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# Technical Coefficients and Trade Coefficients in South Korean and in Japanese Economies: Are they the Same?

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**Abstract:** ***This paper compared technical coefficients and trade coefficients in South Korean economy to those in Japanese economy based on 30-sector classification of world input-output tables of the year of 2000, 2005 and 2010. The results showed that South Korean economy had higher technical coefficients than that of Japanese economy, but statistically they were not significant. South Korean economy used more input to produce output compared to that of Japanese economy. Technical index of South Korean economy was lower than that of Japanese economy, but statistically it was not significant. Based on trade coefficients, this study showed that South Korean economy had lower domestic component than Japanese economy did. This difference was statistically significant. Japanese economy, technically, worked more efficiently; and Japanese economy used more domestic input. This paper also revealed that technical index had a positive correlation with domestic component.***

**Keywords:** technical coefficients; trade coefficients; domestic component; impor component

## 1. Introduction

The economy of South Korea is the fourth largest economy in Asia and the 11th largest in the world. It is a mixed economy (Anonymous, 2016a; Kerr, A., &Wright, E., 2015), dominated by family-owned conglomerates called chaebols, however, the dominance of chaebol is unlikely and at risk to support the transformation of Korean economy for the future generations (Anonymous, 2016b; Hwang Lee, 2015). South Korea is famous for its spectacular rise from one of the poorest countries in the world to a developed, high-income country in just one generation. This economic miracle, commonly known as the Miracle on the Han River (Kleiner, J., 2001), brought South Korea to the ranks of elite countries in the OECD and the G-20. South Korea still remains one of the fastest growing developed countries in the world following the Great Recession. It is included in the group of Next Eleven countries that will dominate the global economy in the middle of the 21st century. By creating favorable policy directive for economic development as preceded by Japanese economic recovery as the logistic supplying bastion for American troops in the Korean peninsula during and after the Korean War (Overholt, W. H., 2011), South Korea's rigorous education system and the establishment of a highly motivated and educated populace is largely responsible for spurring the country's high technology boom and rapid economic development (Anonymous, (2014). Having almost no natural resources and always suffering from overpopulation in its small territory, which deterred continued population growth and the formation of a large internal consumer market, South Korea adapted an export-oriented economic strategy to fuel its economy, and in 2014, South Korea was the seventh largest exporter and seventh largest importer in the world. Bank of Korea and Korea Development Institute periodically release major economic indicators and economic trends of the economy of South Korea.

The economy of Japan is the third-largest in the world by nominal GDP and the fourth-largest by purchasing power parity (Anonymous, 2015; Kyung Lah, (2011) and is the world's second largest developed economy (Anonymous, (2013). Japan is a member of the G-7. According to the International Monetary Fund, the country's per capita GDP (PPP) was at $37,519, the 28th highest in 2014 (Anonymous, 2016a) down from the 22nd position in 2012 ( Anonymous, 2014). Due to a volatile currency exchange rate, Japan's GDP as measured in dollars fluctuates widely. Accounting for these fluctuations through use of the Atlas method, Japan is estimated to have a GDP per capita of around $38,490.

Japan is the world's third largest automobile manufacturing country (Anonymous, 2014b), the largest electronics goods industry, and is often ranked among the world's most innovative countries leading several measures of global patent filings (Anonymous, 2014c). Facing increasing competition from China and South Korea (Morris, B., 2012), manufacturing in Japan today now focuses primarily on high-tech and precision goods, such as optical instruments, hybrid vehicles, and robotics. Besides the Kantō region (Yoshihiko, I., 2004); Toshihiro, K., 2002; Junichiro, M., Kajikawa, Y., Sakata, Ichiro, S., 2010; Schlunze, R, D., 2008), the Kansai region is one of the leading industrial clusters and manufacturing centres for the Japanese economy (Anonymous, 2017). Japan is the world's largest creditor nation (Chandler, M., 2011; Mitsuru, O., 2013). Japan generally runs an annual trade surplus and has a considerable net international investment surplus.

Japan and South Korea are close neighbors, as they are both main allies of the United States in the Northeast Asia. The Ministry of Foreign Affairs of Japan explains that ROK is 'Japan’s most important neighbor that shares strategic interests with Japan (Anonymous, 2016c). In recent years, however, the relationship has greatly deteriorated due to many disputes, including the territorial claims on Liancourt Rocks (Dokdo or Takeshima), Japanese prime ministers'

visits to Yasukuni Shrine, and differing views on Imperial Japan's treatment of colonial Korea, as well as Japan's refusal to negotiate Korea's demands that it apologize or pay reparations for mistreatment of World War II comfort women from Korea. These tensions have complicated American efforts to promote a common front against Chinese threats in the region (Alastair, G., 2015).

Production is a process of combining various material inputs and immaterial inputs (plans, know-how) in order to make something for consumption (the output). It is the act of creating output, a good or service which has value and contributes to the utility of individuals (Kotler, P., Armstrong, G., Brown, L., and Adam, S. (2006). Production function, in economics, is equation that expresses the relationship between the quantities of productive factors (such as labour and capital) used and the amount of product obtained. It states the amount of product that can be obtained from every combination of factors, assuming that the most efficient available methods of production are used (Britanica.com, 2017).

In economics, a production function relates physical output of a production process to physical inputs or factors of production. The production function is one of the key concepts of mainstream neoclassical theories, used to define marginal product and to distinguish allocative efficiency, the defining focus of economics. The primary purpose of the production function is to address allocative efficiency in the use of factor inputs in production and the resulting distribution of income to those factors, while abstracting away from the technological problems of achieving technical efficiency, as an engineer or professional manager might understand it. Production function denotes an efficient combination of inputs and outputs (Wikipedia, 2017)

The production function can be defined as the specification of the minimum input requirements needed to produce designated quantities of output (Mishra, K., (2007). Assuming that maximum output is obtained from given inputs allows economists to abstract away from technological and managerial problems associated with realizing such a technical maximum, and to focus exclusively on the problem of allocative efficiency, associated with the economic choice of how much of a factor input to use, or the degree to which one factor may be substituted for another. In the production function itself, the relationship of output to inputs is non-monetary; that is, a production function relates physical inputs to physical outputs, and prices and costs are not reflected in the function (Malakooti, B., 2013).

The inputs to the production function are commonly termed factors of production and may represent primary factors, which are stocks. Classically, the primary factors of production were Land, Labor and Capital. Primary factors do not become part of the output product, nor are the primary factors, themselves, transformed in the production process. The production function is not a full model of the production process: it deliberately abstracts from inherent aspects of physical production processes that some would argue are essential, including error, entropy or waste, and the consumption of energy or the co-production of pollution. Moreover, production functions do not ordinarily model the business processes, either, ignoring the role of strategic and operational business management (Wikipedia, 2017).

In input-output model, total input comprises of intermediate consumption input and value-added. Total input is summation of local and imported input. Technical coefficients are the ratio of total intermediate input (domestic and imported) to total input which are equal to total output. Technical index is the inverse of technical coefficient.

The objective of this paper is to compare technical and trade coefficients between South Korean economy to those of Japanese economy using data from National Input-Output Table (NIOT) of the two countries from World Input-Output Database (WIOD) for the year 2000, 2005 and 2010.

## 2. Method of Analysis

An input-output table records the "flows of products from each industrial sector considered as a producer to each of the sectors considered as consumers" (Miller and Blair, 1985). In the production process, each of these industries uses products that were produced by other industries and produces outputs that will be consumed by final users (for private consumption, government consumption, investment and exports) and also by other industries, as inputs for intermediate consumption. These transactions may be arrayed in an input-output table, as illustrated in Figure 1.

The columns of Figure 1 provide information on the input composition of the total supply of each product *j* ($X_j$), this is comprised by the national production and also by imported products. The value of domestic production consists of intermediate consumption of several industrial inputs *i* plus value added. The interindustry transactions table is a nuclear part of this table, in the sense that it provides a detailed portrait of how the different economic activities are interrelated. Since, in this table, intermediate consumption is of the total-flow type, this implies that true technological relationships are being considered. In fact, each column of the intermediate consumption table describes the total amount of each input *i* consumed in the production of output *j*, regardless of the geographical origin of that input.

The input-output interconnections illustrated in Figure 1 can be translated analytically into accounting identities. On the demand perspective, if $Zij$ denote the intermediate use of product *i* by industry *j* and $y_i$ denote the final use of product *i*, we may write, to each of the *n* products:

$$X_i = Z_{i1} + Z_{i2} + \ldots + Z_{ii} + \ldots + Z_{in} + y_i \quad (1)$$

On the supply side, we know that:

$$X_j = Z_{1j} + Z_{2j} + \ldots + Z_{ji} + \ldots + Z_{nj} + w_j + m_j \quad (2)$$

in which $w_j$ stands for value added in the production of *j* and $m_j$ for total imports of product *j*.

Of course, it is required that, for i = j, $x_i = x_j$, i.e., for one specific product, the total output obtained in the use or demand perspective must equal the total output achieved by the supply perspective. These two equations can be easily related to the National Accounts' identities.

Technical coefficients are defined as total input used to

produce output that come from domestic and imported; $a^{n}_{ij} = a^{nn}_{ij} + a^{nk}_{ij}$, where: $a^{n}_{ij}$= national technical coefficient, $a^{nn}_{ij}$ = intra-nation coefficient (domestic input) and $a^{nk}_{ij}$ = inter-nation coefficient (imported input).

National Input-Output Table of South Korea and Japan for the year of 2000, 2005 and 2010 are available from World Input Output Data Base (Timmer, M. P., Los, B., Stehrer, R. and de Vries, G. J., 2016). Calculation on technical coefficients, technical index and trade coefficients will be based on 30 sectors classification of South Korea and Japan National Input-Output Tabel for the year of 2000, 2005 and 2010.

| Product | 1 2… n | Total Intermediate Demand | Final Demand | Total Demand |
|---|---|---|---|---|
| 1<br>2<br>…<br>n | $a_{ij} X_j$ | $\sum a_{ij} X_j$ | Y | Xi |
| Total Intermediate Consumption | $\sum a_{ij} X_j$ | | | |
| Value-added | $W_j$ | | | |
| Total Supply Domestic | $\sum a_{ij} X_j + W_j$ | | | |
| Imported Product | $M_j$ | | | |
| Total Supply | $X_j$ | | | |

Sectors are classified as follows, S-1: Crop and animal production, hunting and related service activities; S-2: Forestry and logging; S-3: Fishing and aquaculture; S-4: Mining and quarrying; S-5: Manufacture of food products, beverages and tobacco products; S-6: Manufacture of textiles, wearing apparel and leather products; S-7:Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials; S-8: Manufacture of paper and paper products; S-9:Printing and reproduction of recorded media; S-10: Manufacture of coke and refined petroleum products; S-11: Manufacture of chemicals and chemical products; S-12:Manufacture of basic pharmaceutical products and pharmaceutical preparations; S-13:Manufacture of rubber and plastic products; S-14: Manufacture of other non-metallic mineral products; S-15:Manufacture of basic metals; S-16:Manufacture of fabricated metal products, except machinery and equipment; S-17:Manufacture of computer, electronic and optical products; S-18: Manufacture of electrical equipment; S-19: Manufacture of machinery and equipment not elsewhere classification; S-20: Manufacture of motor vehicles, trailers and semi-trailers; S-21: Manufacture of other transport equipment; S-22: Manufacture of furniture; other manufacturing; S-23: Repair and installation of machinery and equipment; S-24: Electricity, gas, steam and air conditioning supply, water collection, treatment and supply, sewerage; waste collection, treatment and disposal activities; S-25: Construction; S-26: Wholesale and retail trade, accommodation and food service activities; S-27: Transportation, and communication, warehouse and postal and courier service, publishing, motion picture, television and computer, consultancy, etc; S-28: Financial service, real estate, legal accounting, architecture and engineering, advertising, other public administration activities; S-29: Education, scientific research and development, human health and social worker activities; and S-30: Other service activities.

Comparison between technical coefficients in South Korean and Japanese economies will be made by employing statistical different test, t-test for non-correlation; comparing t-calculated and t-table for 95 per cent significant level.

## 3. Results and Discussion

### Technical Coefficients and Technical Index

Technical coefficient in this study is defined as proportion of input used to produce output in an economy. The smallest the proportion of input used to produce output the most efficient the economy is. Table 1 presents proportion of input used in South Korean and Japanese economies in the year of 2000, 2005 and 2010. In the year of 2000, proportion of input used in South Korean economy, on average was 57.62 per cent. The lowest proportion of input was in Sector-28 (31.03%) and the highest proportion of input was in Sector-10 (81.43%). Meanwhile in Japanese economy, on average, proportion of input was 54.87 per cent. The lowest proportion was in Sector-28 (28.98%) and the highest proportion was in Sector-20 (74.52%). On average the proportion of input in South Korean economy (57.62%) was higher than that in the US economy (54.87%), but it was not statistically significant. It means that Japanese economy was more efficient than South Korean economy as Japan economy used less input.

In the year of 2005, on average, proportion of input used to produce output in South Korean economy was 60.99 per cent with the lowest proportion was in Sector-3 (37.99%) and the highest proportion was in Sector-10 (80.70%). In Japanese economy, proportion of input was 56.89 per cent with lowest proportion in Sector-28 (28.98%) and the highest input proportion was in Sector-11 (76.04%). On average, the proportion of input in South Korean economy (60.9%) was higher than that in Japanese economy (56.89%), but it was statistically not significant. Even though it was statistically not significant, Japanese economy, technically, was more efficient than South Korean economy as less input was used in Japanese economy.

**Table 1:** Proportion of input used in South Korean and Japanese economies: 2000, 2005 and 2010

| | South Korean economy | | | Japanese economy | | |
|---|---|---|---|---|---|---|
| Sector | 2000 | 2005 | 2010 | 2000 | 2005 | 2010 |
| Sector-1 | 0.3518 | 0.3845 | 0.4579 | 0.4516 | 0.4728 | 0.5054 |
| Sector-2 | 0.3497 | 0.3817 | 0.4536 | 0.3275 | 0.4639 | 0.5049 |
| Sector-3 | 0.3453 | 0.3779 | 0.4493 | 0.4352 | 0.4508 | 0.4670 |
| Sector-4 | 0.3315 | 0.3963 | 0.4174 | 0.5894 | 0.7036 | 0.7620 |
| Sector-5 | 0.7899 | 0.7885 | 0.8107 | 0.5745 | 0.5903 | 0.5849 |
| Sector-6 | 0.6944 | 0.7089 | 0.7317 | 0.6288 | 0.6656 | 0.6274 |
| Sector-7 | 0.6536 | 0,.6742 | 0.7187 | 0.6121 | 0.6164 | 0.6433 |
| Sector-8 | 0.6600 | 0.6849 | 0.7237 | 0.6537 | 0.6463 | 0.6936 |
| Sector-9 | 0.6630 | 0.6870 | 0.7260 | 0.4938 | 0.4280 | 0.4456 |
| Sector-10 | 0.8143 | 0.8070 | 0.8431 | 0.5612 | 0.6315 | 0.6467 |
| Sector-11 | 0.7222 | 0.7269 | 0.7539 | 0.7028 | 0.7604 | 0.7866 |
| Sector-12 | 0.7234 | 0.7282 | 0.7557 | 0.5559 | 0.5426 | 0.5590 |
| Sector-13 | 0.6148 | 0.6588 | 0.6875 | 0.6504 | 0.6665 | 0.6657 |
| Sector-14 | 0.6034 | 0.6463 | 0.6770 | 0.5664 | 0.5666 | 0.5839 |
| Sector-15 | 0.7090 | 0.7150 | 0.7561 | 0.7062 | 0.7214 | 0.8445 |
| Sector-16 | 0.5942 | 0.6721 | 0.6966 | 0.5947 | 0.6219 | 0.6225 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Sector-17 | 0.7134 | 0.7198 | 0.7215 | 0.6299 | 0.6261 | 0.6298 |
| Sector-18 | 0.7177 | 0.7230 | 0.7254 | 0.6335 | 0.6474 | 0.6971 |
| Sector-19 | 0.6363 | 0.6851 | 0.7108 | 0.6095 | 0.6063 | 0.5812 |
| Sector-20 | 0.6947 | 0.7497 | 0.7387 | 0.7452 | 0.7352 | 0.7382 |
| Sector-21 | 0.6943 | 0.7506 | 0.7359 | 0.7201 | 0.7230 | 0.6395 |
| Sector-22 | 0.4890 | 0.5476 | 0.7238 | 0.6294 | 0.6402 | 0.6467 |
| Sector-24 | 0.4928 | 0.5501 | 0.6496 | 0.4527 | 0.5056 | 0.6041 |
| Sector-25 | 0.6038 | 0.5254 | 0.6536 | 0.5306 | 0.5455 | 0.3488 |
| Sector-26 | 0.4075 | 0.5544 | 0.4571 | 0.4036 | 0.4116 | 0.2977 |
| Sector-27 | 0.5071 | 0.6060 | 0.5747 | 0.4443 | 0.4596 | 0.5168 |
| Sector-28 | 0.3103 | 0.3981 | 0.3285 | 0.2898 | 0.2758 | 0.5625 |
| Sector-29 | 0.3465 | 0.3981 | 0.3699 | 0.3278 | 0.3398 | 0.3162 |
| Sector-30 | 0.4769 | 0.4411 | 0.4876 | 0.3917 | 0.4347 | 0.3146 |
| Average | 0.5762 | 0.6099 | 0.6392 | 0.5487 | 0.5689 | 0.5806 |
| Variance | 0.0238 | 0.0197 | 0.0206 | 0.0155 | 0.0154 | 0.0196 |

Source: Processed from WIOT, 2017.

In the year of 2010, on average, proportion of input to produce output in South Korean economy was 63.92 per cent. It was higher than that of the year 2000 (57.62%) and 2005 (60.99%. It means that technically South Korean economy in 2010 was more in-efficient compare to that in 2005 and 2000. The lowest proportion of input in that year was in Sector-28 (32.85%) and the higher input proportion was in Sector-10 (84.310%). Meanwhile, in Japanese economy the proportion of input was in average 58.06 per cent with lowest proportion in Sector-26 (29.77%) and highest proportion in Sector-15 (84.55%). Compared to South Korean economy, input proportion in Japanese economy in the year of 2010 was smaller (58.06%) than that South Korean economy (63.92%), but it was statistically not significant. Again, in 2010 Japanese economy was more efficient than that in South Korean economy as proportion of input in Japan economy (58.06%) was less than that in South Korean economy (63.92%).

Figure 1 (left panel) presents technical coefficients represented by proportion of input in South Korean economic sectors. In the year of 2000 South Korean economic sectors with input proportion less than 50 per cent were: Sector-1, Sector-2, Sector-3, Sector-4, Sector-22, Sector-24, Sector-26, Sector-27, Sector-28, Sector-29 and Sector-30. Other sectors had input proportion more than 50 per cent. In the year of 2005, South Korean economic sectors with input proportion less than 50 per cent were: Sector-1, Sector-2, Sector-3, Sector-4, Sector-28, Sector-29 and Sector-30. Other sectors had input proportion more than 50 per cent. In the year of 2010, South Korean economic sectors with input proportion less than 50 per cent were: Sector-1, Sector-2, Sector-3, Sector-4, Sector-26, Sector-28, Sector-29 and Sector-30. Other sectors had input proportion more than 50 per cent.

Figure 1 (right panel) presents technical coefficients represented by proportion of input in Japanese economic sectors for the year 2000, 2005 and 2010. In the year of 2000, Japanese economic sectors with input proportion less than 50 per cent were: Sector-1, Sector-2, Sector-3, Sector-9, Sector-24, Sector-26, Sector-27, Sector-28, Sector-29, and Sector-30. Other sectors had input proportion more than 50 per cent. In the year of 2005, Japanese economic sectors with input proportion less than 50 per cent were: Secto-1, Sector-2, Sector-3, Sector-9, Sector-26, Sector-27, Sector-28, Sector-29, and Sector-30. Other sectors had input proportion more than 50 per cent. In the year of 2010, Japanese economic sectors with input proportion less than 50 per cent were: Sector Sector-3, Sector-9, Sector-25, Sector-26, Sector-28, Sector-29, and Sector-30. Other sectors had input proportion more than 50 per cent.

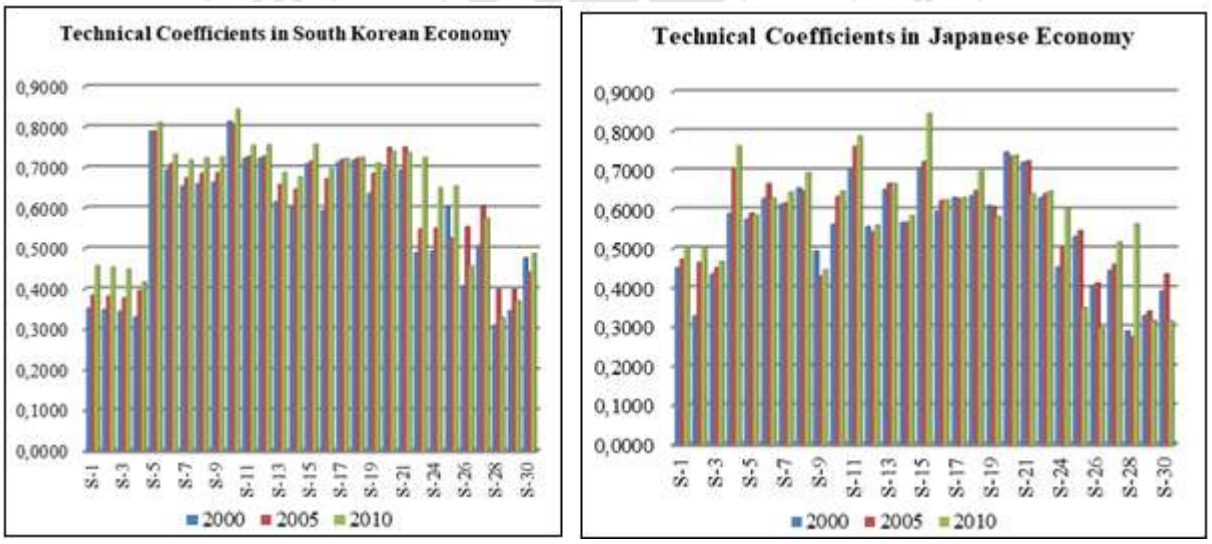


**Figure 1:** Technical Coefficient in South Korean and in Japanese Economies: 2000, 2005, and 2010

In all of the years during 2000, 2005 and 2010 Japanese had about the same number of economic sectors with input proportion less than 50 per cent than South Korean economy do. In the year 2000, Japan had 10 economic sectors with input proportion less than 50 per cent; meanwhile South Korea had 10 economic sectors with input proportion less than 50 per cent. In the year of 2005, Japan had 9 economic sectors with input proportion less than 50 per cent; meanwhile South Korea had 7 economic sectors with input proportion less than 50 per cent. In the year of 2010, Japan had 7 economic sectors with input proportion less than 50 per cent; while South Korea had 8 economic sectors with input proportion less than 50 per cent. It can be then stated that even though it was not statistically significant, Japanese economy, technically, operated in more efficient way than South Korean economy as input proportion in the Japanese

economy were lower than those in South Korea economy. Japanese economy used less input in order to produce output compare to that of South Korea.

Technical index is defines as inverse of input proportion used to produce output in an economy. The most the index the most efficient the economy is. Table 2 presents technical indices in South Korean and Japanese economies for the year of 2000, 2005 and 2010. On average, technical indices of South Korean economy were: 1.8892; 1.7293 and 1.6495 consecutively for the year of 2000, 2005 and 2010. Technical indices of Japanese economy were 1.9375; 1.8619 and 1.8521 consecutively for the year of 2000, 2005 and 2010. It is clearly shown that technical indices in Japanese economy were higher than that in South Korean economy. Statistical test proved that the difference on technical indices between Japanese and South Korean economy were not statistically significant. It can be stated that Japanese economy, technically, more efficient than South Korean economy as Japanese technical indices were higher than South Korean technical indices.

**Table 2:** Technical Indices in South Korean and Japanese Economies: 2000, 2005 and 2010

| Sector | South Korea economy | | | Japanese economy | | |
|---|---|---|---|---|---|---|
| | 2000 | 2005 | 2010 | 2000 | 2005 | 2010 |
| Sector-1 | 2.8424 | 2.6008 | 2.1841 | 2.2143 | 2.1150 | 1.9785 |
| Sector-2 | 2.8597 | 2.6197 | 2.2046 | 3.0536 | 2.1555 | 1.9807 |
| Sector-3 | 2.8961 | 2.6461 | 2.2259 | 2.2977 | 2.2185 | 2.1412 |
| Sector-4 | 3.0170 | 2.5236 | 2.3955 | 1.6966 | 1.4212 | 1.3123 |
| Sector-5 | 1.2660 | 1.2682 | 1.2335 | 1.7406 | 1.6941 | 1.7097 |
| Sector-6 | 1.4400 | 1.4107 | 1.3667 | 1.5903 | 1.5023 | 1.5939 |
| Sector-7 | 1.5300 | 1.4833 | 1.3914 | 1.6337 | 1.6224 | 1.5544 |
| Sector-8 | 1.5151 | 1.4602 | 1.3819 | 1.5297 | 1.5472 | 1.4418 |
| Sector-9 | 1.5084 | 1.4556 | 1.3775 | 2.0253 | 2.3363 | 2.2440 |
| Sector-10 | 1.2281 | 1.2391 | 1.1861 | 1.7818 | 1.5835 | 1.5464 |
| Sector-11 | 1.3846 | 1.3757 | 1.3264 | 1.4229 | 1.3151 | 1.2712 |
| Sector-12 | 1.3824 | 1.3733 | 1.3232 | 1.7988 | 1.8430 | 1.7890 |
| Sector-13 | 1.6265 | 1.5179 | 1.4546 | 1.5375 | 1.5003 | 1.5022 |
| Sector-14 | 1.6572 | 1.5473 | 1.4771 | 1.7655 | 1.7650 | 1.7126 |
| Sector-15 | 1.4105 | 1.3985 | 1.3226 | 1.4159 | 1.3862 | 1.1842 |
| Sector-16 | 1.6830 | 1.4879 | 1.4356 | 1.6815 | 1.6081 | 1.6065 |
| Sector-17 | 1.4017 | 1.3892 | 1.3860 | 1.5877 | 1.5971 | 1.5877 |
| Sector-18 | 1.3933 | 1.3832 | 1.3786 | 1.5786 | 1.5447 | 1.4346 |
| Sector-19 | 1.5717 | 1.4596 | 1.4068 | 1.6407 | 1.6495 | 1.7205 |
| Sector-20 | 1.4395 | 1.3338 | 1.3537 | 1.3419 | 1.3602 | 1.3546 |
| Sector-21 | 1.4402 | 1.3324 | 1.3588 | 1.3887 | 1.3832 | 1.5636 |
| Sector-22 | 2.0451 | 1.8260 | 1.3816 | 1.5887 | 1.5621 | 1.5463 |
| Sector-24 | 2.0291 | 1.8178 | 1.5395 | 2.2088 | 1.9780 | 1.6554 |
| Sector-25 | 2.0291 | 1.8178 | 1.5395 | 1.8846 | 1.8332 | 2.8671 |
| Sector-26 | 1.6563 | 1.9034 | 1.5300 | 2.4777 | 2.4297 | 3.3592 |
| Sector-27 | 2.4541 | 1.8036 | 2.1878 | 2.2510 | 2.1760 | 1,9350 |
| Sector-28 | 1.9720 | 1.6502 | 1.7400 | 3.4511 | 3.6252 | 1.7778 |
| Sector-29 | 3.2224 | 2.5121 | 3.0441 | 3.0507 | 2.9426 | 3.1627 |
| Sector-30 | 2.8858 | 2.5121 | 2.7035 | 2.5527 | 2.3004 | 3.1783 |
| Average | 1.8892 | 1.7293 | 1.6495 | 1.9375 | 1.8619 | 1.8521 |
| Variance | 0.3816 | 0.2214 | 0.2297 | 0.2951 | 0.2682 | 0.3394 |

Source: Processed from WIOT, 2017.

Figure 2 (left panel) presents technical indices in South Korean economic sectors. On average at national level, technical index in South Korean economy were 1.8892; 1.7293 and 1.6495 consecutively for the year of 2000, 2005 and 2010. In the year of 2000 South Korean economic sectors with technical indices more than 2.0000 were: Sector-1, Sector-2, Sector-3, Sector-4, Sector-22, Sector-24, Sector-25, Sector-27, Sector-29 and Sector-30. Other sectors had technical index less than 2.0000. In the year of 2005, South Korean economic sectors with technical indices more than 2.0000 were: Sector-1, Sector-2, Sector-3, Sector-4, Sector-29, and Sector-30. Other sectors had technical index less than 2.0000. In the year of 2010, South Korean economic sector with technical indices more than 2.0000 were: Sector-1, Sector-2 Sector-3, Sector-4 and Sector-27. Other sectors had technical index less than 2.0000.

Figure 2 (right panel) presents technical indices in Japanese economic sectors for the year 2000, 2005 and 2010. On average at national level, technical index in Japanese economy were: 1.9375; 1.8619 and 2.8521 consecutively for the year of 2000, 2005 and 2010. In the year of 2000, Japanese economic sectors with technical indices more than 2.0000 were: Sector-1, Sector-2, Sector-3, Sector-9, Sector-24, Sector-26, Sector-28, Sector-29 and Sector-30. Other sectors had technical index less than 2.0000. In the year of 2005, Japanese economic sectors with technical indices more than 2.000 were: Sector-1, Sector-2, Sector-3, Sector-4, Sector-9, Sector-26, Sector-28, Sector-29 and Sector-30. Other sectors had technical index less than 2.0000. In the year of 2010, Japanese economic sectors with technical indices more than 2.0000 were: Sector-3, Sector-9, Sector-25, Sector-26, Sector-27, Sector-29 and Sector-30. Other sectors had technical index less than 2.0000.

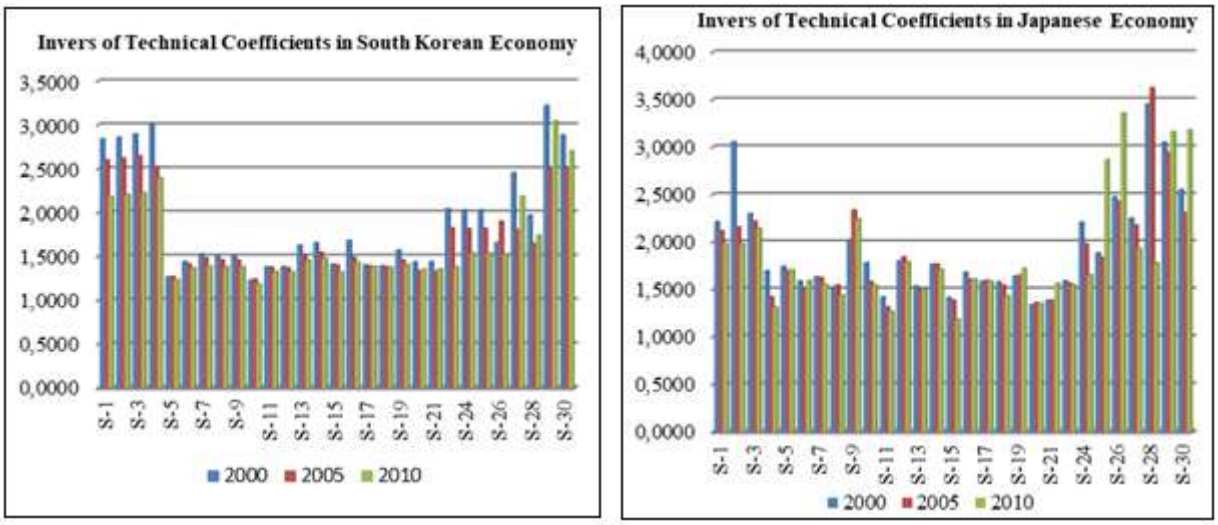


**Figure 2:** Technical Index in South Korean and in Japanese Economies: 2000, 2005, and 2010

In all of the years during 2000, 2005 and 2010, Japan and South Korea had almost the same number of economic sectors with technical indices more 2.0000. In the year 2000, Japan had 9 economic sectors technical indices more than 2.0000; meanwhile South Korea had 10 economic sectors with technical indices more than 2.0000. In the year of 2005, Japan had 8 economic sectors with technical indices more than 2.0000; meanwhile South Korea had only 6 economic sectors with technical indices more than 2.0000. In the year of 2010, Japan had 6 economic sectors with technical indices more than 2.000; while South Korea had 5 economic sectors with technical indices more than 2.0000. Even though, Japanese economy technically operated in more efficient way than South Korean economy, but it was statistically not significant. Japanese economy had higher technical indices compare to that of South Korea. Proportion of input and technical index analysis ini comparing technical efficiency between Japan economy and South Korean economy confirm each other. Statistically, there were no different in technical coefficient between Japanese economy and South Korean economy.

**Trade Coefficient: Domestic and Import Components**

In input-output model, trade coefficients are simply defined as proportion of input that come from both domestic and import. Table 3 presents domestic transaction in South Korean and Japanese economies for the year of 2000, 2005 and 2010.

In Figure 3 and Table 3, on average at national level, domestic transactions in South Korean economy were 81.41 per cent; 80.18 per cent and 79.72 per cent consecutively for the year of 2000, 2005 and 2010. It means that the rest of transactions were imported; 18.59 per cent in year 2000, 19.82 per cent in 2005 and 20.28 per cent in 2010. In the year of 2000, all sector in South Korean economy had domestic transactions more than 80 per cent, except Sector-7, Sector-10, Sector-14, Sector-15, Sector-17, Sector-22 and Sector-24 had domestic component less than 80 per cent. In the year of 2005, all South Korean economic sectors had domestic transactions more than 80 per cent, except Sector-7, Sector-10, Sector-14, Sector-15, Sector-17, and Sector-24 had domestic transactions less than 80 per cent. In the year of 2010, all South Korean economic sectors had domestic transactions more than 80 per cent, except Sector-7, Sector-10, Sector-11, Sector-14, Sector-15, Sector-16, Sector-17, and Sector-24 that had domestic transaction less than 80 per cent.

Table 3 and Figure 3 also present domestic transactions in Japanese economy. Consecutively for the year of 2000, 2005 and 2010, on average at national level, domestic transactions in Japan economy were: 91.14 per cent, 88.07 per cent and 87.44 per cent. It was indicated that import transactions in Japan economy were only 8.83 per cent for the year of 2000, 11.93 per cent for the year of 2005, and 12.56 per cent for the year of 2010. In the year of 2000, all Japan economic sectors had domestic transactions more than 80 per cent except Sector-4 and Sector-10 that had domestic transactions less than 80 per cent. In the year of 2005, all Japan economic sectors had domestic transactions more 80 per cent, except Sector-4, Sector-10, and Sector-24 which had domestic transactions less 80 per cent. In the year of 2010, Japan economic sectors had domestic transactions more than 80 per cent, except Sector-4, Sector-10, and Sector-24 that had domestic transactions less 80 per cent.

In Figure 3 (left panel) and Figure 4, in the year of 2000, there were 22 South Korean economic sectors with domestic transactions more than 80 per cent. While in Japan economic sectors the numbers were 27 (Figure 3 right panel and Figure 4). In the year of 2005, as shown in Figure 5, there were 23 South Korean economic sectors with domestic transactions more than 80 per cent, compared to 26 sectors in Japan economy. In the year of 2010, as also shown in Figure 6, there were 20 South Korean economic sectors with domestic transactions more than 80 per cent, compared to 26 sectors in Japan economy. In all years (2000, 2005 and 2010), Japan had more number of economic sectors with 80 per cent domestic input than that of South Korean, and it was statistically significant.

From discussion above, one can see that Japan economy had higher technical indices than those of South Korean economy, but statistically it was not significant. Japan economy had also higher and significant domestic transaction than South Korean economy. The questions arise

then, how was the relationship between technical index and domestic component as well as the relationship between technical index and domestic component? In more general question, how was the relationship between technical coefficients and trade coefficients?

From South Korean data, the higher is the domestic component the higher the technical index is. Correlation between technical index and domestic component was positively weak (r = 0.34). The regression coefficient was positive (0.013 and statistically significant (t-calculated= 3.35; t-table= 1.66). Correlation between technical coefficient and domestic component was negative, but weak (r = -0.39). Regression coefficient was also negative (-0.004) and statistically significant (t-calculated= -3.99; t-table= 1.66). It could be interpreted that correlation between import component and technical coefficient was positive

**Table 3:** Domestic Transaction (%) in South Korean and Japanese Economies: 2000, 20005 and 2010

| Sector | South Korean economy | | | Japanese economy | | |
|---|---|---|---|---|---|---|
| | 2000 | 2005 | 2010 | 2000 | 2005 | 2010 |
| Sector-1 | 87.77 | 88.08 | 86.07 | 94.12 | 92.32 | 91.06 |
| Sector-2 | 86.54 | 86.41 | 80.71 | 85.43 | 85.46 | 90.37 |
| Sector-3 | 87.71 | 88.34 | 84.36 | 94.46 | 91.68 | 92.04 |
| Sector-4 | 91.70 | 91.56 | 89.00 | 78.75 | 64.16 | 58.83 |
| Sector-5 | 89.53 | 89.84 | 86.94 | 95.06 | 93.73 | 92.90 |
| Sector-6 | 82.24 | 84.41 | 85.09 | 93.76 | 91.96 | 91.24 |
| Sector-7 | 77.32 | 78.38 | 79.79 | 85.49 | 82.86 | 87.08 |
| Sector-8 | 83.63 | 85.76 | 84.26 | 94.84 | 93.75 | 93.17 |
| Sector-9 | 88.43 | 89.37 | 87.49 | 96.18 | 95.17 | 94.74 |
| Sector-10 | 22.40 | 18.15 | 19.70 | 48.93 | 31.93 | 30.50 |
| Sector-11 | 81.06 | 81.02 | 77.70 | 91.98 | 88.52 | 87.88 |
| Sector-12 | 87.39 | 87.07 | 85.60 | 95.61 | 93.89 | 92.99 |
| Sector-13 | 82.47 | 82.18 | 80.06 | 94.32 | 92.37 | 91.22 |
| Sector-14 | 73.95 | 69.89 | 73.88 | 89.46 | 87.31 | 85.90 |
| Sector-15 | 72.06 | 70.74 | 61.83 | 88.84 | 85.06 | 81.62 |
| Sector-16 | 80.37 | 82.61 | 78.10 | 94.46 | 92.95 | 91.98 |
| Sector-17 | 70.93 | 76.93 | 73.65 | 89.74 | 86.62 | 86.75 |
| Sector-18 | 82.47 | 83.81 | 81.67 | 92.44 | 89.23 | 88.03 |
| Sector-19 | 81.98 | 84.15 | 81.94 | 92.88 | 90.81 | 89.85 |
| Sector-20 | 85.21 | 85.63 | 84.50 | 96.62 | 95.40 | 94.21 |
| Sector-21 | 82.45 | 85.97 | 80.38 | 93.43 | 89.18 | 90.06 |
| Sector-22 | 79.47 | 81.01 | 83.72 | 93.47 | 92.33 | 91.66 |
| Sector-24 | 60.97 | 50.79 | 58.71 | 85.96 | 78.66 | 73.87 |
| Sector-25 | 82.46 | 48.56 | 80.80 | 93.54 | 91.62 | 97.96 |
| Sector-26 | 92.62 | 92.60 | 90.21 | 96.60 | 95.73 | 95.72 |
| Sector-27 | 90.05 | 83.49 | 86.63 | 94.88 | 93.42 | 90.48 |
| Sector-28 | 93.33 | 92.83 | 91.52 | 97.34 | 96.99 | 90.97 |
| Sector-29 | 91.64 | 92.75 | 88.43 | 97.35 | 94.59 | 95.71 |
| Sector-30 | 92.70 | 92.84 | 89.00 | 96.98 | 96.47 | 96.99 |
| Average | 81.41 | 80.18 | 79.72 | 91.14 | 88.07 | 87.44 |
| Variance | 183.47 | 258.50 | 189.10 | 84.50 | 159.63 | 177.06 |

Source: Processed from WIOT, 2017.

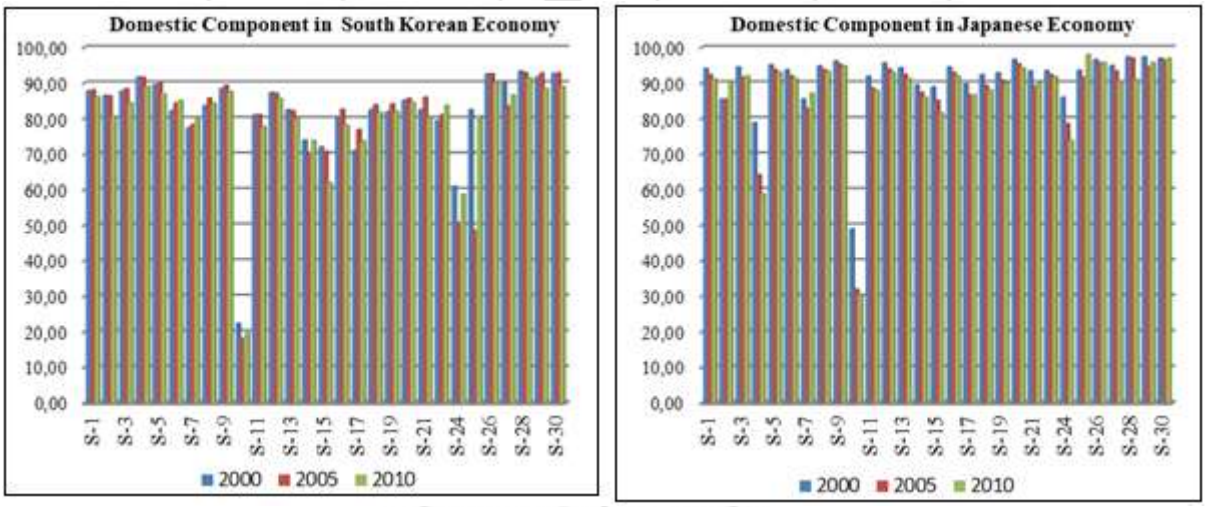


**Figure 3:** Domestic Components in South Korean and in Japanese Economies: 2000, 2005, and 2010

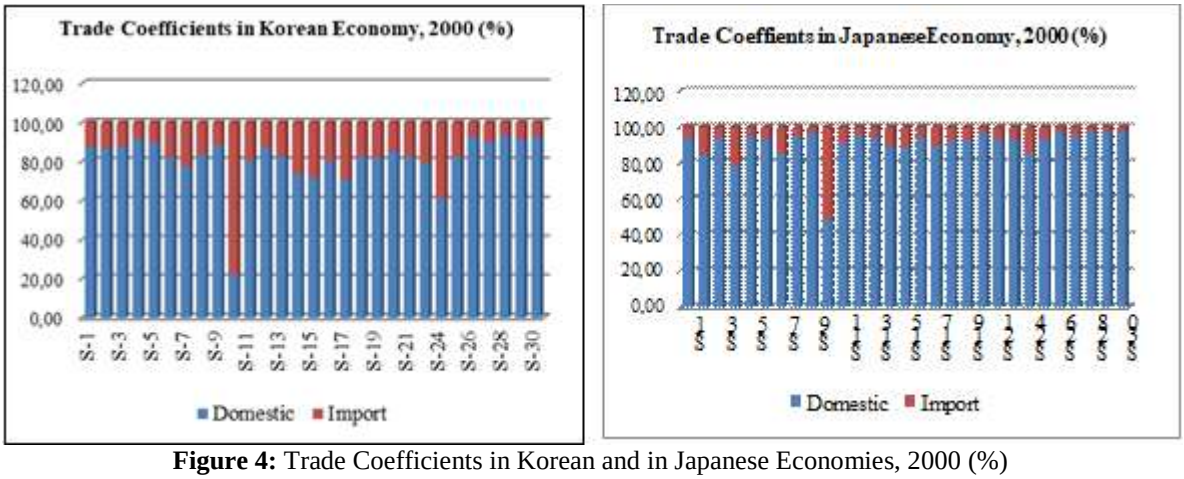


**Figure 4:** Trade Coefficients in Korean and in Japanese Economies, 2000 (%)

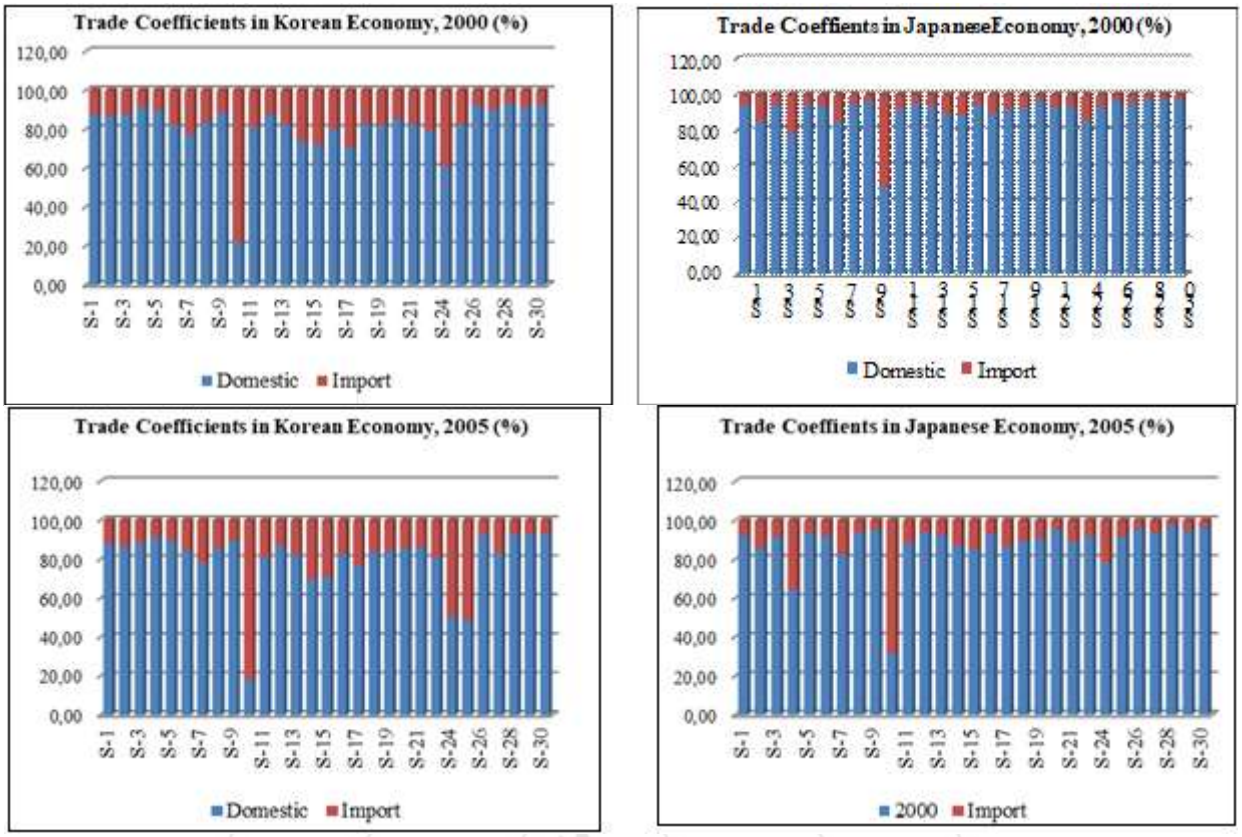


**Figure 5:** Trade Coefficients in Korean and in Japanese Economies, 2005 (%)

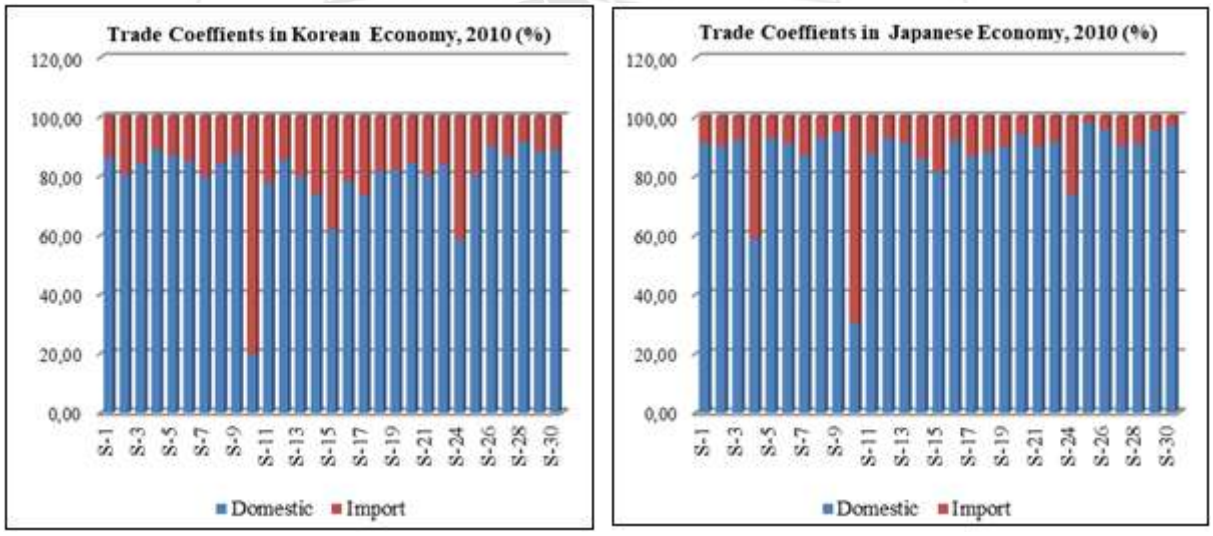


**Figure 6:** Trade Coefficients in Korean and in Japanese Economies, 2010 (%)

Meanwhile, from Japanese case, the higher is the domestic component, the higher the technical index is. Coefficient of correlation between technical index and domestic component was positive but weak (r = 0.28). Regression coefficient was also positive (0.013) and statistically it was significant (t-calculated= 2.69; t-table=1.661). Correlation between technical coefficient and domestic component was negative, but weak (r = -0.28). Regression coefficient was also negative (-0.003) and statistically significant (t-calculated= -2.69; t-table= 1.66).

## 4. Conclusion

Some conclusions could be drawn; firstly, even though it was not statistically significant, technical index in South Korean economy was lower than that of Japanese economy as South Korean economy used more input compared to Japanese economy. Technical coefficient in South Korean economy was higher than that of Japanese economy. Secondly, South Korean economy used less domestic component than Japanese economy did. This difference was statistically significant. Thirdly, there was a weak and positive correlation between technical index and domestic component. South Korean and Japanese data supported that the regression coefficient was positive and statistically significant. Finally, there was a weak negative correlation between technical coefficient and import component. Both South Korean and Japanese data supported the facts. Regression coefficient was negative and statistically significant.

## References

[1] Alastair Gale, (2015), "Enmity between South Korea, Japan Worries U.S.: Seoul's demand for new apology over WWII 'comfort women' complicates regional security ties", Wall Street Journal, https://www.wsj.com/articles/enmity-between-south-korea-japan-worries-u-s-1424132562
[2] Anonymous, (2013), "Country statistical profile: Japan", OECD iLibrary, 28 February 2013, http://www.oecd-ilibrary.org/economics/country-statistical-profile-japan_20752288-table-jpn
[3] Anonymous, (2014), "High performance, high pressure in South Korea's education system", ICEF Monitor, http://monitor.icef.com/2014/01/high-performance-high-pressure-in-south-koreas-education-system/
[4] Anonymous, (2014a), "World Economic Outlook Database – October 2013", International Monetary Fund, http://www.imf.org/external/pubs/ft/weo/2013/02/weodata/weorept.aspx?
[5] Anonymous (2014b), "2013 Production Statistics – First 6 Months", OICA,
[6] http://www.oica.net/category/production-statistics/2016-statistics/
[7] Anonymous, (2014c), "Statistics on Patents", World Intellectual Property Organization,
[8] http://www.wipo.int/ipstats/en/index.html#data
[9] Anonymous, (2015), "World Economic Outlook Database, April 2016 – Report for Selected Countries and Subjects", International Monetary Fund (IMF),
[10] http://www.imf.org/external/pubs/ft/weo/2016/01/weodata/weorept.aspx?pr.x=51&pr.y=3&sy=2016&ey=2020&scsm=1&ssd=1&sort=country&ds=.&br=1&c=158&s=NGDPD%2CNGDPDPC%2CPPPGDP%2CPPPPC&grp=0&a=
[11] Anonymous, (2016a), "South Korea: Introduction", Global EDGE,
[12] https://globaledge.msu.edu/countries/south-korea
[13] Anonymous, (2016b), South Korea Country Report, BTI,https://www.bti-project.org/fileadmin/files/BTI/Downloads/Reports/2016/pdf/BTI_2016_South_Korea.pdf
[14] Anonymous, (2016c), "Section 1: Asia and Oceania - CHAPTER 2", Ministry of Foreign Affairs of Japan, http://www.mofa.go.jp/policy/other/bluebook/2016/html/chapter2/c020100.html
[15] Anonymous, (2016d), "World Economic Outlook Database-October 2015", International Monetary Fund,
[16] http://www.imf.org/external/pubs/ft/weo/2015/02/weodata/weorept.aspx?
[17] Anonymous, (2017), "Profile of Osaka/Kansai", Japan External Trade Organization Osaka, Retrieved October 2017,https://www.jetro.go.jp/austria/topics/20121112014-topics/Profile.pdf
[18] Chandler, M., (2011), "The yen is a safe haven as Japan is the world's largest creditor", Credit Writedowns,
[19] https://www.creditwritedowns.com/2011/08/japan-safe-haven.html
[20] Hwang Lee, (2015), "Development of Competition Laws in Korea", ERIA Discussion Paper Series, ERIA-DP-2015-78, http://www.eria.org/ERIA-DP-2015-78.pdf
[21] Junichiro, M., Kajikawa, Y., Sakata, Ichiro, S., (2010), "Evaluating the Impacts of Regional Cluster Policies using Network Analysis", International Association for Management of Technology,
[22] http://pari.u-tokyo.ac.jp/publications/paper/IAMOT2010_jmori_cluster.pdf
[23] Kerr, A and Wright, E., (2015), A Dictionary of World History, Oxford University Press – via Google Books, https://books.google.com/books?id=POAwBwAAQBAJ&pg=PA367&lpg=PA367&dq=South%20Korea%20mixed%20economy&source=bl&ots=yONJsyFsVb&sig=SBrqOC5XxGZW782TibKQQanl-x0&hl=ko&sa=X&redir_esc=y#v=onepage&q=South%20Korea%20mixed%20economy&f=false
[24] Kleiner, J., (2001), Korea, A Century of Change, ISBN: 978-981-02-4657-0, https://books.google.co.id/books?id=nTCC2ZheFu0C&pg=PA254&lpg=PA254&dq=han+river+miracle&q=han+river+miracle&redir_esc=y&hl=id#v=snippet&q=han%20river%20miracle&f=false
[25] Kotler, P., Armstrong, G., Brown, L., and Adam, S., (2006), **Marketing**, 7th Ed, Pearson Education Australia/Prentice Hall,https://www.abebooks.com/servlet/BookDetailsPL?bi=16509608579&searchurl=sortby%3D17%26an%3Dkotler%2Badam%2Bbrown%2Band%2Barmstrong&cm_sp=snippet-_-srp1-_-title2
[26] Kyung Lah, (2011), "Japan: Economy slips to third in world", CNN.com,
[27] http://edition.cnn.com/2011/BUSINESS/02/13/japan.economy.third/index.html
[28] Malakooti, B., (2013), **Operations and Production Systems with Multiple Objectives**, John Wiley& Sons, ISBN 978-1-118-58537-5, http://as.wiley.com/WileyCDA/WileyTitle/productCd-1118585372.html
[29] Miller, R. and Blair, P., (1985), Input-Output Analysis – Foundations and Extensions, Prentice-Hall (Eds), http://www.usp.br/nereus/wp-content/uploads/MB-2009-05-Ch-2-Found-I-O-Anal.pdf
[30] Mishra, S. K. (2007), "A Brief History of Production Functions", Working Paper, SSRN 1020577, https://www.scribd.com/doc/417083/A-Brief-History-of-Production-Functions
[31] Mitsuru, O., (2013), "Japan World's Largest Creditor Nation for 22nd Straight Year", The Wall Street Journal, https://blogs.wsj.com/japanrealtime/2013/05/28/japan-worlds-largest-creditor-nation-for-22nd-straight-year/
[32] Morris, Ben (2012), "What does the future hold for Japan's electronics firms?", BBC News,
[33] http://www.bbc.com/news/business-17688322
[34] Overholt, W. H., (2011), "Park Chung Hee's International Legacy", Archived from the original on 2014-10-14, https://web.archive.org/web/20141014152256/http://www.ash.harvard.edu/extension/ash/docs/parkjunghee.pdf
[35] Schlunze, R, D., (2008), "Location and Role of Foreign Firms in Regional Innovation Systems in Japan", Ritsumeikan University,
[36] http://www.ritsumei.ac.jp/acd/re/k-sc/ras/04_publications/ria_en/6_01.pdf
[37] Timmer, M. P., Los, B., Stehrer, R. and de Vries, G. J., (2016), "An Anatomy of the Global Trade Slowdown

based on the WIOD 2016 Release", GGDC research memorandum number 162, University of Groningen,
[38] http://www.ggdc.net/publications/memorandum/gd162.pdf
[39] Toshihiro, K., (2002), "Case study of regional university-industry partnership in practice". Institute for International Studies and Training,
[40] https://www.iist.or.jp/wf/magazine/0098/0098_E.html
[41] Yoshihiko, I., (2004), "Strengthening the Competitiveness of Local Industries: The Case of an Industrial Cluster Formed by Three Tokai Prefecters", Nomura Research Institute, http://www.nri.com/global/opinion/papers/2004/pdf/np200475.pdf

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