnam, there was no data for 2014.
Source: own elaboration based on Comtrade database,
https://wits.worldbank.org/WITS/WITS/Restricted/Login.aspx accessed on 15 May 2024

As representatives of Asia, we chose Cambodia, Hong Kong, Iran, Singapore, Taiwan, and Vietnam (Figure 7). We compared their IIT shares with the respective shares of Japan as the Asian most developed country with the constantly lowest IIT shares among G7 members, as well as with IIT shares of China – a BRICS member with relatively high IIT shares and the leader of the world exports.

The weakest participants in IIT in this sample were Iran with the highest share 13% in the year 2006 and Cambodia with the highest share of 11% in 2020; the respective lowest values were: 3% in 2013, 2016-2017 in Iran and in 2003-2004, 2009, and 1012 in Cambodia. In both of them, at the end of the analysed period, we observed a decreasing tendency for these shares.

At the other extreme were Singapore and Taiwan. They participated in IIT relatively intensively. Throughout the dominant part of the analysed period, Singapore had the highest and relatively stable IIT shares. Hong Kong overtook it in 2016 and Taiwan in 2021. Singapore's IIT shares fluctuated between 29% in 2003 and 41% in 2007. It achieved the share of 40% in the years 2008-2009, which proves its intensive participation in IIT during the financial and economic crisis. Singapore's IIT shares were higher than those of Japan and China throughout the whole analysed period. It seems to confirm the high quality/price ratio of its goods. However, during the whole period, Singapore recorded a 4 p.p. fall in the IIT shares from 38% in 2000 to 34% in 2022.

Hong Kong started with a very poor participation in IIT. In 2000, its IIT share was equal to 12%. In 2017, Hong Kong made a jump in IIT share from 4% in 2016 to 44% in 2017. Afterwards, it stayed stable on the new level (2022 – 44%). In 2017, it became the sample leader and remained in this position till the last year of research.

An interesting case is Vietnam, which we may see as an example of successful catching up. Its IIT share increased by 7-8 p.p. from 12% in 2000 to 20% in 2019-2020 and 19% in 2022. It means that Vietnam has managed to produce and sell abroad more advanced (differentiated) goods.

Angola, Botswana, Cameroon, Senegal, Tunisia, and Morocco represented African countries. We compared them with South Africa, a member of BRICS located in Africa (Figure 8). The first feature of IIT of these countries is that all samples but Botswana had IIT shares lower than 25% and thereby

considerably lower than the world average. Angola constituted a special case. Data for it about IIT was unavailable up to 2008, and afterwards – up to the year 2014 – equalled zero. In effect, we present its IIT in Figure 8 exclusively for the years 2015-2022.

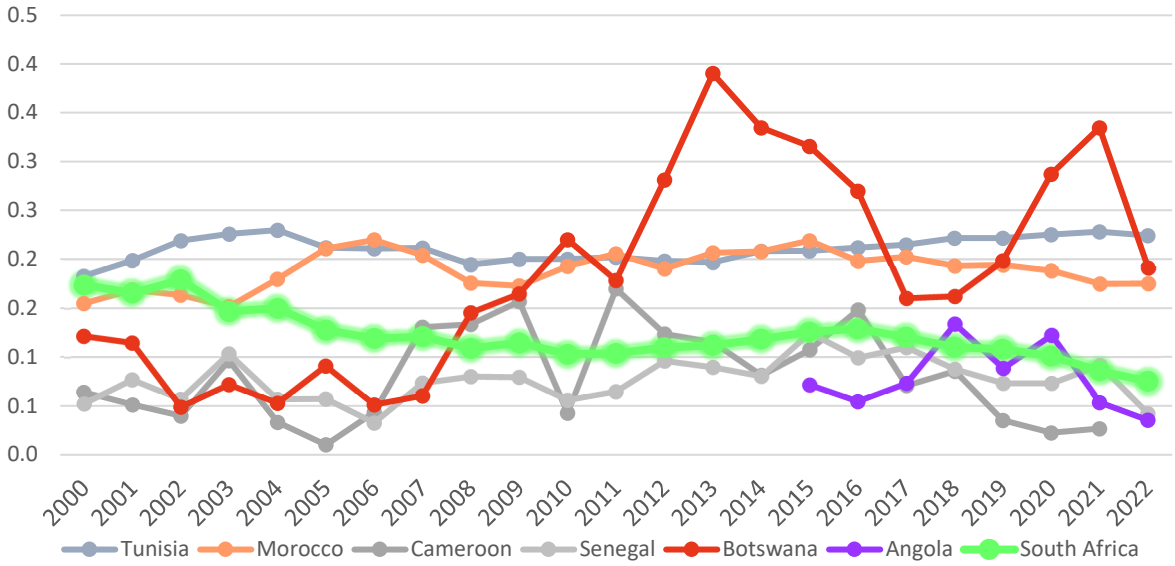

Figure 8. Intra-industry trade of selected developing countries from Africa
Note: For Angola, (non-zero) data were available from 2015, and for Cameroon, data were missing for 2022.
Source: own elaboration based on Comtrade database,
https://wits.worldbank.org/WITS/WITS/Restricted/Login.aspx accessed on 15 May 2024.

The second feature of IIT shares of African countries was their volatility. Tunisia with a fluctuation range of 5 p.p. was an exception. We observed the biggest fluctuations in the IIT shares of Botswana (34 p.p.). The reason might be relatively small trade volume (besides diamond export) and, consequently, a big impact of a few transactions on the whole result. Tunisia had the highest shares in the dominant part of the analysed period, which Morocco overtook in a few years. Tunisia's IIT shares varied between 23% in 2003-2004 as well as in 2020-2021, and 18% in 2000 (2022 – 22%). Its shares showed a slight tendency to increase. Morocco had the lowest value of 15% in 2003 and the highest (22%) in 2006 and in 2015. Both countries experienced an increase in their IIT shares during the whole period (Tunisia by 4 p.p. and Morocco by 3 p.p.).

GL indices for G7 and other developed countries, as well as for BRICS and other developing countries, were lower than those presented by WTO (2013), which calculated them for the years 1996 and 2011 at the HS4 level. However, the general conclusion is the same. In 2011, industrialised developed economies and rapidly industrialising developing economies tended to engage in more intra-industry trade, whereas resource-rich developing economies and least developed countries. Furthermore, GL indices presented in this article were also lower than those presented by Brülhart (2008), who computed them for the period 1962-2006 at the SITC3 and SITC5 level. However, again, the regularities were similar. The highest GL indices were for high-income countries and the lowest for low-income countries. Middle-income countries were somewhere in between.

CONCLUSIONS

Similarly to previous studies, we showed that world trade is still mainly inter-industry. In 2000, intra-industry trade accounted for about 32% of world trade and in 2022, for about 29%. The slight decline in IIT shares has been accompanied by an increasing role of developing countries in international trade flows. Our analysis confirmed that the developed countries conduct much more intensive IIT than the rest of the world. This means that we proved hypothesis H2 that the most developed countries are intensive IIT participants.

Developing countries still have not caught up with the developed ones as far as IIT is concerned. Their IIT shares are still much lower than those of developed ones. However, in a few of them, like India or Vietnam, the intensification of IIT is visible. It follows that we also confirmed hypothesis H3 that the developing countries have IIT intensity under the world average, but some developing countries show a tendency to increase their IIT shares over time. Thus, there is a space for industrial policies in developing countries. We recommend more intensive capital inflows into these countries and intensification of their manufacturing production, *e.g.*, in the framework of global value chains.

The problem of measuring the IIT of developing countries is not only their insignificant shares but also the lack of necessary data. We have described it in the cases of Cuba, Venezuela, and Angola, but this is a much more general problem. The political systems of many developing countries and their poor statistical institutions do not allow for collecting and reporting data to international organisations. Sometimes, they just do not collect such data.

During 23 years of our investigation, the world economy changed drastically. The most important change came with progressing digitisation that changed the ways to conduct business, making shopping, and influenced even consumers' preferences. The COVID-19 pandemic caused another change. In effect volume and pattern of international cooperation have evolved. Moving away from globalisation to regionalisation in international production is of special importance. The next factor changing international cooperation is the many conflicts and even wars experienced in the last decades. All these changes seem to have a big impact on IIT and the fact that its shares remained relatively stable in global as well as in national terms. This means that hypothesis H1 is false. This is the most surprising result of our investigation.

This article is an empirical paper. We do not contribute anything to the theory of IIT. A novel theory of IIT could explore how technological advancements and the increasing complexity of production processes influence the exchange of similar goods between countries. This corresponds to our recommendations for policy (focus on technological innovation). In this context, this article can be a starting point for studies on the grounds of IIT.

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Use of Artificial Intelligence

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Conflict of Interest

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