A Study on Export Capabilities and Industry Emergence

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Abstract

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This study aims to show a country's capability in exporting goods and services can contribute significantly to the emergence of new industries. It has long been considered that a country's long-term economic growth is spurred by the county's production capabilities, otherwise known as export capabilities. Some insightful works have attempted to explain a country's economic growth pattern in conjunction with production capabilities by utilizing the measures of relative comparative advantage and network analysis. However, representing the evolution of the country's capability were met with some difficulties with some countries showing erratic and discontinuous spread of production capability that is not aligned with their pattern of economic development. Such problem could root from the fact that it is cumbersome to fully realize the countries' participatory dynamics in the global value chain. This paper utilizes indicators from the Trade in Value Added (TiVA) data from OECD to perform econometric analysis on how a country's past capabilities, production and value-added capability, can contribute in the emergence of new export capabilities, and thus, industries. The results show that first, value-added data from TiVA databse can represent countries capability yet to be presented by gross exports data. Second, the emergence of the industry is correlated higher to the value-added capabilities of related industries in the past. Third, emergence of new industries follows different paths of capability development depending on the income level of the country.

Keywords: Capabilities theory; Trade theory, Economic Development, Global Value Chain, Comparative Advantage

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Chapter 1. Introduction

This study aims to show the value-addedness of countries' export items contribute considerably to their industry emergence. Through utilizing Value-added data produced by OECD(Backer & Miroudot, 2013), it is possible to stratify the extent to which a country has added real value in a product's production process. In other words, value-added data can represent a country's capability of producing goods that leads to consequent emergence of industries.

A close relationship exists between export, production capability, and economic development. Production capability and export both exert considerable amount of force on economic development. Emergence of new industries and its following development features a path-dependent characteristic as it is driven by the accumulated experience and capability of the past. In other words, the development of new industries is prompted by the movement of knowledge and capability underneath the production capability needed to propagate export activities.

The Product Space(Hidalgo, Klinger, Barabasi, & Hausmann, 2007) effectively portrays the path-dependency of a country’s expansion of export portfolio. However, when such movement of knowledge and capability is portrayed in a form of network analysis, some countries show an erratic and discontinuous spread of production capability that is not aligned with their pattern of economic development. This could be due to the increasing trend of global fragmentation of production, where numerous countries participate in a chain of distinct production stages, driving export volume to no longer fully represent a countries' comparative advantage.

Therefore, a reimplementation of quality-based measure in the Product Space is suggested to show the quality dimension of a countrys comparative advantage. Through using the Trade in Value-Added(TiVA) data produced by OECD, this research will be able to refine the results offered by the original product space, all the while showing how value-addedness in a product can propagate advances in nearby products.

Chapter 2. Literature Review

2.1 Industry Emergence and economic development

Industry emergence, or the emergence of new sectors in a country has been recently considered as one of the fundamental processes of economic development. This is especially true in the light of the several industrial revolutions the humanity has had for the past few hundred years. As Saviotti and Pyka has said in 2013, “a very large number of new sectors have been created since the industrial revolution, and examples of these sectors are those producing cars, aircraft, computers, radios, television, refrigerators, plastics, etc’. Indeed, the creation of new sectors have benefitted a number of countries and firms by allowing them to enjoy a temporary monopoly following the first-mover advantage. Emergence of new sectors and industries, therefore, follows largely a Schumpeterian logic where the new sectors are created and destroyed as the innovators enter and exit them.

Briefly outlining the logic, the emerged industries soon face saturation by the imitators that intensifies the internal competition. With the increased demand for the product of the new sector, the adjustment gap is filled up to transform the sector into a mature industry. In a mature industry, many incumbent firms decide either to stay or to leave, where exits can make the industry become an old or fallen industry. The firms that exit may create or enter a new sector, closing up a loop of Schumpeterian industry cycle. Since firms entering new sectors, according to this logic, experience a temporary monopoly where the aggregated effect potentially lead to overall economic development. By this mechanism, the emergence of new sectors, is even considered as one of the fundamental mechanisms of economic (P. P. Saviotti & Pyka, 2004); (Pyka & Saviotti, 2013).

Emergence of new industries or sectors is also a result of ‘structural change’. Here, ‘structural change’ refers to the changes occurring due to structural shift and increasing variety. Such structural change leads to economic growth, as proposed by many researchers (Fagerberg, 2000); (Peneder, 2003); (Timmer & de Vries, 2009), where aggregate productivity and the innovation rates of different sectors were correlated at the country level. Here, the divergent patterns of economic growth of many countries were explained on the basis of heterogeneous technological advance patterns of different industries.

In early days, however, structural shift was the main factor the most economist focused on when explaining the change in economic structure. Structural shift was tackled especially during the mid-20th century when rapid development of manufacturing industry was witnessed through global industrialization. Many has shown the transition to manufacturing industry has led to economic acceleration (Fisher, 1939); (Fabricant, 1940); (Clark, 1940). However, as the importance of technology and knowledge became heightened in modern days, increase in variety of industries, especially the increase in total number of technology-based industries, had been highlighted as the source of accelerated economic growth(P. P. Saviotti & Pyka, 2004); (Kim & Heshmati, 2014).

Several attempts were made to highlight the importance of industry emergence by describing the regional diversification in terms of industry relatedness(Neffke, Henning, & Boschma, 2009). Also, the emergence of technology-based sectors were analyzed under a proximity-based analysis where the term ‘new’ is set to describe when the technological activities develop comparative advantage from nothing(Colombelli, Krafft, & Quatraro, 2014). A TEVECON model is a prime example of a model that attempts to explain economic development on the basis of industry emergence(P.-P. Saviotti, Pyka, & Jun, 2016). In all these literatures, emergence of new sectors or industries is considered as a structural change in region that can have positive effect in economic development of the region.

2.2 Export and economic growth

There have been numerous studies that attempted to link export with economic developments, thereby explaining how countries obtain a certain comparative advantage over others. The milestone literature in respect to comparative advantage can date back to Ricardian model first introduced by David Ricardo in his seminal work "Principles of Political Economy and taxation (1817)". Here, he introduced his theory on international trade that builds on comparative advantage and specialization. Ricardian trade specialization is the result of differentiated labour productivity of different countries.

After that, the factor proportions theory roamed the economic landscape. HOS model, for example, considered the initial endowments, capital and labour, as the main source of production goods (Ohlin, 1933; Heckscher, 1949). Therefore, a country is comparative advantage in export items is based on what the country is abundant in, be it labour or capital.

Contrary to the belief observed in neo-classical microeconomics, Chamberlin considered product differentiation as welfare enhancing as opposed to welfare reducing(Bellante, 2004). According to Silva(2001), Chamberlin characterized market nature "both by the number of firms and the product differentiation, where firms control product (differentiated) prices, quantities, product quality, and, in this process, they use tools such as advertising in result of differentiated production, attempting to "better" sell his own (differentiated) product". In other words, Chamberlin looked at monopolistic competition from nonprice competition as well as price competition as well. Departing from foregoing Chamberlinian monopolistic competition, the notion of intra-industry specialization, or, horizontal specialization started to emerge. While Dixit and Stiglitz showed product variety expands along with economic growth(1977), Krugman formulated models to show the effects of both inter- and intra-industry specialization((Krugman, 1985); Krugman, 1981). Such findings suggest the conventional assumptions regarding endowments and technology, which are highly related to forces behind inter-industry trade, were compared with consumer utility and scale economies, a driving force behind intra-industry trade.

Empirical research in regards to the relationship between product variety in trade and economic growth were explored by many researchers. For example, Feenstra(1994) found that incorporating new product varieties in U.S. import portfolio can still explain the high income elasticity. Study of the relationship between import and export varieties and gdp growth across 19 OECD countries showed positive result, according to Funke and Ruhwedel (2001)

Product quality, or quality margin, of traded goods is also a frequently used tool of gauging economic growth. The basic idea is that richer countries with process and export higher-quality goods(Hummels & Klenow, 2005). Such as idea is also expressed as ‘vertical differentiation model’ which were set out by a number of scholars. Harry Flam and Elhanan Helpman(1987), for example, showed that the North-South divide also experience quality difference in exported items. Grossman and Helpman(1991) proposes that product innovation in quality generates an ever-expanding range of horizontally differentiated products (a variety margin of products) as both quality- and variety-based models have identical reduced forms. Finally, Schott(2004) tested for the quality difference in imported goods of the U.S., finding that there exists an endowment-driven specialization pattern *within* product categories, while the results rule against for *across* product categories.

One of the most important changes in the last several decades, however, opened up a new domain of trade specialization: vertical specialization. While the term vertical specialization, coined by Balassa(1967) and Findlay(1978), refers to the increasing interconnectedness of a good’s production sequence whereby multiple countries participate in a particular production stage, there is a wide array of terms describing the very phenomenon: ‘disintegration of production’, ‘vertically fragmented production process(OECD, 2012)’, ‘multi-stage production’, and ‘intra-product specialization’. The mid-1990s encountered the ever-increasing scope and scale of inter-connectedness of the global economy accompanied by the chains of global supply and complex trade relations(OECD, 2018). According to Hummels et al(1999), vertical specialization occurs under three conditions: (1) a good must be produced in multiple sequential stages, (2) two or more countries must specialize in producing some, but not all, stages, and (3) at least one stage must cross an international border more than once. One must not that the meaning of vertical ‘specialization’ differs slightly from that of vertical ‘differentiation’, as specializing refers to being in charge of one or more processes in the making of a single product variety, while differentiating implies an improvement in quality of otherwise identical products. The notion of vertical specialization was used to explain the growth of international trade(Yi, 2003) and global production(Hummels et al, 1998).

2.3 Capabilities Theory

As the role of technology entered the picture in the 1960s, classical economics that dealt with endowments were met with skepticism. Posner's technology gap theory resonated with the economics community, whereby certain industrial sectors may well benefit more than others from the use of technology. Countries specialising in such technology-intensive sectors will enjoy a temporary monopoly as long as they assume the position of technological lead(Posner, 1961). A formal neoclassical model of Posner's idea was put forward by Krugman in his work 'A ' Technology Gap' Model of International Trade' in 1985, where he has shown 'exports can be ranked on a ' scale' of goods' which are organized in a ladder-like form with each associated countries. A more evolutionary take on modelling of the 'technology gap' can be referred to Krugman's later work that shed light on the 'learning-by-doing' nature of the evolution of comparative advantage(Krugman, 1987). Through this, it was shown that there are other determinants that underscore the country's ability specialize in industrial sectors other than endowments. A technological capability, otherwise can be expressed as knowledge, plays a critical role in fostering lead in production, moreover demonstrating a continuous development of comparative advantage following the evolutionary pattern of knowledge attainment.

The great relevance between 'capability' and economic growth must be stressed. Hirschman's classic *The Strategy of Economic Development*(1958) puts forward his belief in engaging in productive activities that can prompt 'forward thrusts that are meant to create incentives and pressures for further actions'. Moreover, the MIT production in the Innovation Economy (PIE) Commission has linked the enhancement in productive capability as a major source of innovation, furthermore economic growth (Dertouzous et al, 1989). As such, the importance of manufacturing, historically and empirically, is shown through various case studies of the US itself, and other fast-following countries. Pisano and Shih(2012) argues that it is the investment in manufacturing sector that will revamp the lost potential of America, and the actions from both private firms and government is needed in this context. Berger(2013), in his publication *Made in America*, refers to the inseparable nature of innovation and production, thus their role in improving a nation'(Audretsch, 1987)s productivity. Subsequent work produced by the PIE Commission in 2014 repeatedly confirms the importance of production in innovation and economy, additionally stressing the procurement of production ecosystems(Locke & Wellhausen, 2014).

What does the emergence of new industries imply about capability building? Evolutionary Economics postulates that the development of new industries are based on the accumulated experience and capabilities(Neffke et al., 2009). Patel and Pavitt(1997) has shown that there is a path dependency in firms' capability building, and their complexity builds up over time. Furthermore, the emergence of new industries in a region was shown to have high correlation to its pre-existing industrial structure. Such argument was tested in both regional and national level, where it was shown that the proximity to the regional industrial structure is more conducive to the emergence of new industrial outcomes than national industrial structure(Boschma, Minondo, & Navarro, 2013). In the study where the structural change of Industry portfolio was analyzed from the viewpoint of evolutionary economics, ‘regional branching’ behavior demonstrated the path-dependent nature of industry expansion(Neffke, Henning, Boschma, 2009).

The expansion of industry portfolio based on accumulated capability can be represented through network visualization. Hidalgo et al. (2007) presented a ‘product space’ where classified products are linked according to the proximity − a probability a two set of products are exported simultaneously. Hausmann and Klinger(2019) puts forward the similar concept explain how the initial industrial structure determine the consecutive path of industrial expansion. The results of both studies show that countries tend to expand their export basket by ‘jumping’ to nearby products, showing industrial advancement is based on past and current capabilities. Especially important to this is the fact that there are core products that is dominated by high-income countries and peripheral products reversely exported by low-income countries. The simulation result given by Hidalgo et al. (2007) explicates that those countries occupying the peripheral products have more difficulty in approaching the core products.

2.4 Global Value Chain and Value-addedness

Theories regarding the trade specialization pattern went through a series of evolution, from endowment-based view to a more capability-centered view. It is possible to see that the network visualization and simulation of countries’ export pattern over time confirmed the latter view by showing that countries’ development in comparative advantage have path dependent nature.

Current trend of trade specialization pattern where the role of vertical specialization is being strengthened at an ever-increasing speed, however, sets a hurdle in fully acknowledging a country's genuine capability. Due to the obscurity in interpreting the export data in terms of intermediate goods and final goods, some countries were shown to have comparative advantage in goods where they only serviced the less-value-added stage of the production process i.e. assembly stage. Therefore, representing the country's authentic knowledge and production capability can be better carried out through incorporating the value-added dimension of exported products.

Incorporating the value-added dimension in representing country's capability means more attention should be given to the fragmented nature of value chain and departs from the idea of exchanging only final goods. Referencing the idea of a value chain, where Gereffi and Fernandez-Stark described as a "full range of activities that firms and workers do to bring a product from its conception to its end use and beyond(2011)", it is possible to know a production of a good inevitably involves steps and processes that sequentially adds value to the product. The relevant activities can refer to all processes needed in producing a final god, those including design, production, marketing, and distribution. The term 'Global Value Chain' became a standard term in the 2000s, where Porter first suggested the term to describe the trade or an activity an organizational body performs to add value to the organization’s product and services (Porter, 1985). The phenomenon of global value chain adds the three core ideas to this (Backer & Miroudot, 2013): 1) the increasing fragmentation of production across countries, 2) countries more and more specializing in tasks and business functions rather than a physical final good, and 3) heightened importance of global networks with global buyers and suppliers as key players. Therefore, the interpretation is as follows: with many players being involved in the globally dispersed production processes of goods and services, specializing in the production activity that adds most value is becoming a crucial factor in increasing a country’s competitiveness within the global value chain.

Ideas equivalent to that of value chain made its first appearance in the realm of academia in the name of commodity chain in late 1970s (Bair, 2005). It was after the 1980s, however, the phenomenon of globally fragmented production processes gained traction to enlarge into a formidable scale due to the rapid technological development, liberalization of trade and investment, regulatory reforms in transportation and infrastructure, and increase in global demand as a result of unprecedented rate of economic development(Backer & Miroudot, 2013).

It is easy to understand that being connected to each other bore significant importance in economic gains from trade and thus, economic development. Indeed, Pankaj Ghemawat, a developer of DHL Global Connectedness Index, has utilized the idea of supply chain to emphasize the growing importance of interconnectedness between countries and involvement in international flows in economic development

(Altman, Ghemawat & Bastian, 2019). According to him, countries with high global interconnectedness enjoyed a very high level of human resources and economic development where global interconnectedness admittedly factored in a such outcome. Global Value Chain is also an outcome of firms reallocating the production steps in more efficient regions, thereby optimizing the overall production process. Factors that compose the regional comparative advantage, for instance “Technological progress, costs, access to resources and markets and trade policy”, has accelerated the disintegration of production process which prompts firms to build efficiency and competitiveness (Backer & Miroudot, 2013). In sum, being involved in Global Value Chain in the modern world, as hard it is not to be, gives salutary effect to a nation’s economic development and gaining of global competitiveness.

Participation in global value chains by OECD countries in 2008 was about 40% to 80% of total exports(Backer & Miroudot, 2013). This is comparable to the 21 non-OECD countries, suggesting wide range of participation in the global value chain by countries around the world. Indeed, Gereffi, Humphrey and Sturgeon (2005) found that one of the most important features of the modern economy is the vertical integration of transnational corporations. However, it is important to note that the trend of vertical integration of transnational corporations redefines the core competence of firms in the most value-added sectors of innovative product strategy, marketing, manufacturing and services, and reduces the ownership of non-essential sectors such as general-purpose services and mass production. Similarly, it was shown that emerging countries began to specialize in intermediate goods between 1995 and 2008, especially in Asia (China, Malaysia, Philippines, Singapore) and the Americas (Chile). This shows that there exists a direction of stream in global value chain, where upstreamness represents the higher value-added and downstreamness represents the lower. The activities associated with them also vary, upstreamness usually associated with marketing and branding and downstreamness with mass production and general-purpose services.

Value-addedness captures the essence of country's contribution in producing a product. To quote Robert (2014), "value-added exports break down GDP sold across destinations", showing the significance of value-addedness have on the country's economic growth. Value addedness is calculated through a two-step process: First, total amount of output that is needed to produce the final good in final destination is aggregated. Second, flesh out how much of domestic input was contributed in generating that output. In order to do this, global input-output framework is utilized to track backwards how the final product arrived in the final destination, using well the input requirements from other countries.

Value-added data utilized in this study follows the same logic. The description of the data describes it as a value that "captures the value added that industries export both **directly**, through exports of final goods or services and, **indirectly** via exports of intermediates that reach foreign final consumers (households, government, and as investment) through other countries" and also to be interpreted as 'exports of value added’(OECD, 2016).

Attempts to represent capability with value-added data was made by expressing the comparative advantage as a vertical comparative advantage(VCA) (Beaudreau, 2013). Indeed, existing trade theory as well as trade data were at odds with observed trade pattern((Dunning, 1995)). In this literature, many descriptive statistics were used to show the importance of vertical comparative advantage on the basis of what capability each industry may possess, those including resource-based and knowledge-based. However, no effort was made to show how these calculated capabilities can have impact on countries economic development, especially from the perspective of industry emergence.

Chapter 3. Methods

3.1 Research Scope

This research attempts to show that the ability to create value in products and exports better represents the capability of a nation, furthermore better predicts the emergence of new industries, which is very closely related to economic development. In order to do this, this research utilizes the publicly available data that indicates the value-added amount of total exports in monetary form and shows its relationship to capability and its relation to future industry emergence. It must be noted that the data utilized in this research is in aggregate form, ISIC revision 3, 2-digit. Therefore, this research shows how the comparative advantage of an industry, not a single product from an industry, can play a role in the emergence of new industries. Thus, following hypothesis is constructed:

Hypothesis 1: Value-added exports can represent the capabilities a country has.

The method will include a network analysis, following pioneering work of Hidalgo and Hausmann, where exported products and the similarity between them are portrayed in a form of network. By showing the probability of industry i gaining comparative advantage at time t depending on how capable the nearby industries were at time t-5 with value-added data, it is expected to show the importance of countries developing value-creating export capability in making new industries emerge. Therefore, following hypotheses is constructed :

Hypothesis 2: Value-added exports of related industries will have more be more positively related to emergence of industry i in the future.

Hypothesis 3: Effects of gross exports and value-added exports of related industries on future emergence of industry i will differ accordingly to a country's development stage.

3.2 Data

Many data types that aim to express the value-addedness of countries' exports are available. One of the examples is the Asian International Input-Output (AIO) Table. AIO table is constructed by IDEJETRO and contains the information regarding input composition and output distribution of each domestic industry. The data is available for years between 1985 and 2005 at 5 year interval, covering 76 sectors. The limitation of this data for this study, however, is the country coverage as it only contains input-output information of Indonesia, Malaysia, the Philippines, Singapore, Thailand, China, Taiwan, Korea, Japan, and the US. GTAP Input-Output Data Base records the annual flows of goods and services for the entire world economy, those including more than 120 countries and 57 sectors. The data is predominantly used as a 'key input into contemporary applied general equilibrium (AGE) analysis (Walmsley, T., Aguiar, A., & Narayanan, B., 2012)'. A problem with GTAP Input-Output data, despite the advantage of its wide coverage, was that the data is quite specifically constructed for the use in AGE analysis, which meant the database was not adequate to serve as an economic variable as it would be treated in this analysis. The authors of GTAP database quote "… the objective of the GTAP Data Base is not to provide IO tables, but to facilitate the operation of economic simulation models ensuring users a consistent set of economic facts (Walmsley, T., Aguiar, A., & Narayanan, B., 2012)". However, the biggest flaw of both AIO table and GTAP database is that the data was collected based on a particular benchmark year, which puts a huge constraint on conducting a time-series analysis. The World Input-Output Table is a database most widely used for global value chain research. The database integrates the two sets of data, the supply and use of resources and international trade in goods and services, collected around the world to construct a harmonized world input-output tables(Timmer, M. P., Dietzenbacher, E., Los, B., Stehrer, R. and de Vries, G. J., 2015). OECD TiVA database is vis-à-vis to WIOT in terms coverage and construction method and carries an advantage of accessing the derived indicators of exports and value-added rather than calculating them from the raw data. Thus, TiVA data was utilized in this analysis. The data are from the 2016 version of OECD-WTO TiVA database(OECD, 2016), covering 64 economies including both OECD and non-OECD economies and 33 sectors from 1995 to 2011. The sectors are classified following the 4^{th} Revision of ISIC classification. Two indicators were used, Gross Exports (EXGR) and Domestic value added embodied in foreign final demand (FFD_DVA). GDP per capita data extracted from Penn World Table was used as a control variable(Feenstra, et al, 2015). With this, a balanced panel dataset is constructed.

3.3 Variables

In order for this research to show the comparative advantage an industry of a country has to others, a adequate measure must be used. Following Balassa's definition(1965), Revealed Comparative Advantage of industry i of country c is calculated using the equation (1).

$$(1)\ RCA_{(c,i)} = \frac{\frac{x(c,i)}{\sum_i x(c,i)}}{\frac{\sum_c x(c,i)}{\sum_{i,c} x(c,i)}}$$

Formally, an industry i of country c is considered to have a comparative advantage (RCA) if the RCA measure exceeds 1. Thus, when RCA at time t equals 0 and RCA at t+n equals 1, such industry is termed as transition industries((Hidalgo et al., 2007)). However, Balassa's revealed comparative advantage(RCA) has a problem of its output ranging from 0 to an infinity, meaning it cannot be compared on both sides of 1. In order to combat this issue, Laursen(2000) developed a measure that transforms RCA value into a symmetric value, which is also the dependent variable of this analysis. Calculation of RSCA is as follows:

(2) $$RSCA_{(c,i)} = \frac{(RCA_{(c,i)}-1)}{(RCA_{(c,i)}+1)}$$

Using the RCA measure of county c in industry i, it is possible to approximate the closeness between industries. Although many factors can contribute in determining the closeness between industries, those including labor intensity, available land, capital, technological sophistication, inputs and outputs involved in the production process, and requisite institutions, Hidalgo assumes the production of two product will be conducted in tandem if they require similar inputs (e.g. institutions, infrastructure, physical factors, technology, etc), therefore takes outcome-based measure to quantify the closeness between two products(Hidalgo et al., 2007). This study takes the same approach and apply the concept on the industry level, as expressed by the following equation (3):

$$(3)\ \ \phi_{i,j,t} = \min\{P(RCA_{i,t}|RCA_{j,t}),\ P(RCA_{j,t}|RCA_{i,t})\},$$

$$\text{where } P(RCA_{i,t}|RCA_{j,t})\ is\ the\ conditional\ probability\ of$$

$$exporting\ good\ i\ given\ that\ you\ export\ good\ j$$

The intuition is that if the ratio between the number of countries producing products from industry i(or j) and the number of countries producing products from industry i and j simultaneously is closer to 1, it is more likely that the capability needed to produce products from industry i is similar to that of product from industry j, and vice versa. Since this intuition inherently results in pairwise conditional probability, one should take the minimum value between the two. The closeness of two industries is named ‘proximity’ hereafter. Using the proximity values, a network constructed to express and visualize the relationship between industries, where a node represents an industry and an edge represents the proximity between industries(Figure 1).

As can be seen from the figure, an industry can be connected to multiple industries by a different degree, or not be connected at all. The figure does not depict the degree of proximity, however it is possible to understand that an industry will be connected to other industries that require the similar capability to produce export items. With this logic, the level of capability of the connected (or related) industries i to industry j can be calculated using the following equation:

$$(4)\ \omega_i = \sum_j x_j \phi_{ji} \,/\, \sum_j \phi_{ji}$$

x_i equals to 1 when the connected industry i has RCA more than 1, and zero otherwise. ϕ_{ij} less than 0.5 was also omitted to capture the main interrelations. ω_j is referred to as 'density' and will be served as a method to produce the two independent variables. The econometric analysis will have two density measures of industry i produced using the export data and value-added data regressed against the revealed symmetric comparative advantage (RSCA) industry i has after 5 years. In other words, this analysis will be testing how much the capability the related industries of industry i will affect the capability industry i will have in the future.

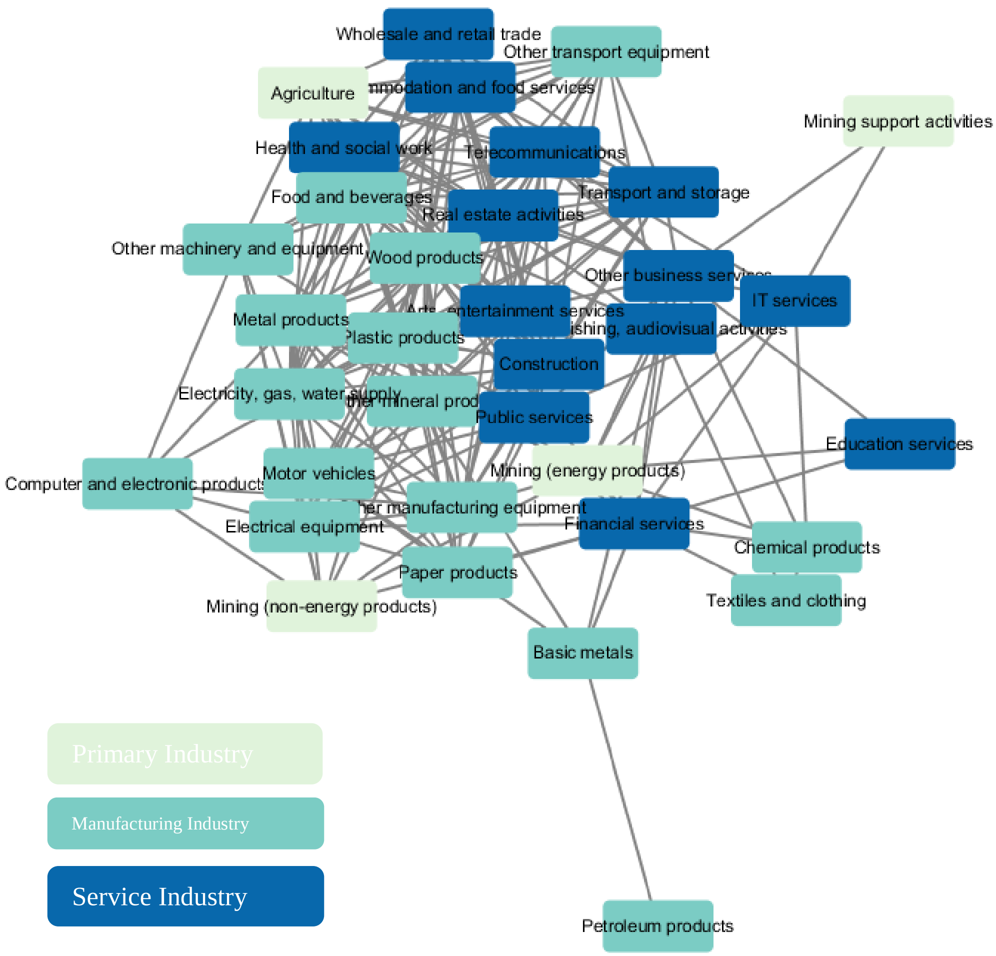

Figure 1 Network Representation of Industries

Source: Author’s drawing

3.4 Method

This analysis first attempts to show how value-added data can act as a proxy for capability. Thus, three indicators that can explain innovation and capability is chosen to show correlation between them. Also, descriptive statistics are used to show the validity of value-added data. Second, econometric analysis will be conducted to show how value-added export can contribute in total export in 5 years time.

This study conducts Generalized Least Squares (GLS) estimation. Density values based on gross export volume and value-added export volume of industry i of country c at time t are utilized as the independent variables. RSCA value based on gross export volume of industry i of country c at time t is utilized as the dependent variable. Control variables include GDP per capita, and RCA values for both export and value-addedness expressed in binary form when the value equals to or is more than 1. Because this study uses a panel dataset, there is a possibility a few of OLS assumptions may be violated. To ensure this, robustness test on heteroskedasticity and autocorrelation is made. Also to control the effects on country, industries, and time, dummies for each component is included. The econometric estimation is expressed as follows:

$$(5)\ \boldsymbol{RSCA_{Gross}Exports_{c,p,t+5}} = \boldsymbol{\beta_1 Density\_Value\ Added_{c,p,t}} + \boldsymbol{\beta_2 Density\_Gross\ Exports_{c,p,t}} + \boldsymbol{\Phi_c} + \boldsymbol{\Psi_p} + \boldsymbol{\alpha_t} + \boldsymbol{\varepsilon_{c,i,t}}$$

This study goes further to understand the effects of gross exports and value-added exports. GLS estimation is conducted separately according to the development level of countries. Development level of countries are grouped accordingly to World Bank standard of income economies, where low-income economies are economies with GNI per capita less than $1,025, lower-middle economies are that ranging between $1026 and $3995, upper-middle income economies are that ranging between $3,996 to $12,375, and high income economies are that more or equal to $12,376(World Bank, 2020).

Chapter 4. Result

4.1 Can value-added data act as a proxy for capability?

With many research utilizing gross export data to calculate relative comparative advantage, therefore interpreting it as a proxy for capability, this study attempts to see if value-added data can represent them as well. In order to see this, value-added data was correlated with the primary indicators that represent the notion of capability. The indicators were chosen on the basis of three criteria: technological capability, human resource capability, and production capability. Such decision was made under the taxonomy of Beaudreau(2011)(Beaudreau, 2013), where comparative advantage of vertical specialization is formalized in two types: structural and arbitrage vertical comparative advantage(VCA)(Table 1).

For Knowledge-Creation Advantage, number of patents was used. For resource advantage, exports of final products were used. For labor advantage, number of researchers in R&D was used. For Capital Advantage, the amount of fixed capital formation was used. The results show that there is a highly positive relationship between value-added exports and advantages in knowledge-creation and resource(Figure 2, Figure 3). A considerable relationship was observed between value-added exports and advantages in labor and capital(Figure 4, Figure 5). The same was revealed when conducted simple regression, as can be seen in Table 2, Table 3, Table 4 and Table 5.

The results confirm that value-added exports are closely related to the main indicators of capability, justifying the utilization of the data in this study.

Table 1 Beaudreau (2011) Taxonomy of VCA ((Beaudreau, 2013))

VCA	Type	
Knowledge-Creation Advantage	Structural	Ability to abstract, innovate, conceive, and realize VAVCs
Resource Advantage	Structural	Possess natural resources, renewable and non-renewable
Labor Advantage	Arbitrage	Abundant, cheap labor (Skilled and unskilled)
Capital Advantage	Arbitrage	Abundant, cheap capital (long-term and short-term)

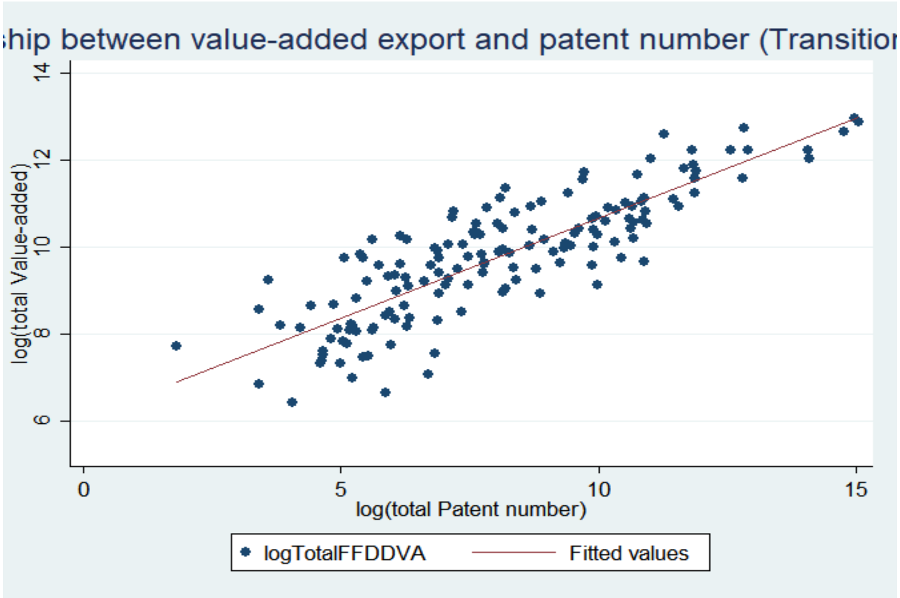

Figure 2 Relationship between patent number and total value-added

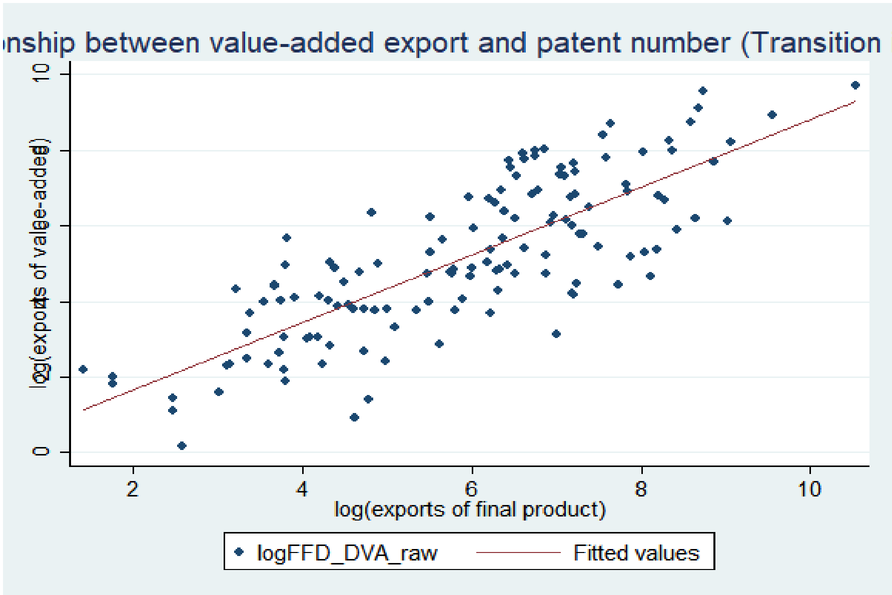

Figure 3 Relationship between exports of final product and value-added exports

Figure 4 Relationship between researchers in R&D and total value-added

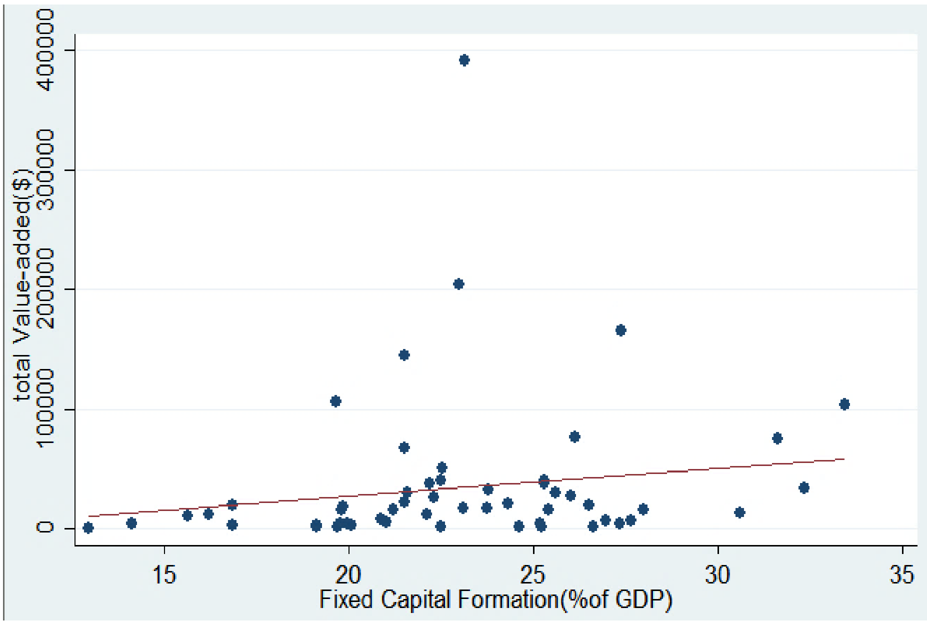

Figure 5 Relationship between fixed capital formation and value-added

Log(total value-added)	Simple Regression
Log(total patent number)	0.448^{***}
	(0.000)
_cons	6.295^{***}
	(0.000)
N	6900
adj. R^2	0.7051
F	16497.24
	(0.000)

Table 2 Simple regression between patent number and total value-added

Log(exports of value-added)	Simple Regression
Log(exports of final product)	0.931^{***}
	(0.000)
_cons	-0.611^{***}
	(0.000)
N	31150
adj. R^2	0.6775
F	65449.37
	(0.000)

Table 3 Simple regression between exports of final product and value-added exports

Total value-added	Simple Regression
Researchers in R&D	0.0000123^{***}
	(0.000)
_cons	0.0366^{***}
	(0.000)
N	19500
adj. R^2	0.0457
F	934.13
	(0.000)

Table 4 Simple regression between researchers in R&D and total value-added

Total value-added	Simple Regression
Fixed capital formation	1882.425***
	(0.000)
_cons	8451.685***
	(0.000)
N	380.84
adj. R^2	0.0119
F	380.84
	(0.000)

Table 5 Simple regression between fixed capital formation and value-added

In order to show the validity of value-added data, Revealed Symmetric Comparative Advantage(RSCA) of top five industries are compared. RSCA calculated based on gross exports and value-added exports are shown for selected countries(Table 6). As can be seen, top five industries are ranked differently when based on two different export data. For countries of high income(USA, Japan, Germany, Korea), knowledge-intensive industries are highlighted in terms of both gross and value-added exports. This result is not a surprise considering countries in high development stages is likely to have capability on export both in terms of gross volume and value-added volume. The results are more interesting for countries that are believed to have capability only on assembly and OEM: China, for instance has high gross exports RSCA values in industries such as computer, electronic and optical equipment and electrical machinery and apparatus, while in value added RSCA only electrical machinery and apparatus is reflected. In RSCA, textiles industry is shown to have the highest capability which is commonly thought to be the competitive industry of developing countries. Such result is analogous to India, where outsourcing of business activities is prevalent. While industries such as computer and related activities, R&D, and telecommunications is in top tier in terms of gross exports, value-added exports show primary sectors such as agriculture, hunting, forestry and fishing, and coke, refined petroleum products and nuclear fuel is competitive. Such disconnection between competitiveness shown through gross exports and value-added exports poses concern that there may be capabilities that cannot be represented through export data alone. Countries in developing regions, such as Cambodia, Vietnam and Thailand are shown to have similar capabilities in terms of both gross and value-added exports, especially in the primary sector. This well represents the fact that developing countries are yet to have global competitiveness in pure exports nor value-added exports.

Table 6 Table showing top 5 industries in 2011 with highest RSCA based on gross exports and value-added exports of selected countries.

USA			
Gross Exports		*Value-added Exports*	
Education	0.559	Renting of machinery and	0.414

		equipment	
Renting of machinery and equipment	0.552	Education	0.367
Pulp, paper, paper products, printing and publishing	0.403	Other transport equipment	0.327
Financial intermediation	0.334	Pulp, paper, paper products, printing and publishing	0.316
R&D and other business activities	0.302	R&D and other business activities	0.266
Korea			
Gross Exports		*Value-added Exports*	
Other transport equipment	0.477	Other transport equipment	0.547
Computer, Electronic and optical equipment	0.413	Computer, Electronic and optical equipment	0.524
Coke, refined petroleum products and nuclear fuel	0.350	Motor vehicles, trailers and semi-trailers	0.463
Motor vehicles, trailers and semi-trailers	0.316	Basic metals	0.446
Basic metals	0.165	Electrical machinery and apparatus, nec	0.303
Cambodia			
Gross Exports		*Value-added Exports*	
Textiles, textile products, leather and footwear	0.862	Textiles, textile products, leather and footwear	0.866

Real estate activities	0.681	Wood and products of wood and cork	0.796
Other community, social and personal services	0.665	Agriculture, hunting, forestry and fishing	0.582
Post and telecommunications	0.606	Other community, social and personal services	0.557
Agriculture, hunting, forestry and fishing	0.383	Transport and storage	0.299

Japan			
Gross Exports		*Value-added Exports*	
Motor vehicles, trailers and semi-trailers	0.417	Motor vehicles, trailers and semi-trailers	0.462
Machinery and equipment, nec	0.321	Computer, Electronic and optical equipment	0.383
Computer, Electronic and optical equipment	0.294	Basic metals	0.363
Other non-metallic mineral products	0.242	Other non-metallic mineral products	0.286
Basic metals	0.181	Machinery and equipment, nec	0.282
China			
Gross Exports		*Value-added Exports*	
Textiles, textile products, leather and footwear	0.551	Textiles, textile products, leather and footwear	0.571
Computer, Electronic and optical equipment	0.488	Wood and products of wood and cork	0.392

Electrical machinery and apparatus, nec	0.368	Other non-metallic mineral products	0.327
Other non-metallic mineral products	0.331	Computer, Electronic and optical equipment	0.304
Fabricated metal products	0.227	Rubber and plastics products	0.296
India			
Gross Exports		*Value-added Exports*	
Computer and related activities	0.687	Computer and related activities	0.626
Other community, social and personal services	0.619	Other community, social and personal services	0.448
Coke, refined petroleum products and nuclear fuel	0.444	Agriculture, hunting, forestry and fishing	0.348
R&D and other business activities	0.343	Coke, refined petroleum products and nuclear fuel	0.314
Post and telecommunications	0.292	Transport and storage	0.199

Germany			
Gross Exports		*Value-added Exports*	
Electricity, gas and water supply	0.757	Motor vehicles, trailers and semi-trailers	0.549
Motor vehicles, trailers and semi-trailers	0.449	Electrical machinery and apparatus, nec	0.443
Machinery and equipment, nec	0.335	Machinery and equipment, nec	0.412
Electrical machinery and apparatus, nec	0.293	Fabricated metal products	0.342
Rubber and plastics products	0.231	Real estate activities	0.306

Vietnam			
Gross Exports		*Value-added Exports*	
Textiles, textile products, leather and footwear	0.583	Agriculture, hunting, forestry and fishing	0.695
Agriculture, hunting, forestry and fishing	0.551	Textiles, textile products, leather and footwear	0.599
Food products, beverages and tobacco	0.520	Food products, beverages and tobacco	0.393
Wood and products of wood and cork	0.482	Other non-metallic mineral products	0.290
Real estate activities	0.257	Hotels and restaurants	0.238
Thailand			
Gross Exports		*Value-added Exports*	
Health and social work	0.603	Food products, beverages and tobacco	0.549
Food products, beverages and tobacco	0.407	Agriculture, hunting, forestry and fishing	0.548
Agriculture, hunting, forestry and fishing	0.403	Textiles, textile products, leather and footwear	0.289
Rubber and plastics products	0.378	Wood and products of wood and cork	0.262
Hotels and restaurants	0.376	Hotels and restaurants	0.234

Source: Author's calculation

Through looking at the relationship between various capabilities and value-added exports, it was possible to see that value-added exports are positively correlated to capabilities represented through technology, human resource, resources, and capital. This shows that value-added export is capable of representing capabilities a country possesses. Moreover, looking at the top five industries a country has relative comparative advantage to in terms of gross and value-added exports, it is possible to see that gross exports alone does not accurately portray the potential capability a country could have in its industries. In countries with relatively ‘fixed’ development stages, meaning countries that are not going through rapid change in economic and social structure, relative comparative advantage represented by gross exports and value-added exports share common insight as to what industries a country is specializing in. However, for countries that are known to be in economic and social changes, two types of comparative advantages in industries tells a wildly different story. Not only the industries a country have advantage in from the perspective of gross exports are reflected similarly to the industries she has of value-added exports, many times the sectors of the industries are shown to be heterogenous. This confirms the assumption that value-added exports can represent capabilities that gross exports cannot. Therefore hypothesis 1: Value-added exports can represent the capabilities a country has can be said to be confirmed.

4.2 What effect do value-added exports have on industry emergence?

4.2.1 Descriptive statistics

Let us consider the density aspect of the export capability. Bearing in mind that the density of industry i represents the level of capability the related industries to industry i have, histogram of density values of transition industries is depicted in figure 6 and 7. As can be seen, histogram of density of gross exports is slightly skewed to the left compared to density of value-added exports. This shows that for industries to transition and gain more capability, exporting capability of related industries are less likely to affect that process than value-adding capability will. In other words, the more industries related to industry i have capability in value-addition, more likely that industry will gain capability exceeding a certain threshold.

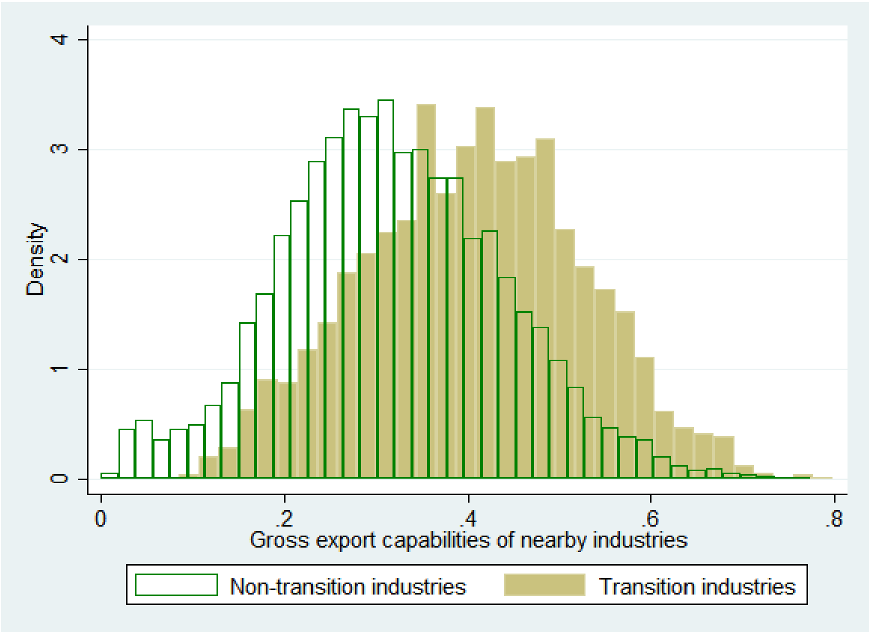

Figure 6 Histogram showing the density of gross exports capability of nearby industries

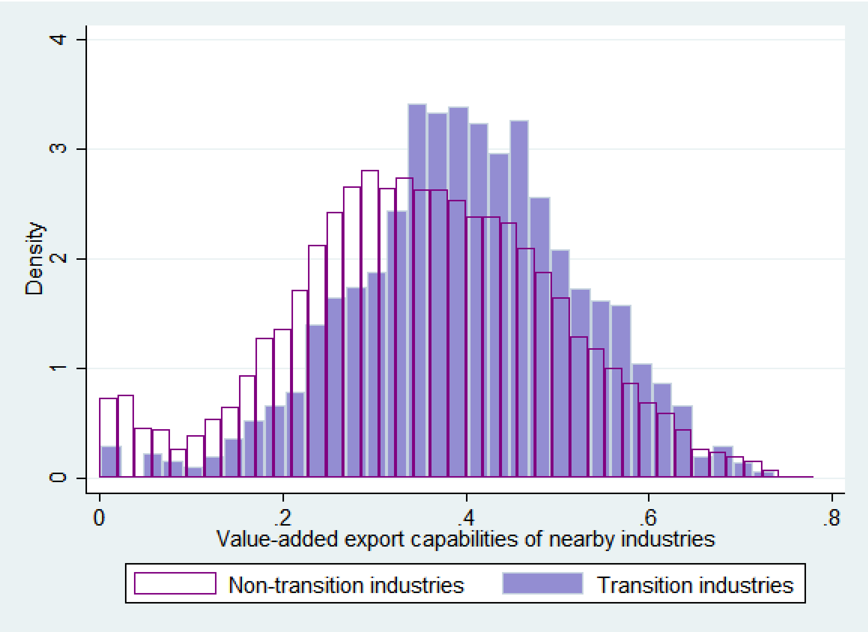

Figure 7 Histogram showing the density of value-added exports capability of nearby industries

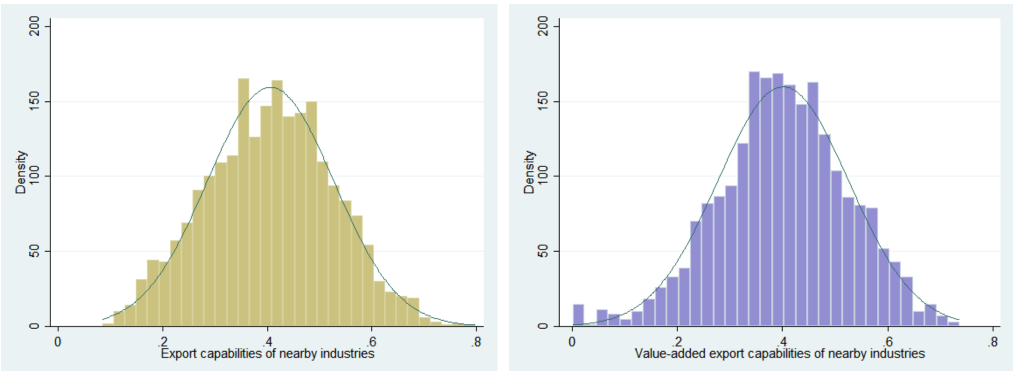

Figure 8 (a) Histogram showing both export capabilities of nearby industries of transition industries (b) Histogram and normal distribution of gross export capabilities of nearby industries of transition industries (c) Histogram and normal distribution of value-added export capabilities of nearby industries of transition industries

4.2.2 Econometric Results

An econometric analysis was conducted to statistically confirm the assumption that value-addedness of related industries can contribute in the growth, thus the emergence of industry i. Because the value of relative comparative advantage was made symmetric and is of continuous value, Generalized Least Squares estimation was used to test the effect of variables Density_Value-added and Density_Gross exports against RSCA_Gross Exports after five years. RSCA_Gross exports is considered as a proxy of industry emergence due to the fact that many utilize the notion of comparative advantage as a growth in capability. Here, growth in capability is assumed to signal the growth in industry, thus increasing the possibility that the industry will emerge with competence. This model is controlled by using the binary RCA value (RCA value of more than 1 was considered 1, 0 otherwsie), GDPpc, and country, product, time effects.

Regression across all countries(1) show that a 1 standard deviation increase in value-added density resulted in a 12.2 percentage point increase in the probability of exporting a product in industry i. Similarly, a 1 standard deviation increase in Gross exports density resulted in 8.19 percentage point increase in the probability of exporting a product in industry i. This confirms hypothesis 2: Value-added exports of related industries will have more be more positively related to emergence of industry i in the future.

This analysis merits further investigation as the effects of two types of exports may have different impact on future industry accordingly to the country's development stages. The development stage is classified in four categories: low income, lower-middle income, upper-middle income, and high income. At the low development stage, coefficient of value-added density was 0.0457 but was not significant. On the other hand, coefficient of gross export density was 0.159 and was significant at 1% level. Thus, building gross export capability of related industries is correlated with industry emergence after five years for low income countries. This can be interpreted as the need of countries to have the capability to produce products that are of world standard, or at least what the world demands in order to build capability in industry.

Contrasting results are shown for lower-middle income countries, as building value-added capabilities of related industries are shown to be significantly correlated with the probability of exporting a product in industry i with the coefficient of 0.0883. However, density of gross export was not significant, showing exports of value added should be considered more importantly in building capabilities of related industry. Stretching the insight gained from looking at low income countries, following interpretation can be made: low income countries should join the global value chain with the export capability accumulated in the its development stage by producing value-addedness to move up its development stage. As value-addedness addresses the capabilities related not only to mere production of products, but also design and manufacturing capabilities such as technology and final products, it can be seen that moving up the development stage requires a more sophisticated set of technologies.

At the higher-income stage of development, gross exports becomes important again but not to the point exceeding the importance of value-added. As can be seen, a 1 standard deviation increase in value-added density resulted in a 18.6 percentage point increase in the probability of exporting a product in industry i, while that of gross exports resulted in 5.8 percentage point. While this still highlights the importance of value-addedness in industry emergence, it also raises caution to not dismiss the effect of gross exports in building industry's capability. As can be interpreted through the econometric result, higher middle income countries begin to gain both export capability and value-added capability. In other words, the countries willing to move up to higher-middle income range must allocate their resources appropriately to develop both production and value-added capability.

At the very last stage of development, interestingly, high income countries experience heightened importance of export capability, along with subtly less important value-added capability. This shows that export capability becomes important again in the emergence of new industries.

By dissecting countries into its income level, it was possible to see that different exports types are needed in industry emergence. Thus hypothesis 3: Effects of gross exports and value-added exports of related industries on future emergence of industry i will differ accordingly to a country's development stage is confirmed.

4.2.3 Robustness test

Because this study uses a panel dataset, there is a possibility a few of OLS assumptions may be violated. To ensure this, robustness test on heteroskedasticity and autocorrelation is made.

Robustness test on heteroskedasticity was conducted using the likelihood-ratio test. LR test statistic is defined as follows:

$$(4)\ \mathrm{LR} = -2(\ln L_R - \ln L_{UR}) \sim \chi^2_{df}$$

H0: error terms will have homoskedasticity

The degree of freedom was set to1859 since the number of group was 1860. The resulting chi-squared was 11620.79 with p-value 0.000, which rejects the null hypothesis at a 1% significance level. Thus, command panel(hetero) was added to the regression.

Robustness test on autocorrelation was conducted using the Wooldridge test that tests the following null hypothesis:

H0: There is no first-order autocorrelation

The resulting p-value was 0.000 which rejects the null hypothesis at a 1% significance level. Thus, command corr(ar1) was added to the regression.

RSCA_Gross Exports$_{c,p,t+5}$	(1) All countries	(2) Low income countries	(3) Lower-middle income countries	(4) Higher-middle income countries	(5) High income countries
Density_Value-added$_{c,p,t}$	0.122***	0.0457	0.0883**	0.186***	0.0711***
	(0.000)	(0.536)	(0.029)	(0.000)	(0.000)
Density_Gross exports$_{c,p,t}$	0.0819***	0.159*	-0.00620	0.0580*	0.0993***
	(0.000)	(0.050)	(0.867)	(0.054)	(0.000)
RCA_Value-added$_{c,p,t}$	0.0981***	0.177***	0.117***	0.108***	0.0748***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
RCA_Gross exports$_{c,p,t}$	0.202***	0.143***	0.193***	0.254***	0.210***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
GDPpc$_{c,p,t}$	-0.513	-10.31	-2.814	-4.847***	1.052
	(0.478)	(0.684)	(0.443)	(0.008)	(0.240)
_cons	-0.312***	-0.0775	0.0546	-0.307***	-0.526***
	(0.000)	(0.405)	(0.279)	(0.000)	(0.000)
N	22320	1470	4920	5430	10170
adj. R^2					
F					

Table 7 Econometric results for two types of density affecting export capability in the future

Year, country, and industry dummies included in all estimations.
p-values in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Chapter 5. Conclusion

This study proposes that export capabilities can explain and impact positively the emergence of industries in a country. In particular, this study aims to show the importance of value-added exports in revealing the capability an industry has in a country, moreover showing that this trend differs across different income groups.

The results show that value-added exports are well correlated with certain indicators that explain the advantage a country might have in terms of technology, resource, human resource and capital. Moreover, there seems to be a heterogeneity in 'capable industries' a country has when viewed from the perspective of both gross exports and value-added exports, especially when that country is going through a rapid economic and social structural change.

The econometric analysis confirms the same intuition, as the probability industry i will develop its comparative advantage increases more when the relative comparative advantages the related industries of industry i is higher in terms of value-added exports. Moreover, the effect gross exports and value-added exports have on industry emergence is quite different when compared across different income groups: gross exports have high impact for low income countries, then value-added exports replace the importance at the lower-middle income countries. For higher-income countries, however, both gross exports and value-added exports are considered to impact the industry emergence significantly with value-added exports having a much higher impact. This coevolutionary trend continues as the countries become high-income, although the overall effect decreases with a slightly higher impact of gross exports on industry emergence remaining.

The implication of these results can be given in threefold: policy implication, managerial implication and academic implication. First, the results offer significant policy implication to countries as to how the resources should be allocated to tackle both gross exports capability and value-added capability appropriately according to its income level. Since the results show the as-is phenomenon of how gross exports and value-added exports interact (or not interact) in different income levels, the countries that are considering to 'move up the ladder' through industry emergence will be given useful guideline as to how countries in the next development stage of them are operating their export capabilities.

Managerial implications bring forefront the importance of belonging in and contributing highly to the global value chain from a firm level. Let us bear in mind that the relative advantages of gross exports highlight the ability to export product, let it be final or intermediate product, and that of value-added exports emphasize the aggregate value a country has added in the final demand. While these two definitions seem to share similar perspective as both can signal the participation in the global value chain, one must understand that there is a wild difference between merely 'joining' the global value chain and 'creating high values' by joining the value chain.

Firms and enterprises must, therefore, understand how their products involved in certain industries can be developed in a way that creates value, especially for those in middle-income countries.

Although there were many literature that utilized the exports data to describe the capability a country has in certain industries and products, a limitation existed in that exports data alone was not an adequate measure to show the country's full competence. In that sense, utilization of value-added exports data and showing the coevolutionary perspective of two types of export capabilities throw considerable implication in expanding the potential importance of value-added data in academia.

The limitation of this research, however, is the aggregate level of export data, as this study only dealt with 2-digit level aggregate industries. The effects of two export capabilities can differ significantly when analyzed again with aggregate data, which can be said as a more accurate description of the reality. Due to the data availability, analysis based on disaggregate industries were not possible, meriting consideration of future work based on a more disaggregated dataset.

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Chapter 7. Appendix

Appendix 1: Correlation table for exports data

	Density_Value-added$_{c,p,t}$	Density_Gross exports$_{c,p,t}$	GDPpc	RCA_Gross exports$_{c,p,t}$	RCA_Value-added$_{c,p,t}$
Density_Value-added$_{c,p,t}$	1.0000				
Density_Gross exports$_{c,p,t}$	0.7694	1.0000			
GDPpc	-0.0998	-0.1817	1.0000		
RCA_Gross exports$_{c,p,t}$	0.4283	0.6008	-0.0388	1.0000	
RCA_Value-added$_{c,p,t}$	0.5662	0.4698	0.0266	0.6727	1.0000

초록

이 연구의 목표는 상품 및 서비스 수출에 있어 국가의 역량이 새로운 산업의 출현에 크게 기여할 수 있음을 보여주는 것이다. 국가의 장기적인 경제 성장은 국가의 생산 능력 (또는 수출 능력)에 의해 촉진되는 것으로 오랫동안 여겨져왔다. 일부 통찰력있는 연구는 효시 비교 우위와 네트워크 분석의 척도를 활용하여 생산 능력과 관련한 국가의 경제 성장 패턴을 설명하려고 시도했다. 그러나 일부 국가에서 나타난 생산 능력의 불규칙적이고 불연속적인 확산은 국가의 경제 발전 패턴과 생산능력의 발전 패턴에는 괴리가 있음을 보여주었다. 이러한 문제는 현재 쓰이고 있는 무역 데이터가 국제 가치 사슬에서의 국가의 참여 역학을 온전하게 나타내지 못한다는 점에서 비롯될 수 있다. 따라서, 본 논문은 OECD의 TiVA (Trade in Value Added) 데이터의 지표를 활용하여 국가의 과거 역량, 생산 및 부가가치 역량이 새로운 수출 역량 및 산업의 출현에 기여할 수있는 방법에 대한 계량분석을 수행한다. 결과는 다음 세가지를 제시한다: 첫째, TiVA 데이터베이스의 부가 가치 데이터가 총 수출 데이터로 제시되지 않는 국가의 능력을 나타낼 수 있다. 둘째, 산업의 출현은 과거 관련 산업의 부가 가치 역량과 더 높은 상관 관계가 있다. 셋째, 새로운 산업의 출현은 국가의 소득 수준에 따라 다른 역량 발전 경로를 따른다.

주요어: **Capabilities theory; Trade theory, Economic Development, Global Value Chain, Comparative Advantage**

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