THE FUNDAMENTAL PATTERNS OF COMPARATIVE ADVANTAGE OF STEEL INDUSTRY IN INDONESIA

Pola Dasar Keunggulan Komparatif Industri Baja Indonesia

Niki Barenda Sari[1], Nagendra Shrestha[2], Craig Parsons[2]

[1]Trade Analysis and Development Agency, Ministry of Trade, Republic of Indonesia, Jl. M. I. Ridwan Rais No. 5, Jakarta 10110, Indonesia

[2]Graduate School of International Social Science, Yokohama National University, 79-3 Tokiwadai Hodogaya-ku, Yokohama-shi 240-8501, Japan

Email: nbarenda30@gmail.com

Naskah diterima: 25/11/2019; Naskah direvisi: 17/02/2020; Disetujui diterbitkan: 06/05/2020; Dipublikasikan online: 15/07/2020

Abstrak

*Pengukuran produktivitas yang akurat dapat memberikan informasi yang berguna dalam meningkatkan daya saing. Oleh karena itu, penting untuk memahami perbedaan dalam produktivitas relatif antar-negara. Hal ini memungkinkan negara untuk fokus dan berspesialisasi dalam produk-produk mereka yang relatif lebih produktif. Penelitian ini bertujuan untuk menganalisis pola dasar keunggulan komparatif, dengan industri baja Indonesia sebagai fokus analisis. Penelitian ini menggunakan analisis RCA berbasis regresi dengan metode variabel instrumen (*instrument variable/IV*) yang menggunakan data ekspor dari 25 negara ke 35 negara tujuan dari tahun 2010-2017. Hasil penelitian menunjukkan bahwa Indonesia memiliki keunggulan komparatif terkuat di industri baja di antara negara-negara ASEAN. Meskipun industri baja adalah industri ke-27 dalam peringkat nilai keunggulan komparatif dalam negeri Indonesia, ada beberapa produk yang memiliki keunggulan komparatif yang kuat dan bahkan memiliki posisi yang kuat secara internasional. Selain itu, penting untuk mengikutsertakan beberapa negara ASEAN sebagai observasi dalam mengestimasi parameter kunci produktivitas karena menghasilkan estimasi baru θ, yang masih sejalan dengan literatur yang ada.*

***Kata Kunci:** Keunggulan Komparatif, Produktivitas, Industri Baja*

Abstract

Accurate productivity measurements can provide useful information in improving competitiveness. Therefore, it is important to understand the differences in relative productivity among countries, allowing countries to focus and specialize in their relatively more productive products. This study aims to analyze the fundamental patterns of comparative advantage, with the Indonesian steel industry as the focus of analysis. This research uses the regression-based method of revealed comparative advantage (RCA) analysis with an instrument variable (IV) method that employs export data from 25 exporting countries to 35 destination countries during 2010 - 2017. The result shows that Indonesia has the strongest comparative advantage in the steel industry among the ASEAN countries. Even though the steel industry is ranked 27th in Indonesia's comparative advantage values, several products have a strong comparative advantage and even a strong position internationally. In addition, it is worth including some ASEAN countries in the observation of estimating the key parameter of productivity, while not the main focus of the paper, yields a new estimate of θ, which is still in line with the literature.

Keywords: Comparative Advantage, Productivity, Steel Industry,

JEL Classification: F11, F13, F14

INTRODUCTION

Pressure for protection from import competition is inevitable, and this seems especially true in the steel industry. For various reasons, the steel industry was the beneficiary of the protectionist policies in the 19th and 20th centuries. One main reason for such policies is that domestic steel production was considered crucial for state independence, as iron and steel are basic commodities and raw material for arms (Kawabata, 2018). In some countries, protection from imports was an important element of government intervention, for example, in Japan until the early 1970s and in Korea, China, and Taiwan up to the early 1990s (Lee, Ramstetter & Movshuk, 2005). Even the U.S. protected its steel industry since the 1960s (James & Parsons, 2005).

In addition to import tariffs, many instruments can be used to protect the steel industry. In the 1960s, voluntary export restraints (VERs) were used against Japanese and European steel in the U.S. steel market. The U.S. steel domestic market urged the government to take action regarding the surge in steel imports. In response, the President negotiated voluntary restraint agreements (VRAs) with Japanese and European steel producers in 1968. These producers agreed to limit steel imports to specified maximum tonnages for a specified period (Daniel & Ross, 1989).

There was also an increase in anti-dumping investigations in the 1980s in the U.S. and Europe. Since then, 624 anti-dumping measures have been applied to steel products, with one-third among them imposed by the U.S. (World Trade Organization, 2019a). Recently, Indonesia has been more active in using this policy tool with 25 anti-dumping measures implemented from 2005-2016, in which 10 of them were related to steel products (World Trade Organization, 2019a).

Indonesia was the 26th largest steel-producing country in 1995 and became the largest steel producer among the ASEAN (Association of Southeast Asian Nations) economies. However, Vietnam’s growth in steel production was so pronounced that it overtook Indonesia’s position as the largest steel producer in ASEAN and became the 19th largest steel producing country in 2016 while Indonesia’s rank dropped to 30th due to stagnant steel production. Even though the scale of steel production in Indonesia is not as large as in the U.S., Japan, or European countries and its steel production has not performed well, the steel industry has been selected as a priority industry for manufacturing in Indonesia according to the Presidential Regulation of the Republic of Indonesia No. 28 Year 2008.

Like many developing economies, Indonesia also protected its steel industry by applying high tariffs on imported steel materials, particularly at the beginning of its steel industrial development. In 1996, the Most Favored Nations (MFN) applied tariff rate was 5%-60%, with a simple average rate of 16.96%, where the highest import tariffs were applied to steel derivative products. Along with trade liberalization, Indonesia reduced import tariffs to a range of 5%-25% in 2005 and became 5%-20% in 2016. However, import tariffs on steel products have increased again in 2019 (World Trade Organization, 2019b).

As the steel industry is often perceived as a strategic sector, many policymakers maintain a relatively high degree of protection until the domestic firms become competitive in the world market (Lee et al., 2005). However, structural problems faced by domestic industries may be one of the causes of a lack of competitiveness. For example, the Indonesian steel industry was established in 1970, about the same time as the Pohang Iron and Steel Company (POSCO) in Korea. Nevertheless, it has not grown as fast as the POSCO because of various constraints. Improvements in productivity and structural change are essential for the survival of the steel industry (Tien, 2005; James & Parsons, 2005). Moreover, productivity improvement is also important to increase the nation's overall standard of living (Demura, 1995).

Accurate productivity measurements can provide useful information in enhancing competitiveness (Tien, 2005). By specializing in the production of relatively more productive goods, a country can gain more from trade. Therefore, it is important to understand the differences in relative productivity among countries to allow countries to focus and specialize in their relatively more productive products.

As the Ricardian comparative advantage says, the country should produce and export relatively more in that product in which it is relatively more productive. Ricardo's main idea is that a country has a comparative advantage in a product if its relative production cost is lower than in other countries (Salvatore, 2013). In other words, the comparative advantage reflects the differences in relative productivity.

Several seminal empirical tests of the Ricardian model have been conducted to show the relationship between exports and productivities. Early empirical tests of the Ricardian model were attempted by MacDougall (1951,1952), Balassa (1963), and Stern (1962), which showed a clear positive relationship between labor productivity and exports. They found that the industries with the higher ratios of the U.S. to U.K. exports had relatively higher productivity of labor in the U.S. than in the U.K. (Salvatore, 2013). A positive relationship between labor productivity and exports was also found in Golub and Hsieh (2000) between the U.S. and the following countries: Japan, Germany, France, U.K., Italy, Canada, Australia, Korea, and Mexico.

The most common measurement of comparative advantage is the Balassa Index of Revealed Comparative Advantage (RCA) (Balassa, 1965). The concept behind the Balassa Index of RCA is that the (unobservable) differences in relative productivity can be inferred from the (observable) pattern of trade since the pattern of trade is determined by differences in relative productivity (French, 2017). However, the Balassa Index has several empirical weaknesses, its theoretical foundation has long been debated, and its poor empirical distribution characteristics have also been criticized.

The theoretical foundation of the Balassa Index has long been debated in the literature since it does not fit the original Ricardian idea of comparative advantage (Bowen, 1983; Vollrath, 1991). While the comparative advantage, according to the theory, is based on the country's intrinsic (ex-ante) nature to produce a certain good relatively more efficiently, the Balassa index is based only on the actual (ex-post) realization of bilateral sector's trade flows. In other words, the Balassa Index confounds comparative advantage with other determinants of trade flows in approximating the RCA (Leromain & Orefice, 2013).

The new theoretically-consistent measure of the Ricardian RCA proposed by Costinot, Donaldson & Komunjer (2012) is more in line with Ricardo's Comparative Advantage (Leromain & Orefice, 2013; French, 2017). As proposed by Costinot et al. (2012), their theory-based approach differs from previous empirical work in three ways. First, the dependent variable in the Ricardian regression should be the log of exports, disaggregated by exporting and importing countries, differenced across exporters and industries, and corrected for differences in levels of openness across exporting countries. Second, this empirical work can and should control all the general equilibrium interactions across countries and industries that affect the partial equilibrium relationship between productivity and exports. Third, this approach allows us to examine the economic origins of the error term since it has micro-theoretical foundations.

The Costinot et al. (2012) model can be used to obtain “revealed” productivity measures at country and industry levels. The simple way of computing revealed measures of productivity provides a theoretically consistent alternative to Balassa’s (1965) well-known index of revealed comparative advantage. Like Balassa (1965), Costinot et al. (2012) offered a methodology that uses relative export data to infer the underlying comparative advantage pattern across countries and industries.

However, there are two important differences between Balassa’s (1965) approach and Costinot et al.’s (2012). First, unlike Balassa’s index, Costinot et al.’s approach ranked at relative productivity level. Second, the approach is based on pairwise comparisons across exporters and industries that are at the core of comparative advantage in a Ricardian world. Unlike Balassa (1965), Costinot et al. (2012) did not aggregate exports across countries and industries. Hence, the model separates the impact of productivity differences from trade costs and demand differences.

Nevertheless, for Indonesia, previous studies about comparative advantage often employed the Balassa Index approach (Aswicahyono & Pangestu, 2000; Adam & Negara, 2012; Setiawan & Sugiarti, 2016; Firmansyah et al., 2017; Riniwati, Harahab & Carla, 2017; Wahyudi & Maipita, 2018; and Immanuel, Suharno, & Rifin, 2019) or another Balassa RCA alternative such as Normalized Revealed Comparative Advantage developed by Yu et al. (2009) (Fakhrudin & Hastiadi, 2016; and Khasanah et al., 2019) and Revealed Symmetric Comparative Advantage developed by Laursen (2015) (Setyari, Widodo & Purnawan (2016). Therefore, this study aims to analyze the fundamental patterns of comparative advantage using the superior Costinot et al.’s (2012) approach for the Indonesian steel industry. It would examine the fundamental patterns of comparative advantage in the steel industry and attempt to explore who specializes in the steel industry. The second objective is used to determine which products are best suited to Indonesia.

RESEARCH METHOD

Costinot's study's main goal is to examine the relationship between the observed trade flows and observed productivity levels. Using trade and productivity data, they offer the first theoretically consistent Ricardian test. The model assumes labor productivity, which differs across industries, and has two components: a deterministic component, which is country-and-industry-specific and reflects the fundamental productivity that captures climate, infrastructure, and institutions that affect the productivity of all producers; and a stochastic component, which is randomly drawn across countries, industries, and varieties and reflects idiosyncratic differences in technology across varieties (Costinot et al., 2012).

In testing cross-sectional predictions, the procedure allows us to estimate the extent of intra-industry heterogeneity, typically denoted as "θ." The relationship between productivity and exports is governed by this key structural parameter. The result implies that ceteris paribus, the elasticity of (adjusted) bilateral exports concerning the observed productivity, is positive, as the Ricardian model predicts. Costinot et al. (2012) find θ to be around 6.53.

Based on the framework presented in Costinot et al. (2012), trade flows can be defined as follows:

$$ln(\tilde{x}_{i,j,k}) = \delta_{i,j} + \delta_{j,k} + \theta ln(\tilde{z}_{i,k}) + \varepsilon_{i,j,k} \quad \text{...}(1)$$

where i, j, k indicate exporter, importer, and industry, respectively, $\delta_{i,j}$ are country-pair fixed effects, $\delta_{j,k}$ are importer-industry fixed effects and $\tilde{z}_{i,k}$ approximates for the observed productivity level of country i in sector k. In a Ricardian world, variations in relative productivity levels should be fully reflected in relative producer prices, and thus we can measure the variation in productivity across countries and industries using differences in producer price indices. Under the assumption that variable trade costs (and other components of the error term $\varepsilon_{i,j,k}$) are orthogonal to the observed productivity, an OLS estimate of equation (1) provides an unbiased estimation of θ, the extent of intra-industry heterogeneity in this model (Costinot et al., 2012).

According to Costinot et al. (2012), the θ is assumed to be common across industries. The common θ rules out the possibility of interaction between differences in wages across countries and differences in intra-industry heterogeneity in determining the pattern of trade. Hence, this will maintain the tight relationship between fundamental productivity and comparative advantage at the core of the standard Ricardian model.

However, there are two potential sources of bias with the OLS estimation: 1) simultaneity bias due to agglomeration effects through which higher export levels lead to higher productivity levels and 2) attenuation bias due to measurement error in productivity. To circumvent these potential sources of bias, Costinot et al. (2012) suggested estimating the equation by the method of instrumental variables (IV) with the endogenous regressor-productivity levels $ln(z_{i,k})$ - instrumented with the log of resẽarch and development (R&D) expenditures at the country-industry level. The assumption is that relative R&D expenditures are associated with trade flows only through their impact on relative productivity, i.e., relative producer prices (Costinot et al., 2012). Therefore, this study employs the IV method to estimate equation (1).

Technological differences are assumed to be exporter-industry specific and depend on two parameters: the fundamental productivity $z_{i,k}$, which is exporter-industry specific, and a measure of productivity dispersion θ, which is country invariant (Leromain & Orefice, 2013). $z_{i,k}$ captures factors related to cross-country variation of productivity, such as climate, infrastructure, and institutions that affect all producers in a given country and industry. $z_{i,k}$ can be retrieved by approximating the technological differences by an exporter-industry fixed effect in the empirical counterpart of equation (1). The estimated θ from equation (2) can be used to obtain revealed measures of productivity by estimating:

$$ln(x_{i,j,k}) = \delta_{i,j} + \delta_{j,k} + \delta_{i,k} + \varepsilon_{i,j,k} \quad \ldots(2)$$

where $\delta_{i,j}$, $\delta_{j,k}$, and $\delta_{i,k}$ are exporter-importer, importer-industry, and exporter-industry fixed effects, respectively. From the OLS estimation of equation (2), we capture the measure of technological differences through the exporter-industry fixed effect $\delta_{i,k}$. Hence, we can recover the parameter $z_{i,k}$ from (1) as follows:

$$z_{i,k} = e^{\delta_{i,k}/\theta} \quad \text{......................................(3)}$$

Having values $z_{i,k}$ we could continue in following Costinot et al. (2012) and compute the pairwise indices of comparative advantage. Costinot et al. (2012) argued that the simple way of computing revealed measures of productivity $z_{i,k}$ introduced above provides a theoretically consistent alternative to Balassa's revealed comparative advantage.

Alternatively, following Leromain & Orefice (2013), a weighted index of RCA can be computed as follows:

$$RCA_{i,k} = \frac{z_{ik}\overline{z_{..}}}{\overline{z_{i.}}\,\overline{z_{.k}}} \quad \text{......................................(4)}$$

where $\overline{z_{..}}$ is the average of all z_{ik} coefficients across all industries and countries, $\overline{z_{i.}}$ is the average of z_{ik} for the country i across all sectors, and $\overline{z_{.k}}$ is the average of z_{ik} for the sector k across all exporters. Given formula (4), a country i has a comparative advantage in sector k if $RCA_{i,k}$ is greater than 1.

The estimation used in this study only requires two types of data which are: trade flows, as the dependent variable, and productivity levels. Trade flows at the 2-digit level, and 3-digit level of International Standard Industrial Classification (ISIC) rev 3, and 4-digit level of Harmonized System 2002 Classification (HS) from 2010-2017 were retrieved from the World Bank Integrated Trade System (WITS), while producer price data from the GGDC Productivity Level Database (Inklaar & Timmer, 2008) was used as a proxy of productivity level following Costinot et al. (2012).

This study performed the estimation on a set of 25 exporting countries (G20 countries and some ASEAN countries) and 35 destination countries. The 25 exporting countries consist of Argentina, Australia, Belgium, Brazil, Canada, China, Germany, Spain, France, UK, India, Indonesia, Italy, Japan, Republic of Korea, Mexico, Malaysia, Netherlands, Philippines, Russia Federation, Thailand, Turkey, U.S., Vietnam, and South Africa. Meanwhile, the 40 destination countries are the top 40 importing countries based on the value of imports they received in 2016.

To estimate the productivity-to-export elasticity (θ), following Costinot et al. (2012), a 2-digit level of ISIC rev 3 was used for the trade flow data in line with data available for productivity levels. However, to measure the revealed comparative advantage, the 3-digit levels of ISIC rev 3 was used, since it gives more specific industrial classification concerning the steel industry. The 2-digit level of ISIC rev 3 only captures the metal industry, which is too broad to analyze the steel industry. Instead, the 3-digit level contains the manufacture of the basic iron and steel industry, which is more precisely evaluated. Moreover, to obtain more detail of steel products, the 4-digit level of HS 2002 within the manufacture of basic iron and steel was employed.

RESULTS AND DISCUSSION

The estimation results of θ

To estimate equation (1), the productivity as the independent variable is the inverse of the average producer price in an exporter-industry. However, data for some ASEAN countries, such as Malaysia, Philippines, Thailand, and Vietnam, is not available in the GGDC Productivity Level Database (Inklaar & Timmer, 2008). Therefore, their producer prices are assumed to be the same as Indonesia, the only available data for an ASEAN country.

Table 1. Cross Sectional Results

Dependent variable	log (exports)	log (exports)
	(1)	(2)
log (productivity based on producer prices)	1.50	7.98
	(0.0511)*	(1.0414)*
Estimation method	OLS	IV
Exporter × importer fixed effects	YES	YES
Industry × importer fixed effects	YES	YES
Observations	21.148	20.994
R^2	0.7851	0. 6273

Source : Authors' calculation
Note : Heteroskedasticity-robust standard errors are reported in parentheses.
*Statistically significant at the 1% level.

The first column of Table 1 reports the estimation results from θ from estimating equation (1) by OLS. In line with the prediction of the Ricardian model, this estimate is positive and statistically significant. According to this estimate of the productivity-to-exports elasticity, a 1% change in productivity is equal, associated with a 1.5% change in exports.

Meanwhile, the second column of Table 1 reports the IV estimate of θ. Compared to the OLS estimates, the magnitude of θ is considerably larger—7.98 rather than 1.50—and still statistically significant. As Costinot et al.

(2012) argued, compared to the OLS estimates, the IV estimation results in a higher magnitude of θ because the OLS estimates suffer from attenuation bias since producer prices are extremely difficult to measure accurately in practice.

This estimate of θ is preferred over the estimate using OLS and is in line with previous estimates of θ obtained by researchers using different methodologies. Eaton & Kortum (2002) estimated θ to be 3.60 using wage data and either 8.28 or 12.86 using data on price gaps between countries (to proxy for trade costs), while Simonovska & Waugh (2014) estimated θ to be 4.5 using the adjusted price gap methodology of Eaton & Kortum (2002). Finally, in Costinot et al. (2012), it is stated that Donaldson estimated θ to be 5.2 (on average) using a trade costs approach in commodity-by-commodity in colonial India.

Distribution of RCA

This section describes the statistical distribution properties of the RCA index. We investigate the shape of the distribution and the time stationarity of RCA. The time stability of the distribution is an important feature in assessing whether the new index is a proper measure of the Ricardian comparative advantage. Thus, a proper measure of comparative advantage should not vary much over time (Leromain & Orefice, 2013). One of the most relevant critiques in the literature concerns the lack of time stationarity of the Balassa Index (Hinloopen & Van Marrewijk, 2001; De Benedictis & Tamberi, 2004).

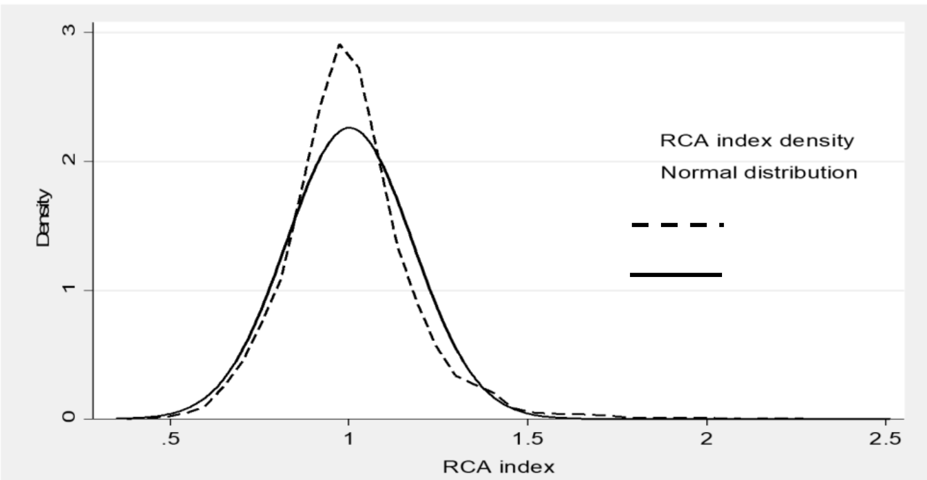


Figure 1. Density Distribution of the RCA Index

Source: Authors' calculation

The former difference in the symmetry of distributions can also be shown by simple density function graphs in Fig. 1. Fig. 1 illustrates the shape of the RCA distribution across 25 countries at the 2-digit level commodity over time. The density function of the RCA index is symmetric around one (one being the threshold for having a comparative advantage in a certain sector) and very close to a normal distribution (shown in the solid line of Fig. 1). This first evidence shows an important property of the RCA index that has a symmetric, thin-tailed distribution. This finding indicates that an increase in the number of small-size countries does not cause a long-right-tail distribution of the RCA, as is often the case of the Balassa Index.

Moving to the time stability of the distributions, Table 2 reports the 10th, 25th, 50th, 75th, and 90th percentile values of the RCA index distribution along the period 2010-2017. The RCA index is stable over time. For example, in the 50th percentile and the 75th percentile, the RCA has a constant value of 0.99 and 1.09 over the period 2010-2017. In addition, the RCA means it is stable over time, meaning that it does not suffer the presence of outlying values, and the mean value of the RCA distribution, being stationary, is a good measure of comparative structural advantage.

Table 2. Empirical Distribution of RCA Based on Yearly Export Flows

	RCA index							
Percentile	2010	2011	2012	2013	2014	2015	2016	2017
10	0.80	0.80	0.80	0.80	0.81	0.80	0.79	0.79
25	0.90	0.89	0.90	0.90	0.90	0.90	0.90	0.90
50	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
75	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
90	1.21	1.21	1.20	1.21	1.21	1.21	1.21	1.21
Max	2.51	2.14	2.36	2.13	2.21	2.05	1.94	1.98
Min	0.48	0.35	0.51	0.54	0.42	0.46	0.41	0.52
Mean	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Median	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Std. Dev	0.18	0.18	0.18	0.18	0.18	0.18	0.17	0.17

Source: Authors' calculation

RCA of Steel Industry

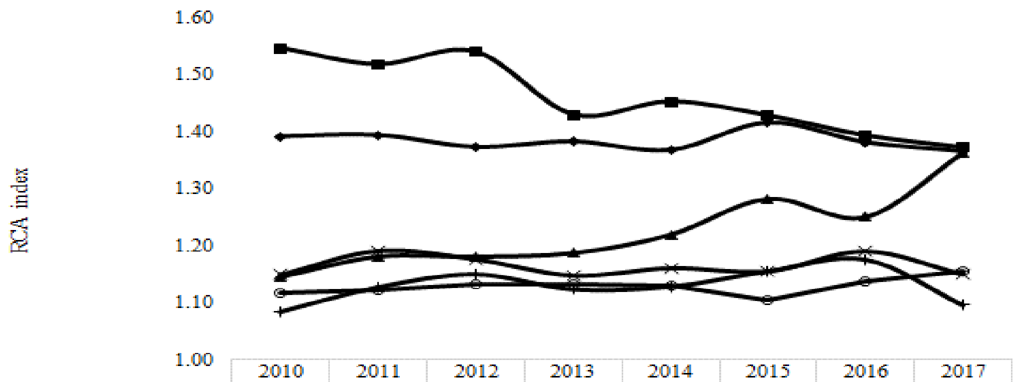
To see the patterns of the steel industry comparative advantage, the comparative advantage values for each country are presented in Table 3. The countries are ranked in ascending order of steel industry comparative advantage. The overall pattern that emerges seems reasonable. Russia, South Africa, Brazil, Korea, Japan, and India have the top RCAs in the steel industry.

Table 3. World Steel Industry's Fundamental Pattern of Comparative Advantage

Rank	Country	RCA index								Trend
		2010	2011	2012	2013	2014	2015	2016	2017	
1	Russian Federation	1.55	1.52	1.54	1.43	1.45	1.43	1.39	1.37	(1.74)
2	South Africa	1.39	1.39	1.37	1.38	1.37	1.42	1.38	1.37	(0.11)
3	Brazil	1.14	1.18	1.18	1.19	1.22	1.28	1.25	1.36	2.15
4	Korea, Rep.	1.12	1.12	1.13	1.13	1.13	1.11	1.14	1.16	(0.05)
5	Japan	1.15	1.19	1.18	1.15	1.16	1.16	1.19	1.15	0.36
6	India	1.18	1.23	1.19	1.24	1.22	1.08	1.11	1.13	0.27
7	Argentina	1.09	1.16	1.12	1.11	1.09	1.05	1.07	1.10	(1.34)
8	Turkey	1.08	1.13	1.15	1.12	1.13	1.16	1.18	1.10	(0.74)
9	Belgium	1.06	1.08	1.07	1.04	1.04	1.05	1.03	1.02	(0.72)
10	Spain	1.01	1.03	1.05	1.01	1.00	1.01	1.02	1.00	(0.22)
11	Mexico	0.97	1.00	1.02	1.00	1.00	0.99	1.00	0.97	(1.08)
12	Italy	0.88	0.91	0.90	0.87	0.95	0.91	0.98	0.95	(0.20)
13	Indonesia	1.04	1.03	1.01	1.01	0.98	0.95	1.01	0.95	1.25
14	China	0.82	0.91	0.90	0.88	0.90	0.95	0.94	0.95	0.33
15	Malaysia	0.94	0.96	0.95	0.94	0.95	0.96	0.93	0.93	1.64
16	Vietnam	0.92	0.94	0.96	0.94	0.92	0.94	0.93	0.92	1.15
17	France	0.83	0.89	0.88	0.88	0.89	0.90	0.93	0.92	(0.19)
18	Germany	0.93	0.95	0.98	0.96	0.95	0.96	0.93	0.91	(0.20)
19	United Kingdom	0.93	0.92	0.95	0.92	0.92	0.94	0.91	0.90	(0.47)
20	Netherlands	0.88	0.93	0.92	0.90	0.93	0.93	0.95	0.89	(0.31)
21	Thailand	0.83	0.88	0.84	0.83	0.83	0.84	0.87	0.87	0.30
22	United States	0.87	0.88	0.88	0.87	0.87	0.88	0.86	0.87	(0.11)
23	Canada	0.90	0.89	0.91	0.88	0.86	0.85	0.84	0.83	(1.27)
24	Australia	0.88	0.87	0.85	0.86	0.82	0.79	0.83	0.82	(1.13)
25	Philippines	0.75	0.70	0.71	0.69	0.65	0.68	0.75	0.67	(0.71)

Source: Authors' calculation
Note: Negative trend is shown in parenthesis

Fig. 2 illustrates that Russia has the highest comparative advantage in the steel industry, followed by South Africa consecutively in the last eight years. While Brazil, Korea, Japan, India, and Argentina are fluctuating in RCA, the most apparent feature of the graph is that Russia experienced a significant negative trend (-1.74%) while Brazil had a strong positive trend (2.15%) during the eight-year period. These trends allow the RCA's disparity between the two countries to be only 0.01 point, much smaller than that of 2010, which was 0.4 points. Meanwhile, the comparative advantage of Japan and India grew slightly by 0.36% and 0.27% per year. In contrast, there are insignificant negative trends in South Africa's and Korea's RCA by -0.11% and -0.05%, respectively.



	2010	2011	2012	2013	2014	2015	2016	2017
Russian Federation	1.55	1.52	1.54	1.43	1.45	1.43	1.39	1.37
South Africa	1.39	1.39	1.37	1.38	1.37	1.42	1.38	1.37
Brazil	1.14	1.18	1.18	1.19	1.22	1.28	1.25	1.36
Korea, Rep.	1.15	1.19	1.18	1.15	1.16	1.16	1.19	1.15
Japan	1.08	1.13	1.15	1.12	1.13	1.16	1.18	1.10
India	1.12	1.12	1.13	1.13	1.13	1.11	1.14	1.16

Figure 2. Top 6 RCA Performance of Basic Iron and Steel Industry

Source: Authors' calculation

Interestingly, even though the RCA values of some selected countries (Indonesia, China, Malaysia, Vietnam, and Thailand) were below the neutral point of RCA at 1, those values grew relatively higher compared to that of top-RCA countries. The trend of Malaysia's RCA was the second-highest among all countries, with 1.64% per year, followed by Indonesia (1.25%), Vietnam (1.15%), China (0.33%), and Thailand (0.30%). These five groups were the only countries that showed a positive RCA trend besides those in the top-6 RCA.

Moreover, Fig. 3 also shows that Indonesia has the most definite comparative advantage in the steel industry among ASEAN countries. Indonesia is on the 13th in the steel industry worldwide, with the RCA index equal to 0.95, while Malaysia, Vietnam, Thailand, and the Philippines are on the 15th, 16th, 21st, and 25th, respectively.

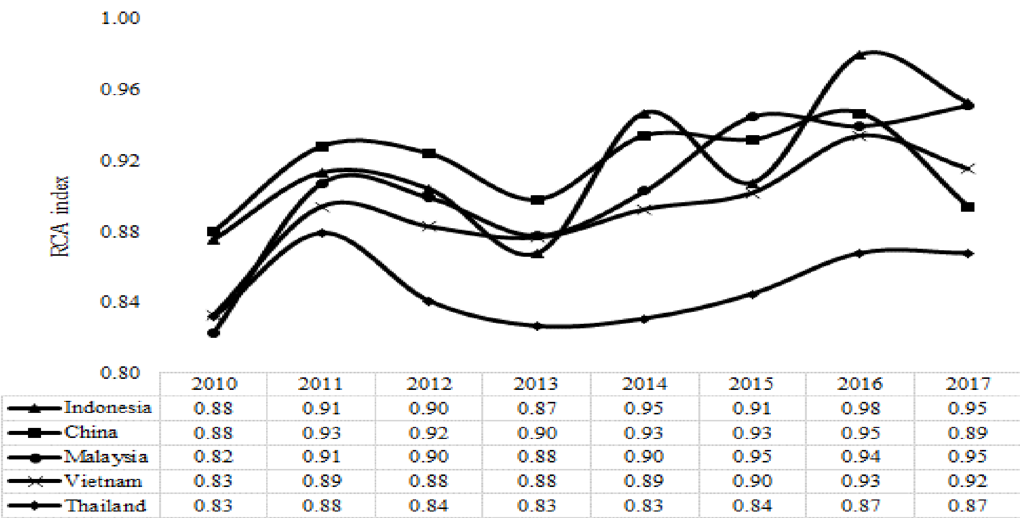


Figure 3. Selected RCA Performance of Basic Iron and Steel Industry

Source: Authors' calculation

Concerning the RCA index, while Indonesia's steel industry is on the 13th among all countries, it is on 27th in within-country ranking of comparative advantage values (Table 4). As mentioned before, the steel industry is one of the growing industries based on comparative advantage performance during the last eight years, with a positive trend of 1.25%.

Table 4. Indonesian RCA Index Across Sectors and Industries

Sector (ISIC 2 digit)	Industry (ISIC 3 digit)	2017 RCA	2017 Rank
Food (15 &16)	Production, processing and preserving (151)	1.18	14
	Manufacture of dairy products (152)	0.69	47
	Manufacture of grain mill products (153)	0.91	31
	Manufacture of other food products (154)	1.07	19
	Manufacture of tobacco products (160)	1.22	10
Textiles (17,18 &19)	Spinning, weaving and finishing of (171)	1.26	8
	Manufacture of other textiles (172)	1.08	18
	Manufacture of knitted and crochet (173)	1.29	5
	Manufacture of wearing apparel, exc (181)	1.31	4
	Dressing and dyeing of fur; manufac (182)	0.66	48
	Tanning and dressing of leather; ma (191)	1.05	21
	Manufacture of footwear (192)	1.50	1
Wood (20)	Sawmilling and planing of wood (201)	1.27	7
	Manufacture of products of wood, co (202)	1.36	2
Paper (21 & 22)	Manufacture of paper and paper prod (210)	1.18	15
	Publishing (221)	0.83	40
	Printing and service activities related (222)	1.18	16
Chemicals (24)	Manufacture of basic chemicals (241)	1.06	20
	Manufacture of other chemical prod (242)	0.94	28
	Manufacture of man-made fibers (243)	1.28	6
Plastics (25)	Manufacture of rubber products (251)	1.13	17
	Manufacture of plastics products (252)	1.01	22

Sector (ISIC 2 digit)	Industry (ISIC 3 digit)	2017 RCA	2017 Rank
Minerals	Manufacture of glass and glass prod (261)	0.99	25
(26)	Manufacture of non-metallic mineral (269)	1.01	24
Metals	Manufacture of basic iron and steel (271)	0.95	27
(27 & 28)	Manufacture of basic precious and (272)	0.92	29
	Manufacture of structural metal pro (281)	0.86	36
	Manufacture of other fabricated met (289)	0.92	30
Machinery	Manufacture of general purpose mac (291)	0.86	38
(29)	Manufacture of special purpose mac (292)	0.84	39
	Manufacture of domestic appliances (293)	1.20	12
Transport	Manufacture of motor vehicles (341)	0.75	45
(34 & 35)	Manufacture of parts and accessories (343)	0.97	26
	Building and repairing of ships and (351)	0.86	37
	Manufacture of transport equipment (351)	1.33	3

Source: Authors' calculation

In order to present a more detailed picture of the Indonesian steel industry, Fig. 4 and Fig. 5 illustrate the comparative advantage values of Indonesian steel products and their positions in terms of international levels. Though the comparative advantage of the Indonesian steel industry, in general, is below the neutral point of RCA, some products that have a definite comparative advantage and even have a strong position at the international level.

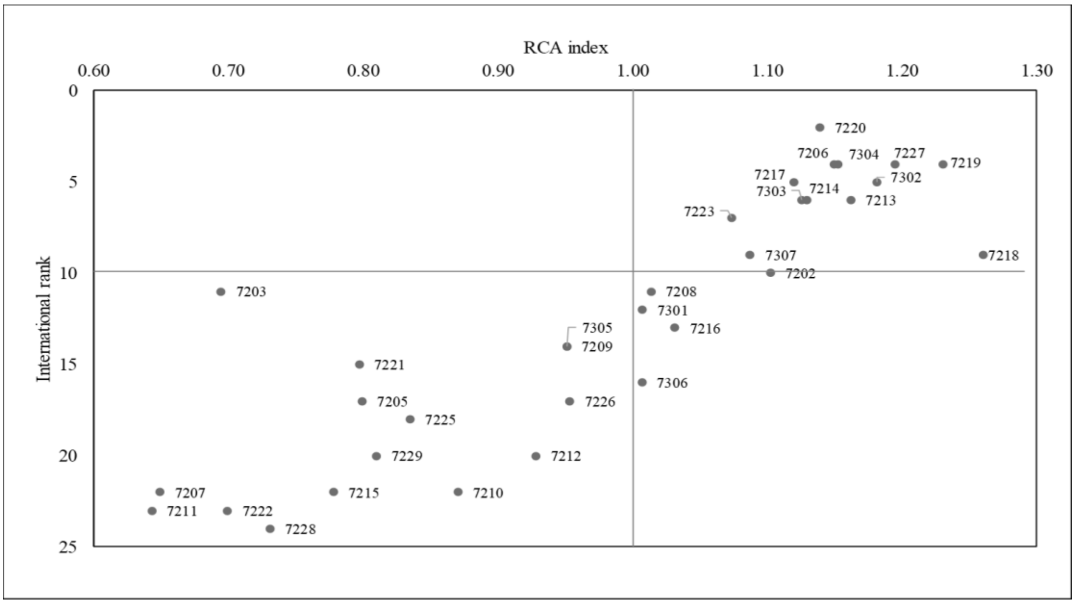


Figure 4. Indonesian Steel Productivity Mapping 2010 (RCA based on HS codes)

Source: Authors' calculation

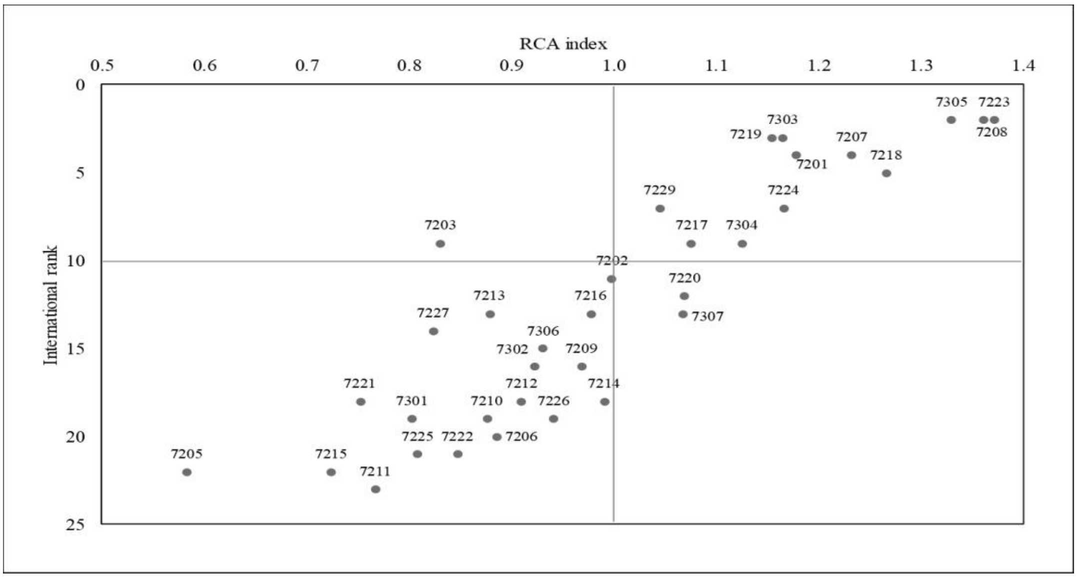


Figure 5. Indonesian Steel Productivity Mapping 2017 (RCA based on HS codes)

Source: Authors' calculation

As shown in Fig. 4 and 5, the value of RCA and its international rank are positively correlated. However, there are some products with a relatively high comparative advantage but weak international positions, implying that they are only strong within the country.

There are some changes in the patterns of steel products' comparative advantage in 2010 and 2017. Firstly, the comparative advantage of Indonesian steel products has become more concentrated shown by the RCA index, which ranges from 0.8-0.9. These changes suggest that Indonesian steel products have improved during the last eight years. However, there is no significant change in the number of products with a strong international position. There were 13 products which their RCA was in the world top-10 in 2010 and 14 products in 2017.

Second, there was a noteworthy change in the comparative advantage value of each product and its position. For example, in 2010, stainless steel, flat-rolled products of widths less than 600mm (HS 7220) had the highest position at the international level in 2010, but in 2017 lost its position and dropped to 12th due to its declining comparative advantage value. Stainless steel in ingots or other primary forms, semi-finished products of stainless steel (HS 7218) that had the highest comparative advantage among Indonesian steel products and was on the 9th position internationally in 2010, managed to have higher advantage and position in 2017. In 2017, stainless steel wire (HS

7223) had the highest RCA and the highest position.

Based on the performance of RCA value and international positions, six products that maintained their top-10 international positions both in 2010 and 2017; they are wire of iron or non-alloy steel (HS 7217); iron or non-alloy steel, flat-rolled products of a width of 600mm or more, hot-rolled, not clad, plated or coated (HS 7208); stainless steel, flat-rolled products of the width of 600mm or more (HS 7219); iron or non-alloy steel; bars and rods, hot-rolled, in irregularly wound coils (HS 7213); tubes, pipes and hollow profiles, of cast iron (HS 7303); and tubes, pipes and hollow profiles, seamless, of iron (other than cast iron or steel (HS 7304).

Lastly, we can highlight the products with a comparative disadvantage. A product is categorized as having a comparative disadvantage when RCA values and international positions were below one during the past eight years. They are granules and powders, of pig iron, Spiegel Eisen, iron or steel (HS 7205); iron or non-alloy steel, flat-rolled products width 600mm or more, clad, plated or coated (HS 7210); iron or non-alloy steel, flat-rolled products, width 600mm or more, clad, plated or coated (HS 7212); stainless steel bars and rods, angles, shapes and sections (HS 7222); alloy steel flat-rolled products, of a width 600mm or more (HS 7225); and iron or non-alloy steel, flat-rolled products, width less than 600mm, not clad, plated or coated (HS 7211).

CONCLUSION AND POLICY RECOMMENDATION

The key structural parameter of the model, θ, is estimated using the trade and productivity data to investigate the patterns of comparative advantage. This parameter implies the elasticity of productivity to exports and how sensitive is the change in exports is relative to the change in productivity levels, ceteris paribus. The estimate of this elasticity, θ=7.98, lies within the range of existing estimates in the literature. This new parameter θ=7.98 extends the literature on the regression-based method RCA since studies on this usually use θ=6.53 as developed by Costinot et al. (2012). Unlike the previous literature, in obtaining this parameter, this study includes several ASEAN countries. Thus, this study provides a new key structural parameter that is more appropriate to use in evaluating the comparative advantage of ASEAN countries.

Using the new θ, the fundamental patterns of comparative advantage were investigated. The overall patterns that emerged seem reasonable. For example, Russia, South Africa, Brazil, Korea, Japan, and India are the top RCA countries in the world steel industry. Though the RCA values of some selected countries (Indonesia, China, Malaysia, Vietnam, and Thailand) are below the neutral point of RCA at 1, those values grow relatively higher compared to that of top-RCA countries. These five countries are the only ones with a positive RCA trend besides those on the top six RCA. It is also a noteworthy finding that Indonesia has the most definite comparative advantage in the steel industry among ASEAN countries.

While the Indonesian steel industry is ranked 13th among all countries, however, the steel industry ranked the 27th among all industries in Indonesia. Though, there are inevitably that there are some products with definite comparative advantage and strong position internationally. Based on our RCA estimates and international positions, six products remained in the top 10 international positions in 2010 and 2017. There were also products with a comparative disadvantage, having low RCA values and international positions during the past eight years.

By considering this pattern in the steel industry, Indonesia can enact some adjustments to enhance its steel products' competitiveness. By specializing in the production of more relatively productive products, Indonesia can gain more from trade. More empirical work of this kind can and should be done for more prominent industries in Indonesia and ASEAN more generally.

ACKNOWLEDGEMENT

The authors thank the Ministry of National Development Planning/ National Development Planning Agency and Japan International Cooperation Agency (JICA) Scholarship for the support and sponsorship of the dual degree program between the University of Indonesia and Yokohama National University.

REFERENCES

Adam, L., & Negara, S.D. (2012). The Development of Indonesian Steel Industry. *Review of Indonesian Economic and Business Studies*, 3 (2).

Aswicahyono, H., & Pangestu, M. (2000). Indonesia's Recovery: Exports and Regaining Competitiveness. *The Developing Economies*, *XXXVIII-4*, 454-89.

Balassa., B. (1963). An Empirical Demonstration of Classical

Comparative Cost Theory. *Review of Economics and Statistics*, pp. 231–238.

———. (1965). Trade Liberalization and Revealed Comparative Advantage. *The Manchester School of Economic and Social Studies*, *33*, 99–123.

Bowen, H. (1983). On the Theoretical Interpretation of Indices of Trade Intensity and Revealed Comparative Advantage. *Weltwirtschaftliches Archiv*, *119(3),* 464-472, retrieved from www.jstor.org/stable/40439150

Costinot, A., Donaldson, D., & Komunjer, I. (2012). What Goods Do Countries Trade? A Quantitative Exploration of Ricardo's Ideas. *Review of Economic Studies*, *79*, 581-608, retrieved from https://doi.org/10.1093/restud/rdr033.

Daniel, R.III., & Ross, M.S. (1989). The Future of the Steel Voluntary Restraint Agreements. *Loyola of Los Angeles International and Comparative Law Review,* 487.

De Benedictis, L., & Tamberi, M. (2004). Overall Specialization Empirics: Techniques and Applications. *Open Economies Review*, *15(4),* pp 323-346.

Demura, Peter. (1995). Productivity Change in the Australian Steel Industry: BHP Steel 1982-1995. *RBA Annual Conference Volume (Discontinued), Reserve Bank of Australia,* 172-184.

Eaton, J., & Kortum, S. (2002), Technology, Geography, and Trade. *Econometrica*, *70,* 1741–1779.

Fakhrudin, U., & Hastiadi, F.F. (2016). Impact Analysis of Normalized Revealed Comparative Advantage on ASEAN's Non-Oil and Gas Export Pattern Using Gravity-Model Approach. *Working Paper in Economics and Business Volume V No. 3/2016.*

Firmansyah, F., Widodo, W., Karsinah, K., & Oktavilia, S. (2017). Export Performance and Competitiveness of Indonesian Food Commodities. *JEJAK: Jurnal Ekonomi Dan Kebijakan, 10(2)*, 289-301. doi:http://dx.doi.org/10.15294/jejak.v10i2.11294

French, S. (2017). Revealed Comparative Advantage: What is it good for? *Journal of International Economics*, *106,* pp 83-103, retrieved from https://doi.org/10.1016/j.jinteco.2017.02.002

Golub, S. S., & Hsieh, C. T. (2000). The Classical Ricardian Theory of Comparative Advantage Revisited. *Review of International Economics*, May 2000.

Hinloopen, J., & Van Marrewijk, C. (2001). On the empirical distribution of the Balassa Index. *Weltwirtschaftliches Archiv*, pp. 1-35.

Immanuel, Suharno, & Rifin, A. (2019). The Progressive Export Tax and Indonesia's Palm Oil Product Export Competitiveness. *Buletin Ilmiah Litbang Perdagangan*, *13(2),* 211-232, retrieved from https://doi.org/10.30908/bilp.v13i2.417.

Inklaar, R., & Timmer, M. P. (2008). GGDC Productivity Level Database: International Comparisons of Output, Inputs and Productivity at the Industry Level. *Groningen Growth and Development Centre Research Memorandum* (GD-104).

James, W.E., & Parsons, C. (2005). International Trade in Steel Products: Evidence on 'Dumping' versus Competitive Behavior. In Lee et al (eds), *Restructuring of the Steel Industry in Northeast Asia*. New York: Palgrave Macmillan.

Kawabata, N. (2018). Development of the Vietnamese Iron and Steel Industry under International Economic Integration. *Tohoku Economics Research Group*, *Discussion Paper No. 396,* retrieved from http://hdl.handle.net/10097/00124165.

Khasanah, U., Huang, W., & Asmara, R. (2019). Indonesian Frozen and

Processed Crab Export Performance and Competitiveness Analysis. *Agricultural Socio-Economics Journal Volume XIX, Number 3 (2019),* 165-171.

Laursen, K. (2015). Revealed Comparative Advantage and the Alternatives as Measures of International Specialization, *Eurasian Bus Rev (2015) Vol 5*, pp. 99 – 115

Lee, H., Ramstetter, E.R., & Movshuk, O. (2005). Issues Raised by Restructuring of the Steel Industry in Northeast Asia. In Lee et al (eds), *Restructuring of the Steel Industry in Northeast Asia*. New York: Palgrave Macmillan.

Leromain, E., & Orefice, G. (2013). New Revealed Comparative Index: dataset and empirical distribution. *CEPII No.2013-20 June*.

MacDougall, G. D. A. (1951). British and American Exports: A Study Suggested by the Theory of Comparative Costs. *Economic Journal*, December 1951 (Part I: pp. 697–724) and September 1952 (Part II: pp. 487–521). Reprinted in R. E. Caves and H. G. Johnson, *Readings in International Economics* (Homewood, Ill.: Irwin, 1968), pp. 553–578.

Riniwati, H., Harahab, N., & Carla, T.Y. (2017). Analysis of Indonesian Crab Export Competitiveness in International Market. *International Review of Management and Marketing, 7(5), 23-27.*

Salvatore, D. (2013). *International Economics: Trade and Finance*. Eight Edition. John Wiley &Sons Inc. Part one: International Trade Theory.

Setiawan, A.E. & Sugiarti, T. (2016). Daya Saing dan Faktor Penentu Ekspor Kopi Indonesia ke Malaysia Dalam Skema CEPT-AFTA. *Jurnal Sosial Ekonomi dan Kebijakan Pertanian Agriekonomika Volume 5, Nomor 2.*

Setyari, N.P.W., Widodo, T. & Purnawan M.E. (2016). Comparative advantage dynamism of Indonesian export products. *Journal of Developing Areas, Tennessee State University, College of Business, vol. 50(5),* pp 57-69, Special I.

Simonovska, I., & Waugh, M. E. (2014). The Elasticity of Trade: Estimates and Evidence. *Journal of International Economics*, *92(1),* pp 34-50, retrieved from https://doi.org/10.1016/j.jinteco.2013.10.001

Stern, R. M. (1962). British and American Productivity and Comparative Costs in International Trade. *Oxford Economic Papers*, pp. 275–296.

Tien, H. (2005). Estimating the Efficiency of Taiwan's Steel-Making Firms. In Lee et al (eds), *Restructuring of the Steel Industry in Northeast Asia*. New York: Palgrave Macmillan.

Vollrath, T. (1991). A Theoretical Evaluation of Alternative Trade Intensity Measures of Revealed Comparative Advantage. *Weltwirtschaftliches Archiv*, *127*, pp. 265-280.

Wahyudi, S., & Maipita, I. (2018). Comparative Analysis on the Market Share of Indonesian Export Commodities: Opportunities and Challenges. *Jurnal Ekonomi Pembangunan: Kajian Masalah Ekonomi dan Pembangunan*, 19(2), retrieved from https://doi.org/10.23917/jep.v19i2.5708.

World Trade Organization. (2019a). Integrated Trade Intelligence Portal ((I-TIP) Goods: Integrated analysis and retrieval of notified non-tariff measures. retrieved from http://i-tip.wto.org/goods/default.aspx?language=en

World Trade Organization. (2019b). Tariff Analysis Online. retrieved from https://tao.wto.org/

Yu, R., Cai, J., & Leung, P. (2009). The Normalized Revealed Comparative Advantage Index. *The Analysis of Regional Science, 43(1),* 267-282.