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Economic catch-up and similarity in trade structures.

Case of BRIC and CIVETS.

경제 추격과 무역 구조의 유사성:
BRICs 와 CIVETS 의 사례를 중심으로

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Graduate School of Seoul National University

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이 논문을 공학석사학위 논문으로 제출함

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Abstract

Economic catch-up and similarity in trade structures:

Case of BRICs and CIVETS.

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The degree to which export composition affects the growth rate of emerging countries has been shown to be contingent upon the similarity in trade structure. The role of export composition in economic growth is examined in this study by analyzing how greater trade structure

similarity across nations might lead to catch-up in income levels in a group of emerging economies. This research compares the Brazil, Russia, India and China (BRIC) and Colombia, Indonesia, Vietnam, Egypt, Turkey, and South Africa (CIVETS) country groups and sectoral export trends to those of current members of the Organization for Economic Co-operation and Development (OECD). The study examines the export trends of OECD nations that developed and became richer earlier with BRIC and CIVETS countries that are considered to be latecomers. In particular, the main interest is in seeing if export patterns help BRIC and CIVETS economies to catch up. The results suggest that BRIC and CIVETS countries that have a higher similarity with OECD economies show a positive and significant effect on economic catch-up.

Keywords: Trade structure, export similarity, economic catch-up, diversification, path-dependence, comparative advantage
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Chapter 1. Introduction

1.1. Research scope and objectives

Economists have long tried to explain the complicated topic of huge disparities in income per capita among countries and regions since the Industrial Revolution. The divergence is not as straightforward as simply dividing the wealth range into two groups of equally wealthy nations and equally poor countries. Alternatively, there are a variety of other possibilities, including the formation of growth “miracles” (Nelson & Pack, 1999), or convergence clubs (Galor, 1996; Phillips & Sul, 2009).

Many countries, for instance, members of the Organization for Economic Co-operation and Development (OECD) or East Asian countries, have managed to use trade-oriented policies to drive economic growth, leading other latecomer economies to adopt similar policies. These policies generally specify the targeted industries as well as potential export destinations, such as Akamatsu's (1962) Asian development framework, which illustrates structural transformation in terms of high-tech export products. Emerging nations coordinated their production practices with regional industry giants, such as Japan, and pursued a learning approach focused on technologies similar to

surrounding countries' more developed, high-tech sectors (Kojima, 2000). Emerging economies are countries that are undergoing significant transformations due to insufficient or incomplete industrialization.

However, there are a few drawbacks to this methodology. One problem, "adding-up," occurs when an excess of companies join certain industries and competition becomes too high (Spence, 2011). Another challenge is that the concept of "high-tech" evolves over time; thus, sectors considered to be high-tech could quickly change, potentially completing the catch-up process for latecomers (Hatzichronoglou, 1997). Therefore, it is important to analyze and introduce various other trade and technological development frameworks.

As the world economy continues to evolve, economic experts often define certain nations and areas in terms of financial development and economic growth., with terms like G-7, G-20, BRIC, and the Next Eleven all being examples of this. The contribution of emerging nations to global and regional growth has expanded dramatically in recent years. The alliance of five emerging economies from Asia, Latin America, and Africa, known as BRICS (Brazil, Russia, India, China, and South Africa which was admitted in 2010) has appeared as one of the major players in recent global interactions. The abbreviation BRIC

was established by O'Neill (2001) to refer to the growing economies of Brazil, Russia, India, and China, which have the potential to overtake the European economy in terms of market size. BRICS accounts for more than a fourth of the world's total land and 41% of its people and has established itself as an essential representative group for international decision-making (Truman, 2006).

Changes in the economy require new techniques for financial forecasting to represent the dynamic context of the global economic landscape (O'Neill, 2011). Thus, additional country groups, such as the CIVETS, were formed based on finance and economics. CIVETS (Colombia, Indonesia, Vietnam, Egypt, Turkey, and South Africa) is a group of emerging market countries that have growing middle classes, young populations, and strong growth rates.

Previous studies show how export composition based on similarity in trade structure can impact a country’s growth rate, as well as how economic catch-up is stimulated by the level of export product similarity. Some extant research examines how a country's trade structure has changed over time to see how it relates to the comparable level of income of new member states through the European Union’s (EU's) economic integration. In the empirical analysis, the dependent variable is GDP per capita compared to GDP per capita of the EU over a single period. The findings reflect different effects of trade structure

similarities on the catch-up of emerging economies (De Benedictis & Tajoli, 2007; 2008). Xu and Song (2000) investigate trade structural similarities and find that Asian nations with similar trade structures face more trade rivalry.

Alternatively, numerous prior studies presume that nations' economies are static in explaining patterns of specialization and diversification (Boschma et al., 2015). For example, Kant (2019) investigates a gap between one country's performance and best practice measures or a country's distance from the frontier, which represents its relative poverty. The author proposes an economic catch-up indicator that quantifies the relative change in the GDP gap between two time periods. This alternative indicator is the preferable measure of catch-up in the current study since catch-up is a fundamentally dynamic process.

Recent studies have attempted to explain the GDP gap by incorporating the dynamic character of diversification in industrial structure. Hidalgo et al. (2007), for instance, pioneers the topic of analyzing a country's diversification stages using a network space analysis by developing a product space. According to their research, a nation is more likely to develop new competence in a product if it already produces comparable products; hence, nations that manufacture core products have a greater potential to diversify compared to countries generating periphery items.

This study examines how trade structures can drive economic growth and reflect technology catch-up. Technological complexity, in this case, is represented by export complexity (Hidalgo & Hausmann, 2009). The focus of this study is to investigate the relationship between the level of export diversification and economic growth. The current paper also examines and attempts to compare two technological paths of developed and developing countries, specifically BRIC and CIVETS. This study looks at the trade structures of BRIC and CIVETS to interpret their economic performance. Both groups of counties are emerging, which means that they are trying to catch up with forerunners, however, BRIC present a more industrially developed group of economies compared to CIVETS.

This empirical research employs international export data to examine similarities from two perspectives, specifically, the similarities between BRIC's and CIVETS' present and past export structures, as well as similarities the two groups have with OECD countries.

The first research question explored in this paper is: Does a closer relationship with industrialized structures result in economic catch-up? In order to answer this question, similarities between OECD countries and BRIC and CIVETS countries' industrial structures are analyzed, as well as similarities between the past and the present industrial structures of BRIC and CIVETS countries.

The second follow-up research question is: Does diversification based on the current export structure lead to economic growth? To answer this question, the path-dependence theory was examined and diversification into related industries was analyzed.

This study explicitly examines whether export patterns help BRIC and CIVETS countries to catch up with developed countries. The results indicate that countries in BRIC and CIVETS that are more comparable to OECD nations have a positive and significant economic catch-up level. The findings show a strong and positive association between export structure catch-up and GDP per capita. Furthermore, the findings reveal that diversification in the export structure of the BRIC or CIVETS shows a notable path-dependence, thereby validating economic catch-up through the path-dependence concept.

1.2. Outline of the study

The remainder of this paper is organized as follows. A literature review of trade structures in economic development, technological catch-up strategies, and other economic catch-up strategies is conducted in Section 2. Section 3 describes, in detail, the data used in this study as well as the methods employed to answer the research questions. In Section 4, findings of the statistical and empirical results

are provided. Last, Section 5 provides a discussion and implications of the results as well as limitations of the study and further research ideas.

Chapter 2. Literature review

2.1. Trade structures in economic development

The basic conceptual idea in international trade theory that demonstrates the positive effect of export diversification on global economic development has been well-formed. There are many different degrees of analysis. For instance, several studies focus on the growth of individual companies (Hobday, 1995), while others focus on leadership transfers across economies at the sectoral level (Giachetti & Marchi, 2017; Lee et al., 2005). The third viewpoint attempts to link those different levels of analysis (Landini et al., 2017). According to previous thorough theoretical justifications, export and technology are essential components of a developing country's economic growth. Smith (1776) and Ricardo (1821) proposed that nations can gain from trade by importing products and services that they produce at a higher cost while exporting what they create at a lower labor cost (Sultanuzzaman et al., 2019).

The classical Ricardian and neoclassical Heckscher–Ohlin–Samuelson and Ricardo–Viner models claim that both approaches in accordance with comparative advantage are based on the concept of specialization instead of diversity (Dutt et al., 2008). Under the

Ricardian concept, countries can benefit from relative cost advantage items by specializing in and exporting them. The Heckscher–Ohlin approach is based on the ratio of productive factors such as physical and human capital, land, labor, and skills.

Similarly, the neoclassical growth model of Solow (1956) explains how exports boost GDP growth. According to the growth model, technology is linked to sophisticated industrialization, which indicates quick economic growth (Sultanuzzaman et al., 2019). Conversely, in an open economy, economic growth is driven by the transfer of technology and knowledge through trade (Frankel & Romer, 1999). Trade theory formed by Veron (1979) implies that by the early stages of a commodity's market cycle, the propensity for newly produced goods should concentrate on developed countries, and afterward, it should focus on the rest of the countries. Since nations are divided by a "technology gap" at different economic development stages, emerging markets are eager to acquire new products through exports (Fagerberg, 1987). Thus, exporting plays a crucial role in standardizing and improving an economy's production methods.

Furthermore, the Schumpeterian viewpoint of economic growth recognizes the changing nature of technological capabilities. However, as Schumpeter pointed out, one of the most important aspects of dynamic rivalry is that some companies consciously aspire to be

technology leaders, while others try to keep pace by imitating the leaders' achievements (Malerba & Lee, 2020; Nelson & Winter, 1982).

For long-run economic growth, Schumpeterian models have three major observable outcomes. First, a rise in the population should enhance per capita income growth. Second, the expected growth of larger economies is faster. Last, changes in the pace of growth should be linked to changes in the level of inputs utilized in knowledge generation (Dinopoulos & Thompson, 1999).

The "modern" trade models place a greater emphasis on the trade margin and are better suited to understanding the factors that influence export diversification. In Krugman's model (1979) international trade is presented under a monopolistic market and nations in equilibrium generate endogenous varieties of exports.

In the recently published papers by Hausmann, Hwang, Rodrik, Klinger, and Hidalgo (Hausmann et al., 2007; Hausmann & Klinger, 2007; Hidalgo et al., 2007), the authors assume that the set of specific goods chosen for export rather than the set of any exported products determines a country's economic development. Observations under this framework show that nations that export products with greater implied levels of productivity grow faster; a high implied productivity level of goods is linked to income and defined by the existence of each commodity in the export baskets of high-income countries. One of the

most essential characteristics of high-productivity products is that there is elastic demand for them on the global market, allowing the country to export in huge quantities without having a substantial negative influence on the terms of trade (Hausmann et al., 2007).

According to a study of the formation of countries' export baskets in the global economy, nations shift their export specialization to those goods that are related to existing goods in the export basket (Hausmann & Klinger, 2006). Therefore, a country's position in the "product space" can have a significant impact on potential export diversification (Hidalgo et al., 2007).

Lee (2011) examines the shifting patterns of export structures among nations since 1970, and suggests that global export structure changes explain most of the observable influence of economic integration on the world economy. Furthermore, in terms of geographical distribution, high-tech sectors have transitioned from developed to developing countries, namely, emerging markets. The analysis of the impact of technological features of exports on economic growth in 71 countries indicates that high-technological exporting products have a greater impact on economic growth than 'traditional' or low-tech exporting goods. Furthermore, he emphasizes that as a result of high-tech, high-quality goods and openness of trade, economies such as China are expanding more swiftly.

The economic development alternative approach accessible to emerging nations has been altered by global value chains (GVCs). GVCs strategy assumes that latecomers join GVCs for various purposes at different phases of technological competency development and competitiveness (Lee et al., 2018). A large part of the shift in export structure and patterns may be explained by the recent growth of International Production Networks (IPNs) and GVCs, which are fundamental aspects of the 21st-century economy (Baldwin, 2014). According to Baldwin's (2016) perspective, it is not formally required to establish whole sectors, since nations can specialize in specific areas of manufacturing and only fit GVCs where domestic suppliers have been formed or may be formed. Because information and communication technologies make trading 'easier,' international bodies have encouraged the development of exports via GVCs as a solution for underdeveloped industrialization in emerging economies (World Bank, 2017). GVC inclusion might temporarily benefit productivity and increase exports; however, it may stifle long-term development, particularly if technology diminishes the necessity for low-skilled labor in developing nations (Sen et al., 2020).

Furthermore, emerging sectors in an economy may benefit from established, similar industries by integrating resources such as infrastructure and knowledge, as well as extending commercial

prospects (Martin & Sunley, 2006). Thus, according to recent research, having to learn from neighboring nations plays an essential significant role in economic advancement (Boschma et al., 2017). Moreover, nations acquire knowledge faster if it is related to the country's current knowledge (Miguelez & Moreno, 2018).

Enabling factors are closely linked to physical closeness in developed economies, which is viewed as a crucial element of metropolitan cities and areas that enable access to trade and ideas. Highly urbanized locations attract a larger number of people who are willing to participate in innovation, entrepreneurship, and creative activities (Feldman and Kogler, 2010; Lee et al., 2021). However, there is less concrete evidence and general understanding of emerging economies, particularly those striving to overcome the phenomenon referred to as "catching-up" or "the middle-income trap."

Previous studies on emerging and forerunner countries referenced in this study also have employed different development strategies. According to Peneder (2003), service and manufacturing exports in innovative high-skilled sectors are positively correlated with per capita GDP growth. Consequently, by producing high-technological goods, the overall growth of OECD nations positively changes. Further, as reported by Lacasa et al. (2019), the historical patterns have boosted technology concentration, which is evident in the development of

innovation capabilities and the diversity of BRIC technological knowledge. Nevertheless, BRIC has intensified frontier technological efforts, revealing the character of each BRIC economy's modernization.

At the total country level, the export composition is a crucial element to use trade as an instrument for economic development (Greenaway et al., 1999). Export-relatedness has been utilized in research to explain a country's technological complexity (Hidalgo & Hausmann, 2009). The complexity of exports is one aspect that influences export success or failure (Szirmai, 2012). The structure of export products and services shows a country's economic capabilities and defines its trade advantages (Hausmann et al., 2007). The export composition typically necessitates judgments on what industrial goods a nation's companies can specialize in and diversify towards. In addition, diversification may help to prevent technology lock-in (Saviotti & Frenken, 2008).

2.2. Technological and economic catch-up strategies

This research takes a Schumpeterian perspective on economic growth, with technology being the primary engine of economic progress (Schumpeter, 1912). Nevertheless, this perspective hasn't received much attention in economic research since technology is frequently seen as an exogenous variable (Rosenberg, 1982). The

majority of worldwide patents are issued by economies in Europe, North America, and certain Asian countries, and there is a clear tendency through time. Hence, it is necessary to emphasize the role of technology in economic growth taking into consideration diverse countries' conditions with various levels of technological development. Thus, new technical capabilities arise steadily as a result of learning from the experience in the industry (Kim, 1997).

In the extant literature, the definition of economic catch-up refers to closing the gap between latecomers and leading countries or companies (Fagerberg & Godinho, 2004). Latecomers, unlike incumbents, differ by lower technological capabilities. Thus, economic catch-up strategies are based on the idea of learning how to integrate and adapt applications and technologies to the domestic environment in order to narrow the gap with leading countries (Malerba & Lee, 2020). These traditional tactics are considered the most straightforward, however, they can lead to lock-in results since following incumbents' technological paths may delay countries' own industrial structure development and trap them in the past.

Hence, in the recent publications, authors argue that latecomers do not just copy the technological development route of more mature and advanced countries, but instead may use different methods such as bypassing some steps or building a unique form of early pioneers'

development pathway (Malebra and Nelson, 2011; Lee, 2013, 2019). These alternative catch-up strategies explain the evolution of the industries in South Korea. Specifically, Lee and Lim (2001) developed three potential catch-up patterns: path-creating, stage-skipping, and path-following.

Path-following catch-up refers to latecomer companies following the same pathway as originators. Latecomer businesses, on the other hand, move faster down the road than the early pioneers. Stage-skipping catching-up describes how latecomer firms follow the originators' course but bypass certain steps, in order to save some time. The third pattern, path-creating is described as when latecomer firms pursue their own technological growth route through path-creating catching-up. It occurs if latecomers, followed by forerunners, take a different road, thus forming a new path.

The technology generation’s future is brighter with the path-creating catch-up pattern, since path-creating companies may absorb technological advancements instantly. On the other hand, path-following and stage-skipping businesses rely on more outdated technology than path-creating businesses. The two patterns, however, profit from competitors' early experiences with outdated technologies. Because of the prospect of decreased productivity, path-creating firms have a larger barrier to entrance than the other alternatives.

Economies at different development levels might face traps such as middle-income traps (Vivarelli, 2016; Liu et al., 2017; Radosevic & Yoruk, 2018;), poverty traps (Bloom et al., 2003; Sachs et al., 2004; Baland & Francois, 1996) and recently discovered middle-innovation traps (Lee et al., 2019). According to earlier research, a middle-income trap occurs when a nation's products are not upgraded in terms of complexity and diversification and are stuck in low-value-added functions.

One example of the middle-income trap is the development path of Brazil and the majority of Latin America during the 1980s (Canuto, 2020). With an extraordinarily high concentration of domestic supply chains, the Brazilian economy stayed on the periphery of this manufacturing revolution. Nevertheless, the limitation of commercial openness in Brazil cost the country's economy in productivity losses. Despite Brazil's location and size, the country has a closed commercial sector (Canuto et al., 2015a). Hence, the Brazilian economy experiences high costs, a lack of competition, and low productivity performance. Moreover, domestic issues include low infrastructure investment, an unfavorable business climate, incoherence in long-term financing, poor decisions regarding public spending on education, and others (Canuto, 2020).

Furthermore, the idea of the middle-innovation trap (Lee et al., 2019) suggests that despite amassing implementation capacity, there is a struggle in ensuring concept design capability. Additionally, the research finds several traps as nations' economies evolve and become more complex. It also indicates an additional trap—the challenge of entering new industries given a country's technological capability. Thus, in a world of trade and technology battles, South Korea is one of the countries which focuses on avoiding falling into the "middle-innovation trap." An implementation-based innovation system differs from a design-based one, suggesting that the shift needs to be coordinated by all players in the innovation system. As a long-term evolutionary process, gaining design competency necessitates a dedication to long-term and persistent policies based on a national agreement (Lee et al., 2019).

Numerous scholars have previously emphasized trade structures as a method of catching-up (Hausmann et al., 2007; McMillan et al., 2014). "Catch-up cycles" refer to the phenomenon of those successive shifts in industry leadership. On the industry level, such as in the steel industry, car industry, and mobile phone industry, shifts in industrial leadership from an existing country to a newcomer are widespread (Lee & Malebra, 2017). Lee and Malebra (2017) suggest that latecomers may secure leadership roles through “windows of opportunity.”

According to this theory, the pattern of consecutive catch-ups that would most likely happen in an industry is determined by a variety of permutations of windows of opportunity and reactions from incumbents and latecomers.

De Benedictis and Tajoli (2007, 2008) propose a regional trade structure similarity approach for enhancing catch-up by newly admitted EU member states. According to this concept, catch-up can occur if catching-up countries match products and services to richer and more technologically sophisticated neighboring countries by integrating their domestic production with the global value chain. The fundamental assumption is that economic growth requires a structural shift from the original products toward high-value-added industries. The findings demonstrate that stronger regional similarity positively correlates with highly technological, established EU countries' income levels, and a shift from initial trade structures leads to an increase in GDP level (De Benedictis & Tajoli, 2007).

Another study that uses the export similarity index investigates the similarity between China and the EU in the global market, with the American market as an example of a more developed market and the Indian market as a developing one, from 2007 to 2013. According to the results of the empirical analysis, China and the EU have a greater degree of export similarity measure in the market of the developed

countries, resulting in strong competition of export goods. However, there is a declining tendency in the emerging nations' markets, which restricts their ability to compete in trade and increases complementary trade (Wang & Liu, 2015).

To summarize, selecting certain industries for growth from a countrywide context requires a multi-pronged strategy simultaneously focusing on various industries. Early-stage emerging countries might benefit from strategies that concentrate on the comparative advantage of developed technology capabilities. Several earlier studies have shown that a nation has a higher probability of entering a new industry with a greater density, i.e., one which is more closely related to the current industrial structure. This is because a country would have a competitive advantage in surrounding sectors due to comparable infrastructure and resources. (Hidalgo et al., 2007; Boschma et al., 2013, 2017).

This study analyses whether emerging economies can leverage advanced and industrially developed countries' trade structures to determine efficient technology development paths. By directly examining trade structure as a factor of growth, this research attempts to connect theoretical concepts with empirical analyses.

Chapter 3. Methods

3.1. Data

The current study makes use of international export data to understand countries' trade structures and to connect the dynamics of trade structures to economic outcomes.

Export data represents countries' industrial performance over the established international classification. While export data has some limitations, for instance, if the country heavily relies on the domestic market, export data might not accurately represent domestic industrial capabilities and commerce, it is still frequently used in previous studies.

Export data is available for more than 55 years which allows for analyzing and comparing industrial structures on a country level. Since only a few countries can offer credible data, this research employs export data to investigate country trade structures and analyze the relatedness to economic growth.

The study's export dataset, which spans the years 1990 to 2019, is available at Harvard University's Growth Lab. This database was collected using data from the United Nations Centre for Trade and Development, providing international export data along with Standard

International Trade Classification (SITC, rev. 2). This research uses 4-digit SITC data which provides a comprehensive and up-to-date classification of approximately 700 goods (The Growth Lab at Harvard University, 2019).

National accounts, labor, capital, and trade data were taken from the Penn World Table (PWT version 10.0. Revision of June 2021; Feenstra et al., 2015). PWT dataset covers data from 183 countries from 1950 to 2019.

The group of industrially developed countries is represented by BRIC: Brazil, Russia, India, and China. Developing countries are represented by CIVETS members: Colombia, Indonesia, Vietnam, Egypt, Thailand, and South Africa. The group of countries toward which the catch-up is analyzed is OECD: Austria, Australia, Belgium, Canada, Chile, Colombia, Costa Rica, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States.

The recent fast-economic growth of BRIC countries has attracted not only global interest but also academia (O'Neill et al. 2005). However, as the "post-BRIC generation" a new set of

prospective dynamic developing economies has emerged and is predicted to take a leading place in growth during the coming decade (Cameron, 2011).

BRIC countries are distinguished by their demographical and economical size, and their GDP growth rates are significantly greater than that of established markets. Moreover, each of the BRIC countries can be characterized similarly by a large population, significant income asymmetry, and relatively low wages. Furthermore, the factors of recent high economic expansion are similar in all the nations. Since their low labor rates, countries attracted a considerable foreign direct investment inflow, which was mainly based on export.

The CIVETS countries are known as the "post-BRIC generation" (Schulz, 2010), owing to their youthful and rapidly rising populations, diverse economies, and appealing investment prospects (Arslan & Tatlidil 2013). According to “The World Factbook”, in 2011 and 2012, the BRIC and CIVETS economies grew faster than the European Union and the United States, with the exception of Egypt, which grew at the same pace as the United States in 2011 and 2012 and Brazil, which grew at a slower rate in 2012.

The economies of the BRIC and CIVETS countries are growing faster than those of the European Union, the United States, and the rest of the world. Analyzing the GDP on a purchasing power parity basis,

the results reveal that BRIC are among the top ten economies, with China placing third behind the European Union and the United States. CIVETS nations are kept lower in the rankings but still stay within the top 50 countries in the world (Caldero´n-Martı´nez & Ruiz-Conde, 2015).

Figure 1 confirms the stable economic growth of both BRIC and CIVETS countries from 1990 to 2019. However, compared to OECD countries there is still a huge gap in GDP per capita.

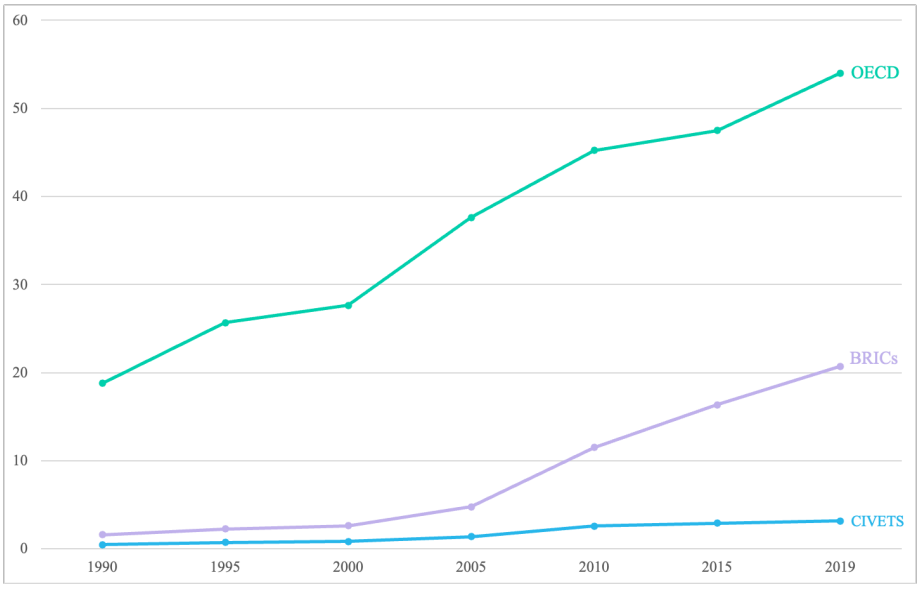

Figure 1. GDP per capita for OECD, BRIC, and CIVETS countries in current US$ (1990-2019)

Source: Data from World Bank (https://www.worldbank.org/indicator/NY.GDP.PCAP.CD)

Consequently, Figure 2 provides evidence that in comparison to other regions, OECD not only indicates stable economic growth but also shows the highest GDP per capita for the last few decades. Hence, in this study OECD group is chosen to represent the forerunning economies.

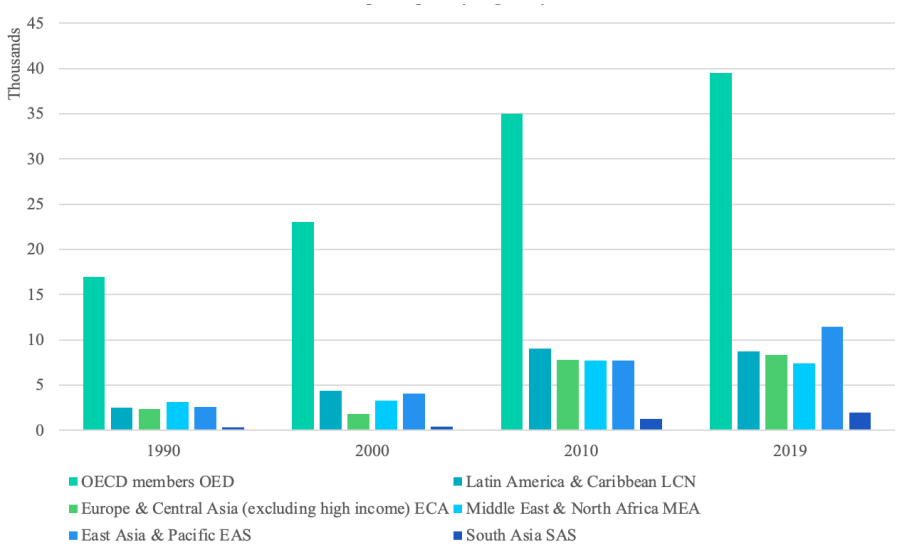

Figure 2. GDP per capita by region, year, in current US$ (1990-2019)

Source: Data from World Bank

(https://www.worldbank.org/indicator/NY.GDP.PCAP.CD)

3.3. Methods

3.3.1. Similarity index:

Generally, data on trade-related structure changes is given using a wide variety of metrics and a range of sectoral specialization indices

but finding an appropriate description of these complicated changes in a measure that can be utilized in empirical exercises is difficult (De Benedictis & Tajoli, 2008).

Estimation begins by evaluating the change of trade similarity through time – from 1990 to 2019 – by assessing a country's export composition's distance from a specific benchmark, using sectoral export proportions toward the OECD market. Using a modification of the Bray–Curtis distance index, the self-similarity index is defined to indicate how the composition of the export basket is changed compared to the start of the transition phase. The Bray-Curtis index avoids the problem of double zeros that can occur in distance measurements such as the Manhattan distance or the Euclidean distance (De Benedictis & Tajoli, 2007, 2008). Furthermore, the OECD, BRIC, and CIVETS-similarity indexes are defined to indicate how the export composition of each individual member changed in relation to its group export basket.

The mathematical similarity index model is:

$$s_{\mathrm{x,y},t} = 1 - d_{\mathrm{x,y},t} = 1 - \frac{\sum_i |x_{i,t} - y_{i,t}|}{\sum_i (x_{i,t} + y_{i,t})} \quad \text{.....(3-1)}$$

where x_i and y_i refer to exports shared by two different countries x and y in sector i and year t, dxy is the Bray-Curtis distance index.

The OECD-similarity measures country x is BRIC and CIVETS, while y is the OECD benchmark. Self-similarity is measured as the similarity among the same country's industrial structure in the determined period of time and the beginning year, 1990.

3.3.2. Econometric analysis

Variables of this research are the following: the dependent variable in this study is GDP per capita. In empirical and theoretical studies, independent variables include variables related to the catching-up process. This study includes a similarity index with OECD countries, which measures the export composition change of BRIC and CIVETS countries and each country's level of similarity to OECD countries as a group. The variable openness quantifies the trade share of GDP, measured as an export plus import. Investment, as defined by the share of gross capital creation in GDP, is one of the other factors that influence catching up along with population and human capital which in the previous literature have been found significant in the catch-up process. To make comparisons of partial effects clearer, variables such as population, openness, and human capital are assessed in natural logs.

The following is the estimated regression to assess the relationship between export basket composition and catching-up:

$$GDPPC_{t+1} = \beta_0 + \beta_1 OECDSim_t + \beta_2 SelfSim_t + X_t + u_t + \varepsilon_t \quad \ldots\ldots$$

……Eq.(1)

where $GDPPC$ is the dependent variable, represented by GDP per capita. $OECDSim$ is the most important variable of interest, which is the similarity between BRIC/ CIVETS countries to OECD countries at year t. The increasing pattern shows higher trade structure similarity. $SelfSim$ is the self-similarity index of each country at year t to itself at the base year 1990.

In the theoretical and empirical literature, X_t is a vector of control variables that are related to the factors connected with the catching-up process. In this study, X_t includes population, human capital, gross capital formation, and openness of the economy. The time-fixed effects are controlled by u_t, and the error term is represented by ε_t .

3.3.3. Density index

Hidalgo et al. (2007) proposed the concept of the product space, which refers to a product net with items that nations are willing to export. The product space illustrates a nation's current export basket as well as how far a product is from the existing export structure. The idea

of density indicates how a certain product is encircled by the country's present export basket. Based on the thorough assessment of the number of similar items that a nation presently exports, a product relatedness metric may detect the score for every product that it does not currently export space, and an indicator of product relatedness termed density may be determined. Hidalgo et al. (2007) discovered how the relatedness indicator is a reliable indicator of a country's future success in creating a future product's comparative advantage. The density measure has been commonly utilized in previous literature on regional economic growth to assess how far a nation is progressing toward the different markets. (Boschma et al., 2017; Hidalgo & Hausmann, 2009; Hausmann et al., 2014).

The study combines the linked technologies of a country utilizing proximity across products, which calls the density of the country's relevant technology: $\omega_{c,i_1,t}$. The mathematical equation of density for country c of industry i at time t is formulated as:

$$\omega_{c,i_1,t} = \frac{\sum_{i_1} x_{i_1} \phi_{i_1,i_2,t}}{\sum_{i_1} \phi_{i_1,i_2,t}} \text{.....(3-2)}$$

where x_{i_1} is a dunny variable for industry i_1, having the value 1 if a country has a competitive advantage and 0 if has not. ϕ is the proximity indicates the distance between industries i_1 and i_2.

$\phi_{i_1,i_2,t}$refers to the proximity index, which is the level of distance among industries i_1 and i_2. Proximity mathematical expression is the following:

$$\phi_{i_1,i_2,t} = \min\{P(RCAx_{i_1} \geq 1 | RCAx_{i_2} \geq 1), P(RCAx_{i_2} \geq 1 | RCAx_{i_1} \geq 1)\}.....$$

.....(3-3)

Here RCA which is Revealed Comparative Advantage is the competitive advantage of a given country. The conditional probability that a country that has a competitive advantage in i_2 would also have it in the industry i_1 is represented as $P(RCAx_{i_1} \geq 1 | RCAx_{i_2} \geq 1)$, and conversely, it's applied as $(RCAx_{i_2} \geq 1 | RCAx_{i_1} \geq 1)$.

According to the formula if the measure of RCA is larger than 1, then a country is deemed to have the competitive advantage in the given industry. RCA is computed by dividing an export share of a country by the proportion of that industry in global exports, with a number larger than 1 leading that the country is qualified within this industry (Balassa, 1965). Hence, if a country has a comparative advantage in a greater range of industries connected to that sector, the density metric of such industry will be near 1.

Following the previous literature' approach (Boschma et al., 2015; Bahar et al., 2014), this research estimates the given equation to

examine the tendencies of industrial diversification in BRIC and CIVETS countries applying density measure and RCA with a 5-year lag to analyze the cause-and-effect interaction between density and comparative advantage development in new industries.

$$RCA_{t+5} = \beta_0 + \beta_1 RCA_t + \beta_2 \omega_t + \beta_3 IndGrowth_t + X_t + \alpha_t + \varepsilon_t \ldots\ldots$$

……Eq.(2)

The dependent variable is RCA_{t+5} which is a dummy variable that reflects the country's advancement in the new industry at the time t. RCA_{t+5} takes the value of 1 if a country has a comparative advantage in a particular industry at year $t+5$ and zero if doesn't have it. Key independent variables of interest are RCA and density at time t. Coefficient y represents whether a country has a comparative advantage at time t and keeps a comparative advantage at time $t+5$. In addition, the equation includes control variables such as industry growth which aimed to control industry growth of the specific county, openness, gross capital, export share and log of GDP per capita are the same as in the previous Eq. (1).

The ordinary least squares (OLS) model is used to estimate the equation, although it might be not optimal since the dependent variable is binomial and not continuous. However, when the right side of the

model includes lagged dependent variables the standard fixed-effect model might result in inconsistent estimates (Bernard & Jensen, 2004). Moreover, because the error component does not follow a normal distribution and the estimator may not be between 0 and 1, the linear estimating approach may have complications (Colombelli et al., 2014). Therefore, to increase estimate efficiency, the study also includes the probit model (Eum & Lee, 2019).

3.3.4. Reverse-causality

Furthermore, to check the results for the reverse causality effect, estimation based on the system-GMM method, which is developed for assessing the panel data model, is introduced (Hansen, 1982; Holtz-Eakin et al., 1988; Leszczensky & Wolbring, 2019). This model is capable of addressing endogeneity issues that might exist in the initial model: Eq. (1). The system-GMM method employs lagged values and the first lag of the first disparities of the endogenous variables.

The mathematical equation is the following:

$$\Delta y_t = \beta_1 \Delta y_{t-1} + \beta_2 \Delta x_t + \varepsilon_t \text{.....Eq.(3)}$$

where the dynamic panel estimators use initial differences to eliminate time-invariant unobserved heterogeneity because the lagged-dependent variable (LDV) from the first lag is linked with ε_t.

Chapter 4. Findings

4.1. Similarity variables summary

4.1.1. Self-similarity shifting from the 1990th export structure

This chapter covers the primary variables of interest, OECD-similarity, and self-similarity. Figure 3 and Figure 4 demonstrate the similarity within its own country in 1990. The self-similarity index has a decreasing pattern across all BRIC and CIVETS countries. These findings suggest that during the last few decades, the industrial structures of BRIC and CIVETS nations have tended to shift to new, diverse sectors.

More specifically, Figure 3 shows the self-similarity index for Russia is quite the same over the last 20 years, suggesting that Russia has not been changing a lot since 2000, while the rest of the BRIC countries have a decreasing self-similarity trend, implying that they have been changing to new industries.

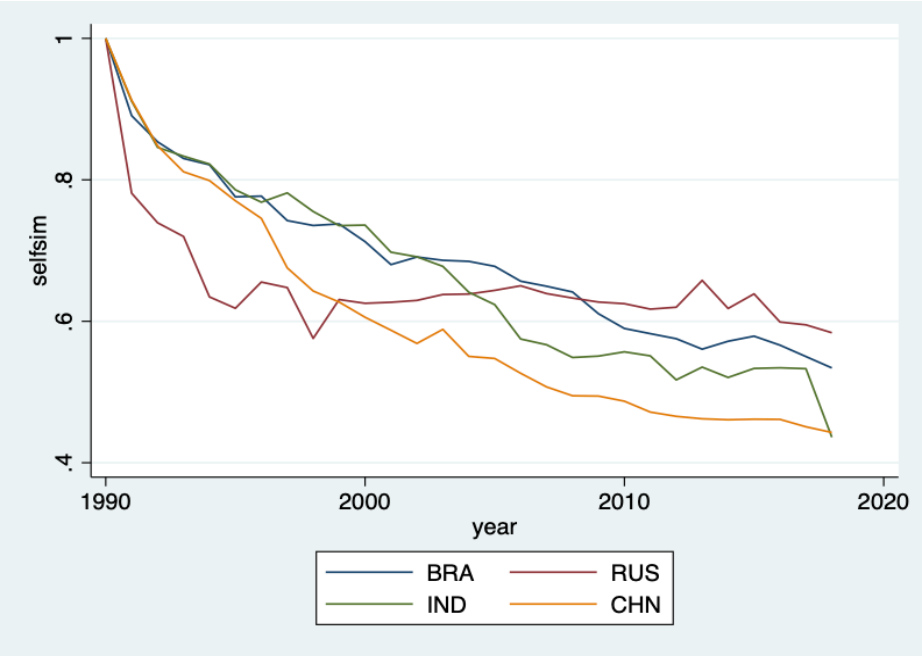

Figure 3. Self-similarity dynamics for BRIC countries in 1990 (1990-2019)

Looking at the CIVETS self-similarity graph (Figure 4), it is worth noting that South Africa after some fluctuation in the 90th has been stable and hasn't shifted to the new industries since 2000. As for the countries such as Colombia, Turkey, Indonesia, and Egypt the index shows a strong dynamic, indicating that these countries kept moving away from their past specialization. However, Vietnam's self-similarity dynamic is quite different since most of the shift happened in the early 90th. After 1996 the Vietnamese self-similarity index shows a modest dynamic.

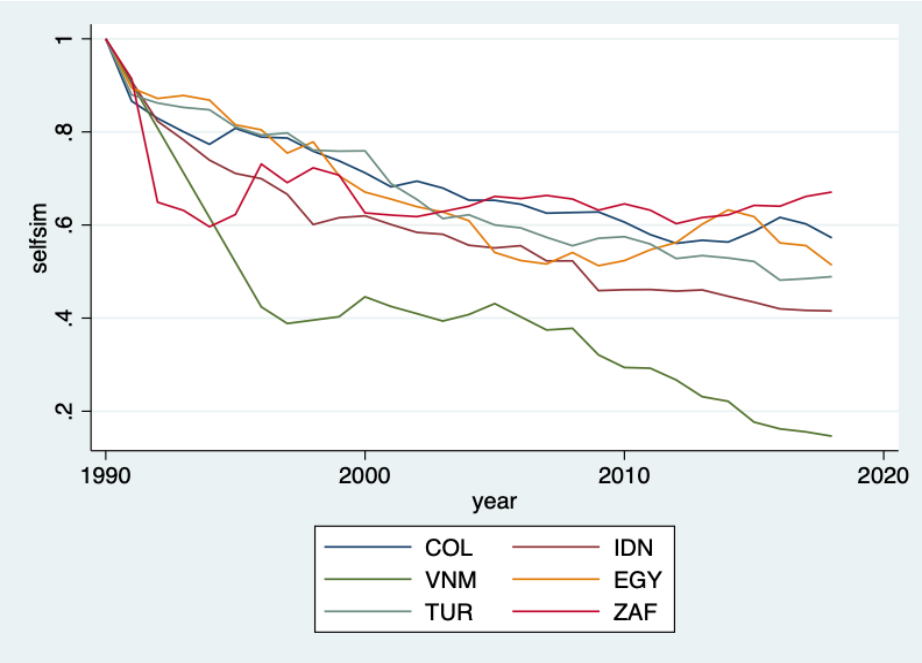

Figure 4. Self-similarity dynamics for CIVETS countries in 1990 (1990-2019)

4.1.2. OECD-similarity trend with BRIC and CIVETS from 1990 to 2019

The OECD similarity demonstrates how similar the trade structures of BRIC/ CIVETS and OECD countries are. Figure 5 depicts the trend of OECD similarity across four BRIC nations from 1990 to 2019. Generally, the OECD-similarity index has a similar pattern across countries. In the case of China, India, and Russia, the similarity to OECD countries over the given period is slightly increasing. As for

the case of Brazil, there have been some fluctuations over the years but the index at the beginning year of the analysis 1990 is similar to 2019.

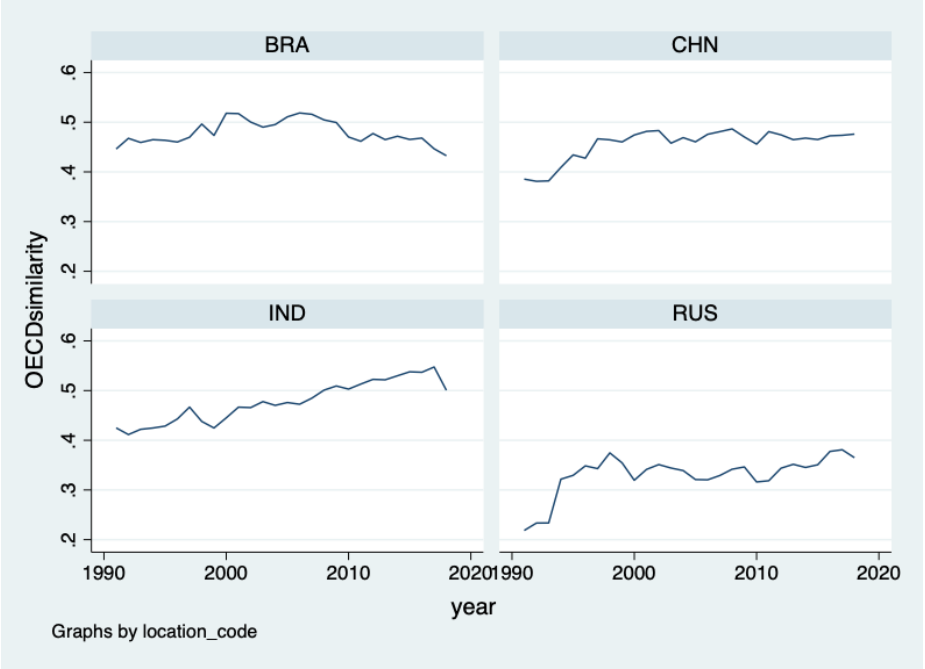

Figure 5. OECD-Similarity with BRIC countries (1990-2019)

Consequently, Figure 6 demonstrates the OECD similarity trend for six CIVETS countries within the same time period. Overall, the OECD-similarity index reflects a growing trend in CIVETS countries, however, there are some variations between countries. In the countries such as Egypt, Indonesia, Turkey, Vietnam, and South Africa the similarity index has an increasing pattern. Colombia, on the other hand, shows increased similarity over the years 2000 and 2010, however, after this increase by 2019 the index goes down to the level of the initial year 1990.

Figures 5 and 6 indicate that countries are shifting away from the previous industrial structures.

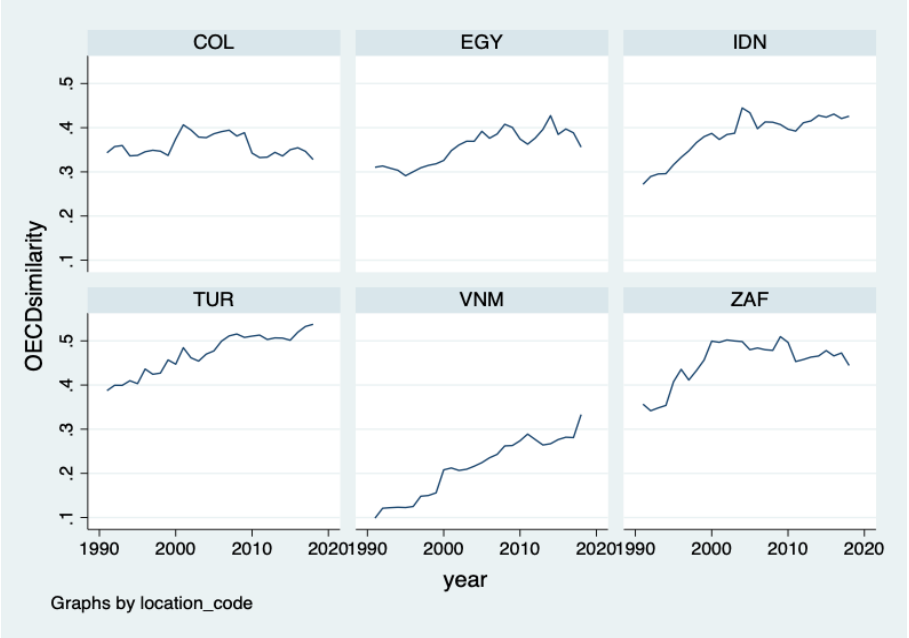

Figure 6. OECD Similarity with CIVETS countries (1990-2019)

4.2. Does getting closer to the OECD industrial structures influence GDP per capita?

Overall, both figures (7) and (8) show that BRIC and CIVETS countries are positively correlated to OECD economies. However, there are some differences across both groups of counties. In the case of BRIC (Figure 7), Russia is the one that differentiates from the rest of

the BRIC countries. Russia is not showing big differences in OECD similarity but has more divergence in GDP per capita.

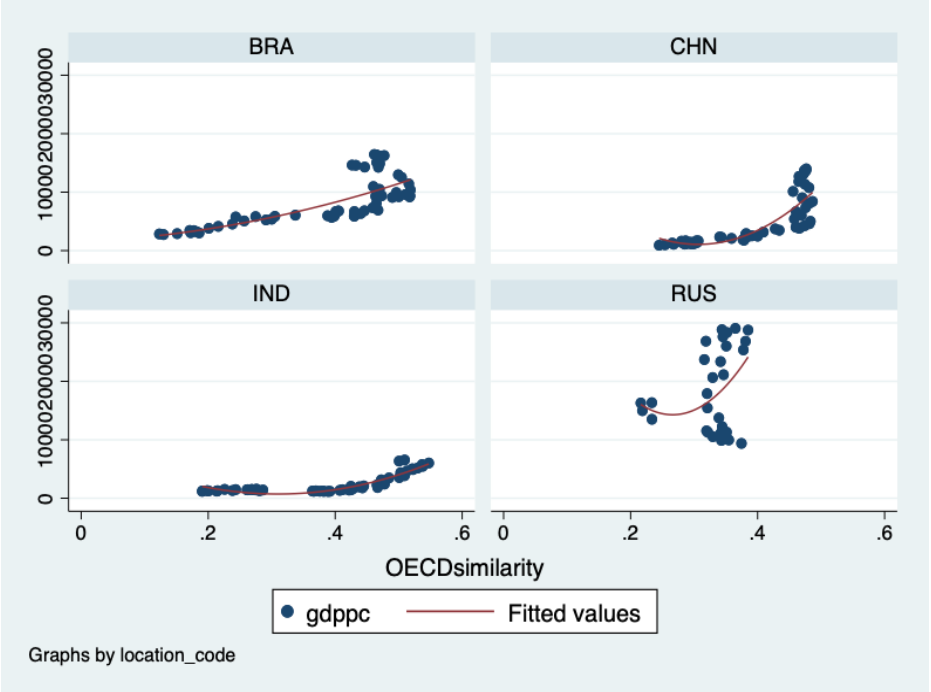

Figure 7. Correlation between GDP per capita and OCED similarity for BRIC

Note: each county represents the country in a certain year.

Looking at Figure 8, Turkey's graph looks different compared to other countries, similar to Russia's graph it shows a higher divergence in GDP per capita. Moreover, a country such as Columbia shows an inverted U-shape curve, which could imply that the country is positively correlated to OECD only to some degree of similarity. At

some point, it faces a lot of competition each other, and it could bring negative effects on its economic growth

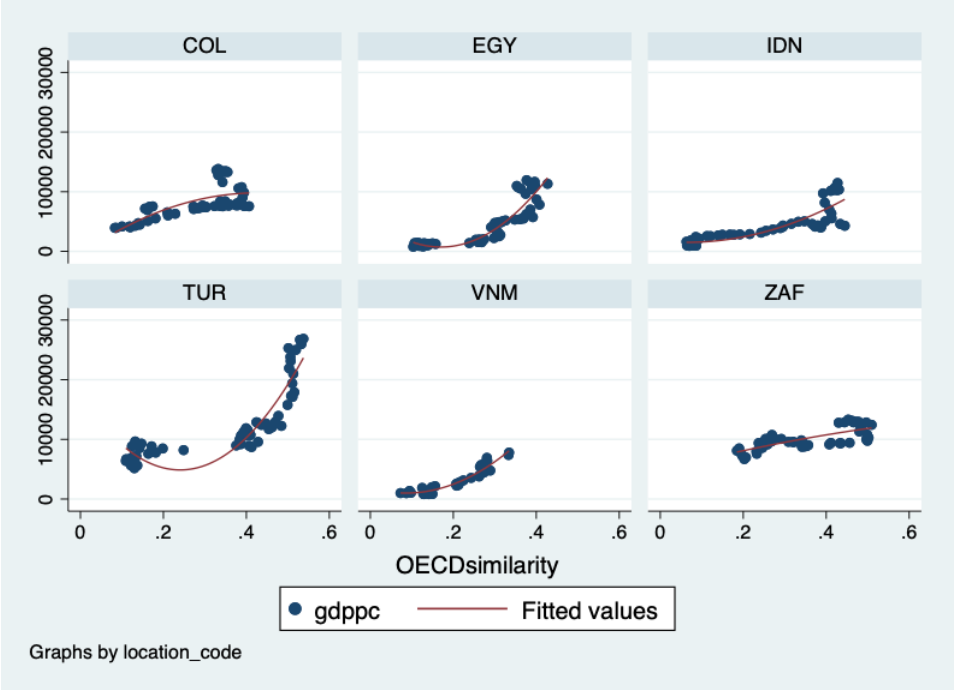

Figure 8. Correlation between GDP per capita and OCED similarity for CIVETS

Note: each county represents the country in a certain year.

4.2.1. Regression results

To analyze whether similarity in industrial structure affects economic catch-up, estimation (1) is conducted, where the dependent variable is GDP per capita as it was suggested by De Benedictis & Tajoli (2008). The GDP per capita variable measures the GDP per

capita of one country of BRIC or CIVETS, as a percentage of the targeted region's average GDP per capita.

Table 1 provides the equation (1) estimation results for BRIC countries. Columns (1) and (3) present regular OLS estimation, while columns (2) and (4) show fixed effect regression over random effect which was chosen in accordance with Hausman test results. The regression primarily looks at the relationship between OECD-similarity and GDP per capita. Columns (1) and (2) estimate findings corroborate the assumptions that GDP per capita is positively linked with similarity to BRIC industrial structures.

Further, columns (3) and (4) presents estimation with all the control variables. The assessment outcomes across several models indicate the same results as the prior estimations, that is, positive and significant impacts of OECD-similarity on GDP per capita. The self-similarity variable shows as non-significant in the fixed effect model (4), meaning that, generally, industrial structure similarity with OECD countries depicts higher significance rather than with own historical structures in the case of BRIC countries. Further, other control variables such as human capital and gross capital are positively and significantly associated with the catching-up process. However, the population variable has a significant, yet negative effect and the

openness variable does not show significance at all in the current regression results.

Table 1. Econometric results of the relationship between GDP per capita and OECD trade structure similarity for BRIC

Dependent variable $GDPPC_{t+1}$	**OLS (1)**	**FE (2)**	**OLS (3)**	**FE (4)**
OECD-similarity	3.504*** (0.628)	4.785*** (0.285)	2.603* (1.279)	3.737** (1.288)
OECD-similarity^2			0.175 (1.683)	-1.176 (1.822)
Self-similarity			-0.343** (0.105)	-0.211 (0.123)
Population (log)			-0.552*** (0.0193)	-1.003*** (0.187)
Openness (log)			0.0137 (0.00759)	0.0208 (0.0107)
Human capital			0.844*** (0.0259)	1.068*** (0.0847)
Gross capital			3.370*** (0.213)	3.674*** (0.227)
Constant	7.121*** (0.244)	6.640*** (0.111)	8.502*** (0.170)	10.39*** (0.935)
R-squared	0.133	0.001	0.966	0.923
Observations	198	198	198	198

Notes: Standard errors are shown in parentheses. * p<0.10, ** p <0.05, *** p<0.01.

Table 2 provides the estimation results of equation (1) for CIVETS countries. Similar to the previous regression, here columns (1) and (2) estimate the correlation of GDP per capita with OECD-similarity which shows as significant and positive. Then, columns (3) and (4) asses the full model with all variables. Again, the results for the relationship between GDP per capita and OECD-similarity have a significant and positive coefficient. Additionally, the squared OECD-similarity variable shows as significant yet negative, implying that when CIVETS countries' industrial structures become too close to those of OECD countries, the impact of industrial similarity on economic growth reduces.

Furthermore, self-similarity is significant and negative, suggesting that, overall, looking at both regression estimation, the shift in industrial structures have little effect on GDP per capita, however, the trajectory of the changes in industry structure influences more significantly. Lastly, same as in the previous regression, human and gross capital appear positive and significant. Contrarily, in the last model (4) population is shown as positive and significant, while openness has a negative and significant result.

Table 2. Econometric results of the relationship between GDP per capita and OECD trade structure similarity for CIVETS

Dependent variable $GDPPC_{t+1}$	**OLS (1)**	**FE (2)**	**OLS (3)**	**FE (4)**
OECD-similarity	4.766*** (0.236)	3.831*** (0.173)	2.155* (0.944)	3.437*** (0.497)
OECD-similarity^2			1.635 (1.377)	-6.863*** (0.747)
Self-similarity			0.165 (0.135)	-0.257** (0.0784)
Population (log)			-0.374*** (0.0302)	0.454*** (0.0997)
Openness (log)			-0.00594 (0.0110)	-0.0155** (0.00577)
Human capital			0.459*** (0.0786)	1.082*** (0.0773)
Gross capital			4.481*** (0.265)	2.504*** (0.193)
Constant	7.279*** (0.0757)	7.553*** (0.0548)	7.598*** (0.155)	4.194*** (0.280)
R-squared	0.569	0.612	0.845	0.932
Observations	308	308	308	308

Notes: Standard errors are shown in parentheses. * p<0.10, ** p <0.05, *** p<0.01.

4.2.2. Robustness

One way to conduct the robustness check is to use time lags for the independent variable in the same model as in tables (1) and (2). Thus, table 3 includes six models with the same regression (1) for BRIC and CIVETS countries with different time lags. The current analysis uses fixed effect regression for the previous equation including all initial control variables with 1-year lag in models (1) and (4), 3-year lag in (2) and (5) models, and 5-year lag in (3) and (6) models.

The results are consistent across all models. Specifically, OECD similarity is shown as positive and significant in all the models which support the positive correlation between GDP per capita and OECD similarity for both BRIC and CIVETS.

In addition, current models also provide some evidence for reverse causality. Since OECD similarity in the past affects GDP per capita in the future. Then, OECD similarity 1 year, 3 years, and 5 years before they all affect the GDP per capita in the same way.

Table 3. Robustness test for econometric results of the relationship between GDP per capita and OECD trade structure similarity for BRIC and CIVETS (with 1, 3, and 5 years lags).

Dependent variable *GDPPC t+1/3/5*	**FE BRIC 1yr. lag (1)**	**FE BRIC 3yr. lag (2)**	**FE BRIC 5yr. lag (3)**	**FE CIVETS 1yr. lag (4)**	**FE CIVETS 3yr. lag (5)**	**FE CIVETS 5yr. lag (6)**
OECD-similarity	3.737**	3.835**	4.162**	3.437***	2.734***	1.607**
	(1.288)	(1.327)	(1.311)	(0.497)	(0.526)	(0.570)
OECD-similarity^2	-1.176	-0.886	-1.456	-6.863***	-5.924***	-4.155***
	(1.822)	(1.918)	(1.926)	(0.747)	(0.800)	(0.859)
Self-similarity	-0.211	-0.116	0.00659	-0.257**	-0.175*	-0.0762
	(0.123)	(0.125)	(0.120)	(0.0261)	(0.0816)	(0.0865)
Population (log)	-1.003***	-1.238***	-1.391***	0.454***	0.375***	0.239*
	(0.187)	(0.196)	(0.193)	(0.0997)	(0.103)	(0.107)
Openness (log)	0.0208	0.00278	-0.0236*	-0.0155**	-0.0115*	-0.0118
	(0.0107)	(0.0109)	(0.0106)	(0.00577)	(0.00572)	(0.00611)
Human capital	1.068***	1.249***	1.495***	1.082***	1.203***	1.366***
	(0.0847)	(0.0927)	(0.0982)	(0.0773)	(0.0842)	(0.0957)
Gross Capital	3.674***	3.209***	2.670***	2.504***	2.383***	2.125***
	(0.227)	(0.238)	(0.238)	(0.193)	(0.207)	(0.232)
Constant	10.39***	11.51***	12.08***	4.194***	4.432***	4.890***
	(0.935)	(0.992)	(0.975)	(0.280)	(0.291)	(0.303)
R-squared	0.923	0.921	0.927	0.932	0.927	0.915
Observations	198	190	182	308	295	283

Notes: Standard errors are shown in parentheses. * p<0.10, ** p <0.05, *** p<0.01.

4.3. Diversification into related industries

The findings from the previous chapter revealed a higher similarity of BRIC and CIVETS countries with OECD industrial structures has a beneficial effect on GDP per capita, suggesting that the direction of industrial structure diversification is more influential rather than change itself. This section, however, looks at the distance of diversification using the path-dependence approach. In order to analyze whether BRIC and CIVETS have followed or resisted path-dependence to catch up with more industrially developed structures, the study looks at the finding from the econometric equation.

The following histograms (Figure 9, 10) aimed to illustrate the probability of a group of countries developing a new sector. The product density indicator was explained in the previous chapter, the higher density of a country's industry implies that the number of industries similar to that industry is larger. The histogram separates the industries based on whether or not entry happened in that industry. Entry differs by with comparative advantage at *t-5* (if RCA>1) and without at *t* (if RCA<1), otherwise, there is no entry. The grey bars represent the ratio of new industry entry, while the highlighted red bars represent no new industry entry.

The two groups presented on the histogram have an obvious distinction. Looking at the product density indicator, it is clearly higher for the group with an entry in comparison to the group with no entry. The results suggest that the possibility of gaining a new comparative advantage in the industry grows if countries have a larger density surrounding that industry. Moreover, the results are applicable both for BRIC and CIVTES countries since the second histogram (Figure 10) has a similar picture, where product density is higher across the entry group compared to the no entry group. The findings support the argument that BRIC and CIVETS countries created new industries relying on established capabilities.

Overall, the CIVETS histogram shows a more skewed distribution to the left for the no-entry and in the case of BRIC it has a more l-shape, however, both entry and no entry have an l-shape but entry has generally higher frequency among the higher density.

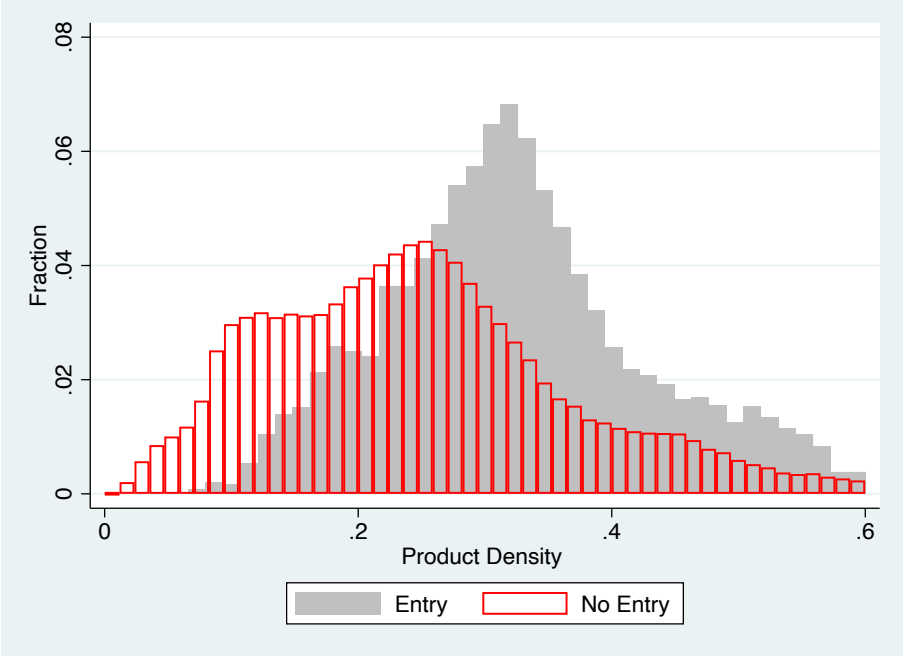

Figure 9. The probability of introducing a new industry depending on existing product density level (BRIC)

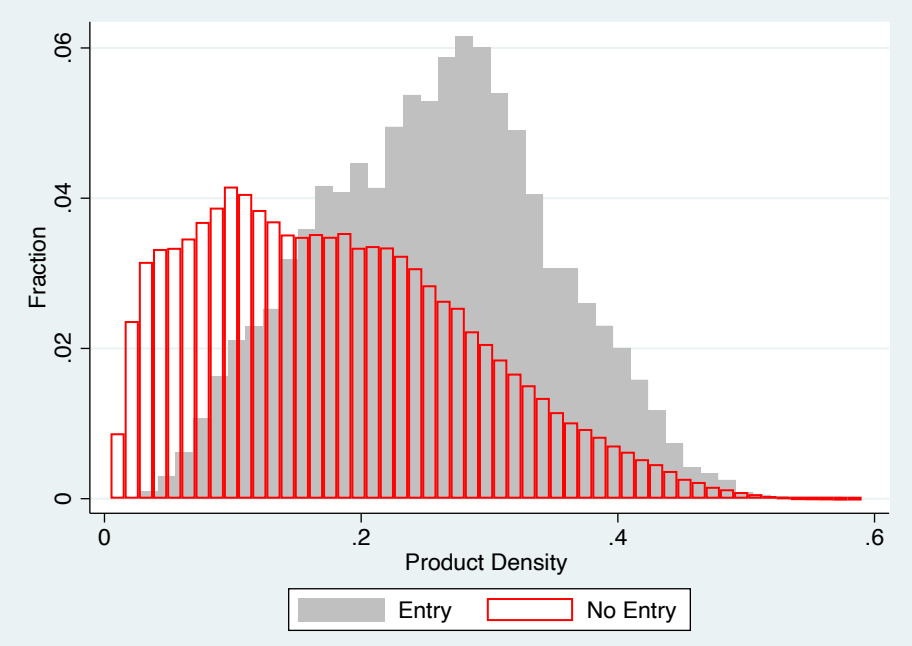

Figure 10. The probability of introducing a new industry depending on the existing product density level (CIVETS)

In addition to statistical evidence, the econometric analysis investigates if the lagged density indicator, which reflects comparative advantage in related industries in the preceding period, does have a positive influence on future expansion into new industries. Here, the dependent variable is the RCA dummy which shows whether the country has a comparative advantage in the past period. The key independent variables of interest are lagged RCA dummy and density. Both linear estimation and probit models are used in the assessment. Columns (1) and (2) include the results for the initial model with only RCA and density variables. Columns (3) and (4) show the results of the full model analysis, including all control variables. Columns (5) and (6) in addition to the same full model include year and location dummy variables. The regression demonstrates positive and significant results across key variables: RCA and density, for both BRIC and CIVETS groups of countries, confirming strong path dependence.

Looking at the industry volume variable, it's shown as negative and significant, implying that countries are more likely to diversify to smaller industries. Usually, industries with higher industry volume are very traditional, for instance, petroleum, automobiles, or semiconductors. Such industries are mostly dominated by mega countries. Those industries are very mature with related technologies being way advanced to catch up with. Thus, emerging countries can't

easily and fast diversify into such industries, hence, they are more likely to enter the industries that still have growth potential.

GDP per capita variable also is shown as positive and significant which implies that countries with higher GDP per capita are more likely to diversify to new industries.

Further, openness in the model (3) and (5) is positively and significantly correlated with the diversification process into new industries. Such results suggest that more open trade patterns of a country help in the diversification process.

Table 4. Econometric results for the probability estimation of diversification into related industries (BRIC, 1990-2019)

Dependent variable RCA_{t+5}	**Baseline OLS (1)**	**Baseline Probit (2)**	**Full model OLS (3)**	**Full model Probit (4)**	**Full model OLS (5)**	**Full model Probit (6)**
RCA	0.694***	0.635***	0.575***	0.129***	0.552***	0.157***
	(0.00263)	(0.0219)	(0.00328)	(0.0261)	(0.00345)	(0.0269)
Density	0.448***	5.436***	0.349***	4.936***	0.490***	4.862***
	(0.0104)	(0.152)	(0.0146)	(0.180)	(0.0199)	(0.218)
Industry Volume			-0.0467***	-0.372***	-0.0520***	-0.379***
			(0.00111)	(0.0180)	(0.00119)	(0.0206)
Openness (log)			0.0151***	0.0175	0.0145***	0.0218
			(0.000990)	(0.0143)	(0.00101)	(0.0146)
Gross capital			0.0820***	-0.0307	-0.400***	-2.935***
			(0.0165)	(0.192)	(0.0292)	(0.268)
Export share (log)			0.0341***	0.365***	0.0381***	0.365***
			(0.000743)	(0.0112)	(0.000781)	(0.0119)
GDP per capita (log)			0.0112***	0.365***	0.149***	1.481***
			(0.00142)	(0.0298)	(0.00984)	(0.0855)
Year dummy	No	No	No	No	Yes	Yes
Country dummy	No	No	No	No	Yes	Yes
Constant	-0.0278***	-3.347***	1.201***	5.324***	0.210*	-3.784***
	(0.00275)	(0.0558)	(0.0273)	(0.347)	(0.0856)	(0.837)
R-squared	0.559		0.577		0.581	
Observations	86998	86998	86998	86998	86998	86998

Notes: Standard errors are shown in parentheses. * p<0.10, ** p <0.05, *** p<0.01.

Table 5. Econometric results for the probability estimation of diversification into related industries (CIVETS, 1990-2019)

Dependent variable RCA_{t+5}	**Baseline OLS (1)**	**Baseline Probit (2)**	**Full model OLS (3)**	**Full model Probit (4)**	**Full model OLS (5)**	**Full model Probit (6)**
RCA	0.678*** (0.00239)	0.626*** (0.0176)	0.534*** (0.00292)	0.138*** (0.0210)	0.515*** (0.00302)	0.142*** (0.0215)
Density	0.344*** (0.0104)	3.282*** (0.106)	0.357*** (0.0123)	3.035*** (0.135)	0.495*** (0.0168)	2.751*** (0.181)
Industry Volume			-0.0429*** (0.000898)	-0.224*** (0.0138)	-0.0475*** (0.000973)	-0.282*** (0.0163)
Openness (log)			0.00737*** (0.000783)	0.0389*** (0.00950)	0.00878*** (0.000805)	0.0262** (0.00975)
Gross capital			-0.0846*** (0.0156)	-0.557** (0.172)	-0.126*** (0.0268)	-0.517* (0.207)
Export share (log)			0.0375*** (0.000563)	0.275*** (0.00710)	0.0392*** (0.000600)	0.290*** (0.00760)
GDP per capita (log)			-0.0260*** (0.00156)	0.139*** (0.0279)	-0.00448 (0.00566)	0.200*** (0.0473)
Year dummy	No	No	No	No	Yes	Yes
Country dummy	No	No	No	No	Yes	Yes
Constant	0.0180*** (0.00226)	-2.734*** (0.0401)	1.567*** (0.0231)	3.914*** (0.307)	1.465*** (0.0517)	4.324*** (0.547)
R-squared	0.490		0.517		0.521	
Observations	121925	121925	121925	121925	121925	121925

Notes: Standard errors are shown in parentheses. * p<0.10, ** p <0.05, *** p<0.01.

4.4. Reverse causality

This section reports the results of a system-GMM model which is aimed to analyze the reverse causality, specifically, if GDP per capita growth can affect OECD similarity.

Table 6 shows a positive and significant correlation between GDP per capita and OECD similarity across all models for BRIC and CIVETS countries except for model (4). It is notable that for all base models (1) and (2), the coefficient of OECD similarity is positive for both CIVETS and BRIC. As for the full models (3) and (4), OECD-similarity is still positive and significant for BRIC countries, however, it loses its significance for CIVETS under the effect of other control variables. Overall, the findings confirm the reverse causality across both groups of economies.

Table 6. Econometric results of system-GMM estimation for BRIC (1990-2019)

Dependent variable $\Delta GDPPC_t$	**GMM BRIC (1)**	**GMM CIVETS (2)**	**GMM BRIC (3)**	**GMM CIVETS (4)**
$\Delta GDPPC_{t-1}$ (log)	0.985***	0.981***	0.963***	0.946***
	(0.00480)	(0.00515)	(0.0162)	(0.00888)
OECD-similarity	0.155***	0.0937***	0.245***	0.0401
	(0.0377)	(0.0248)	(0.0713)	(0.0393)
Self-similarity			-0.103***	-0.00593
			(0.0214)	(0.0142)
Population (log)			0.00461	0.0104
			(0.0115)	(0.00953)
Openness (log)			-0.000220	0.00177
			(0.00225)	(0.00129)
Human Capital			0.0316*	0.0446**
			(0.0159)	(0.0172)
Gross Capital			0.0134	0.250***
			(0.0733)	(0.0487)
_cons	0.100**	0.170***	0.215	0.313***
	(0.0335)	(0.0390)	(0.142)	(0.0681)
Observations	198	308	198	308

Notes: Standard errors are shown in parentheses. * p<0.10, ** p <0.05, *** p<0.01.

Chapter 5. Discussion and Conclusion

5.1 Summary of the study

The effect of economic integration on country convergence and catch-up is a delicate subject. Economic scholars have long examined how economic integration affects a nation's development. Following previous research (De Benedictis & Tajoli, 2007; 2008), this study compares export structures using specific metrics and investigates how various export compositions impact the process of catching-up for emerging economies.

Income convergence is one of the world's big concerns, since large disparities in levels of income and living standards across nations or groups of countries may affect the entire process of global integration. This also holds true in other instances of integration across economies at various development levels. Hence, the current study closes the gap on catching-up in income levels in emerging groups of countries by comparing export composition to those of more industrially developed economies.

The dynamics of BRIC and CIVETS trade structures are examined in this study, with a focus on their convergence with OECD trade structures. By using the data from 1990 to 2019 the research analyzes the closeness in export compositions of BRIC and CIVETS countries to those of OECD. Specifically, the similarity index was employed to examine the similarity with both a country's own past export structure and with OECD. Furthermore, econometric analysis was conducted to estimate the relationship between the export basket and GDP per capita.

Moreover, this study provides some statistical and econometric evidence on the distance of diversification employing the path-dependence approach. Last, by estimating the correlation between present and past competitive advantage and density, the study provides some evidence on the countries' possibility of entering the new industry.

The findings indicated that there is a significant and positive relationship between trade structure convergence and economic catch-up. The results of the research further confirmed the path-dependence of BRIC and CIVETS trade structure dynamics, since new trade goods

formed close to the industries in which the countries already developed a comparative advantage.

5.2 Implications

The findings of this study have a number of critical implications for BRIC, CIVETS, and other countries trying to catch up. Export and industrial structure change are important determinants of economic growth and the ability to close the gap with higher income, more industrially developed countries. The results reveal that direction and distance are the key elements of the industrial structure change. Specifically, the convergence with OECD countries connected to both the trade structure shift towards more industrially developed countries as well as a divergence from the previous trade structure. The speed of catch-up is reduced when there is no directionality because scarce technological resources are scattered over several prospective industries. Furthermore, governments are faced with the tough dilemma of which sectors to select, i.e., which path is ideal. Nevertheless, the impact of innovation development strategies is questionable since these

strategies typically overlook direction, which allows shared objectives to be strategically determined (Weber & Rohracher, 2012). From a national standpoint, selecting certain sectors for growth necessitates a multi-pronged strategy, emphasizing the comparative advantage of current technological capabilities could be especially significant for emerging economies in their early stages. It is worth noting, that structural shift does not happen drastically, but rather gradually.

This study contributes to the extant literature by providing statistical and empirical evidence of industrial structure change and economic catch-up, by analyzing cases of emerging economies. Furthermore, this research provides empirical evidence of path-dependence in industrial structural change, by examining emerging economies' cases. Additionally, the study analyzes the phenomena of reverse causality of the catch-up process and trade structure similarity.

From the perspective of innovation policy, governments of emerging countries should support the technology transfer from developed countries to observe their capabilities so they can focus on developing the same industries in their own counties. Furthermore, trying to diversify into high-tech and complex sectors, which would

appear to be the goal if the only focus is on the direction of structural changes, may be appealing. Yet, taking into consideration that the current capabilities of the emerging counties may vary, economic catch-up strategies and diversification paths would also be different. Last, the gap between existing knowledge and capabilities in related industries may limit diversification opportunities for the latecomer economies.

5.3 Limitations and future research

This study has some limitations which can be addressed in further research. First, throughout the evaluation, this research does not distinguish between the unique industries' characteristics. The ability to advance in a certain industry is affected by its technological, environmental, and cultural aspects. Although all industries make an equal contribution to the catch-up in trade structures, their contributions to economic catch-up might vary (Ibrahim & Vo, 2020). Even though the decomposition of similarity by industries was not the focus of the current research, it was observed that the sectors which have the highest

frequency of entry were discovered to have little technology lock-in since those goods require less knowledge or technological experience to expand into sectors. Hence, continued research on specific industries may help to fill in the gaps in this study.

Furthermore, this research focuses on changes in industrial structures rather than the level of competence of every industry. This research examines whether or not nations have a comparative advantage, assuming that comparative advantage is identical. Nevertheless, various levels of comparative advantage could exist, which might result in alternative options for moving forward with related goods. Hence, other indicators for comparing and monitoring rates of growth for comparative advantage should be incorporated. In addition to what the country exports, the value-added input in international trade would be relevant in understanding the drivers of the economic catch-up of emerging countries.

Last, the study only focuses on the "successful" cases that show positive economic growth in terms of GDP per capita. Hence, the implications might be limited to emerging countries, rather than developing economies in general. Therefore, further research should

investigate other countries' cases and provide relevant suggestions for economic development.

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Abstract (Korean)

무역 구조는 신흥국의 성장률에 영향을 미치는 주요 요소로 다루어지고 있으며, 특히 최근 연구는 국가 간 수출 구조의 유사성을 주목하고 있다. 본 연구에서는 국가 간의 수출 구조 유사성과 경제 추격, 즉 신흥국이 선진국의 소득수준을 따라잡게 되는 과정의 관계를 분석하여 수출 구조가 경제성장에 미치는 역할을 연구한다. 본 연구는 신흥국으로 꼽히는 BRIC 및 CIVETS 에 속한 각 국가의 수출 구조를 상대적으로 산업 고도화가 이루어진 경제협력개발기구(OECD) 회원국의 수출 구조와 비교한다. 이를 통해, 본 연구는 BRIC 과 CIVETS 의 경제가 수출 구조의 변화를 통해 OECD 의 경제수준을 따라잡는 데 영향을 주었는지 확인하였다. 본 연구의 결과는 OECD 국가들과 유사성이 높은 BRIC 및 CIVETS 국가들이 경제 추격을 달성하고 있음을 보였으며, 이를 통해 수출 구조의 유사성이 경제 추격에 긍정적이고 유의미한 효과를 보인다는 것을 시사한다.

주요어 : 무역구조, 수출 유사성, 경제적 추격, 다양화, 경로의존성, 비교우위
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