International Journal of Development and Sustainability
ISSN: 2186-8662 – www.isdsnet.com/ijds
Volume 7 Number 2 (2018): Pages 651-665
ISDS Article ID: IJDS18012907

Sector-specific and spatial-specific multipliers in Japanese economy: World input-output analysis

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Abstract

This article presents and discusses on sectoral and spatial multipliers in Japanese economy using 6-country-30 sector input-output tables for the year 2000, 2005, 2010 and 2014. The results revealed that Firstly, all sectors with total output multipliers more than 2; flow-on effect was more than initial effect. In order to increase output, priority should be given to those sectors with total output multipliers more than 2 as less initial effort will be needed to produce output. Secondly, total output multipliers had negative correlation with percentage of multipliers that occurred in own-sector, but total output multipliers had positive correlation with percentage of multipliers that occurred in other-sector. The higher total output multipliers, the smaller percentage of multipliers occurred in own-sector. All intial effects occurred in own-sector. Direct effects might be occurred in own-sector, but indirect effect might be not. Thirdly, total output multipliers had negative correlation with percentage of multipliers that occurred in own-country, but total output multiplier had positive correlation with percentage of multipliers that occurred in other-countries. The higher total output multipliers, the smaller percentage of multipliers occurred in own-country. All intial effects occurred in own-country. Direct effects might be occurred in own-country, but indirect effect might be not.

Keywords: Total Multipliers; Sector-Specific Multipliers; Spatial-Specific Multipliers

Cite this article as: Muchdie, M. and Sumarso, S. (2018), "Sector-specific and spatial-specific multipliers in Japanese economy: World input-output analysis", *International Journal of Development and Sustainability*, Vol. 7 No. 2, pp. 651-665.

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1. Introduction

In macroeconomics, a multiplier is a factor of proportionality that measures how much an endogenous variable changes in response to a change in some exogenous variable (see among others: Dornbusch and Stanley, 1994; McConnell et al., 2011; Pindyck and Rubinfeld, 2012). In monetary microeconomics and banking, the money multiplier measures how much the money supply increases in response to a change in the monetary base (see among others: Krugman and Wells 2009; Mankiw, 2008). Multipliers can be calculated to analyze the effects of fiscal policy, or other exogenous changes in spending, on aggregate output. Other types of fiscal multipliers can also be calculated, like multipliers that describe the effects of changing taxes.

Literature on the calculation of Keynesian multipliers traces back to Richard Kahn's (1931) description of an employment multiplier for government expenditure during a period of high unemployment. At this early stage, Kahn's calculations recognize the importance of supply constraints and possible increases in the general price level resulting from additional spending in the national economy (Ahiakpor, 2000). Hall (2009) discusses the way that behavioral assumptions about employment and spending affect econometrically estimated Keynesian multipliers.

The literature on the calculation of I-O multipliers traces back to Leontief (1951), who developed a set of national-level multipliers that could be used to estimate the economy-wide effect that an initial change in final demand has on an economy. Isard (1951) then applied input-output analysis to a regional economy. According to Richardson (1985), the first attempt to create regional multipliers by adjusting national data with regional data was Moore and Peterson (1955) for the state of Utah. In a parallel development, Tiebout (1956) specified a model of regional economic growth that focuses on regional exports. His economic base multipliers are based on a model that separates production sold to consumers from outside the region to production sold to consumers in the region. The magnitude of his multiplier is based on the regional supply chain and local consumer spending.

In a survey of input-output and economic base multipliers, Richardson (1985) notes the difficulty inherent in specifying the local share of spending. He notes the growth of survey-based regional input-output models in the 1960s and 1970s that allowed for more accurate estimation of local spending, though at a large cost in terms of resources. To bridge the gap between resource intensive survey-based multipliers and "off-the-shelf" multipliers, Beemiller (1990) of the BEA describes the use of primary data to improve the accuracy of regional multipliers. The literature on the use and misuse of regional multipliers and models is extensive. Coughlin and Mandelbaum (1991) provide an accessible introduction to regional I-O multipliers. They note that key limitations of regional I-O multipliers include the accuracy of leakage measures, the emphasis on short-term effects, the absence of supply constraints, and the inability to fully capture interregional feedback effects.

Grady and Muller (1988) argued that regional I-O models that include household spending should not be used and argue that cost-benefit analysis is the most appropriate tool for analyzing the benefits of particular programs. Mills (1993) noted the lack of budget constraints for governments and no role for government debt in regional IO models. As a result, in less than careful hands, regional I-O models can be interpreted to

over-estimate the economic benefit of government spending projects. Hughes (2003) discussed the limitations of the application of multipliers and provides a checklist to consider when conducting regional impact studies. Harris (1997) discussed the application of regional multipliers in the context of tourism impact studies, one area where the multipliers are commonly misused. Siegfried, et al. (2006) discussed the application of regional multipliers in the context of college and university impact studies, another area where the multipliers are commonly misused. Input-output analysis, also known as the inter-industry analysis, is the name given to an analytical work conducted by Leontief in the late 1930's. The fundamental purpose of the input-output framework is to analyze the interdependence of industries in an economy through market based transactions. Input-output analysis can provide important and timely information on the interrelationships in a regional economy and the impacts of changes on that economy.

The notion of multipliers rests upon the difference between the initial effect of an exogenous change (final demand) and the total effects of a change. Direct effects measure the response for a given industry given a change in final demand for that same industry. Indirect effects represent the response by all local industries from a change in final demand for a specific industry. Induced effects represent the response by all local industries caused by increased (decreased) expenditures of new household income and inter-institutional transfers generated (lost) from the direct and indirect effects of the change in final demand for a specific industry. Total effects are the sum of direct, indirect, and induced effects (West, 1990).

The economy of Japan is a highly developed and market-oriented economy. It is the third-largest in the world by nominal GDP and the fourth-largest by purchasing power parity (IMF, 2016) and is the world's second largest developed economy (OECD, 2013). Japan is a member of the G7. According to the International Monetary Fund, the country's per capita GDP (PPP) was at $37,519, the 28th highest in 2014 (IMF, 2015), down from the 22nd position in 2012 (IMF, 2013). 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 (OICA, 2013), has the largest electronics goods industry, and is often ranked among the world's most innovative countries leading several measures of global patent filings (WIO, 2013). Facing increasing competition from China and South Korea (Morris, 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 (Iwadare, 2004; Kodama, 2002; Mori et al., 2010), the Kansai region is one of the leading industrial clusters and manufacturing centres for the Japanese economy. The size and industrial structure of cities in Japan have maintained tight regularities despite substantial churning of population and industries across cities overtime. Japan is the world's largest creditor nation (Chandler, 2011; Obe, 2013). Japan generally runs an annual trade surplus and has a considerable net international investment surplus. As of 2010, Japan possesses 13.7% of the world's private financial assets (the third largest in the world) at an estimated $13.5 trillion (Allianz, 2015). As of 2015, 54 of the Fortune Global 500 companies are based in Japan (Fortune, 2017), down from 62 in 2013 (Fortune, 2013).

The objective of this paper is to calculates, presents and discusses on sectoral and spatial multipliers in Japanese economy using 6-country-30sector input-output tables for the year 2000, 2005, 2010 and 2014.

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). It is an "excellent descriptive device" and a powerful analytical technique (Jensen et al., 1979). 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 (Oosterhaven and Stelder, 2007; Timmer et al. (2015).

The columns of the input composition are 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 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 can be translated analytically into accounting identities. On the demand perspective, if Z_{ij} 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*. 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. In general term, equation (1) can be written as:

$$x = Ax + y \quad \text{or} \quad x = (I - A)^{-1}y \quad (3)$$

National Input-Output Table of Japan for the year of 2000, 2005, 2010 and 2014 are available from World Input Output Data Base (Timmer et al., 2016; 2015). Calculations of total and disaggregated multipliers, sector-spesific multipliers and country-specific multipliers were following West, G.R. (1990) and modified formula of DiPasquale and Polenske (1980). West (1990) defined the major categories of response as: initial, first-round, industrial-support, consumption-induced, total and flow-on effects. Total effect is calculated as summation of intial, direct-effect (first-round), indirect-effect (industrial-support) and consumption induced effect (as matrix is closed to house-hold row and column, which was not calculated in this study). Flow-on effect is defined as the different between total and initial effects. Modified from DiPasquale and Polenske (1980), sector-specific multipliers of output is calculated as $\sum {}^{cr}b_{ij;}$ c = 1,..,m, and country-specific multipliers of output is calculate as $\sum {}^{cs}b_{ij;}$ i = 1,..n. Note that *c* and *r* are the *m* origin and destination countries, *i* and *j* are

the *n* producing and purchasing sectors, $^{cr}b_{ij}$ is the element of inverse of Leontief matrix, *m* is the number of country and *n* is the number of sectors. Sector classifications and country abbreviations are available at Appendices.

3. Results and discussions

3.1. Results

3.1.1. Total multipliers and flow-on effects

Figure 1 presents disaggregated output multipliers in Japanese economy for the year of 2000 and 2005. In the year of 2000, average national output multiplier was 1.9143; meaning that output flow-on effect was 0.9143 as initial effect was 1.0000. Direct effects of increasing final demand by 1.000 unit would be 0.5304 and indirect effect would increase by 0.3839 resulting total output multiplier of 1.9143. In this year, there were 12 sector in which total output multipliers more than 2; meaning that flow-on effects were higher than initial effects. These sectors were: Sector-6 (2.1123), Sector-8 (2.1377), Sector-11 (2.3137), Sector-13 (2.1970), Sector-15 (2.4450), Sector-16 (2.1039), Sector-17 (2.1730), Sector-18 (2.1814), Sector-19 (2.1192), Sector-20 (2.7673), Sector-21 (2.4412), and Sector-22 (2.0582). In many cases, direct effects were higher than indirect effects, except in Sector-15 (direct effect=28.89% and indirect effect= 30.21%) and Sector-20 (direct effect= 26.93% and indirect effect= 36.94%).

In the year of 2005, average national output multiplier was 2.1860; meaning that output flow-on effect was 1.1860 as initial effect was 1.0000. Direct effects of increasing final demand by 1.000 unit would be 0.5500 and indirect effect would increase by 0.6360 resulting total output multiplier of 2.1860. Indirect effects were higher than direct effect. This year more sector had total multipliers more than 2, meaning that flow-on effects were higher than initial effects. These sectors were: Sector-4 (2.3587), Sector-5 (2.2004), Sector-6 (2.4880), Sector-7 (2.2552), Sector-8 (2.4009), Sector-10 (2.2137), Sector-11 (2.7925), Sector-12 (2.1002), Sector-13 (2.5777), Sector-14 (2.1401), Sector-15 (2.7736), Sector-16 (2.4535), Sector-17 (2.4179), Sector-18 (2.4863), Sector-19 (2.3876), Sector-20 (2.9952), Sector-21 (2.7373), and Sector-22 (2.3812). As on average, indirect effect (27.59%) was higher than direct effect (24.48%), in this year more sectors in which indirect effects were higher than direct effects.

Figure 2: present disaggregated output multiplier in Japanese economy for the year of 2010 and 2014. In the year of 2010, average national output multiplier was 2.2638; meaning that increasing 1.000 unit of final demand would increase to output by 2.2638 unit. Similar to the year 0f 2005, in the year of 2010, indirect effects were higher than direct effect. In 2010, there were 21 sectors in which total output multipliers were more than 2, namely: Sector-1 (2.0875) Sector-2 (2.0142), Sector-3 (2.0061), Sector-4 (2.5343) , Sector-5 (2.2276) , Sector-6 (2.4224), Sector-7 (2.3569), Sector-8 (2.5718), Sector-10 (2.3168) , Sector-11 (2.9640), Sector-12 (2.1671), Sector-13 (2.6435), Sector-14 (2.2170), Sector-15 (3.3382), Sector-16 (2.5975), Sector-17 (2.4926), Sector-18 (2.7203), Sector-19 (2.4113), Sector-20 (3.0789), Sector-21 (2.6078), Sector-22

(2.4607), Sector-24 (2.0746), and Sector-25 (2.1164). More sectors (23 sectors) had indirect effects higher than indirect effects.

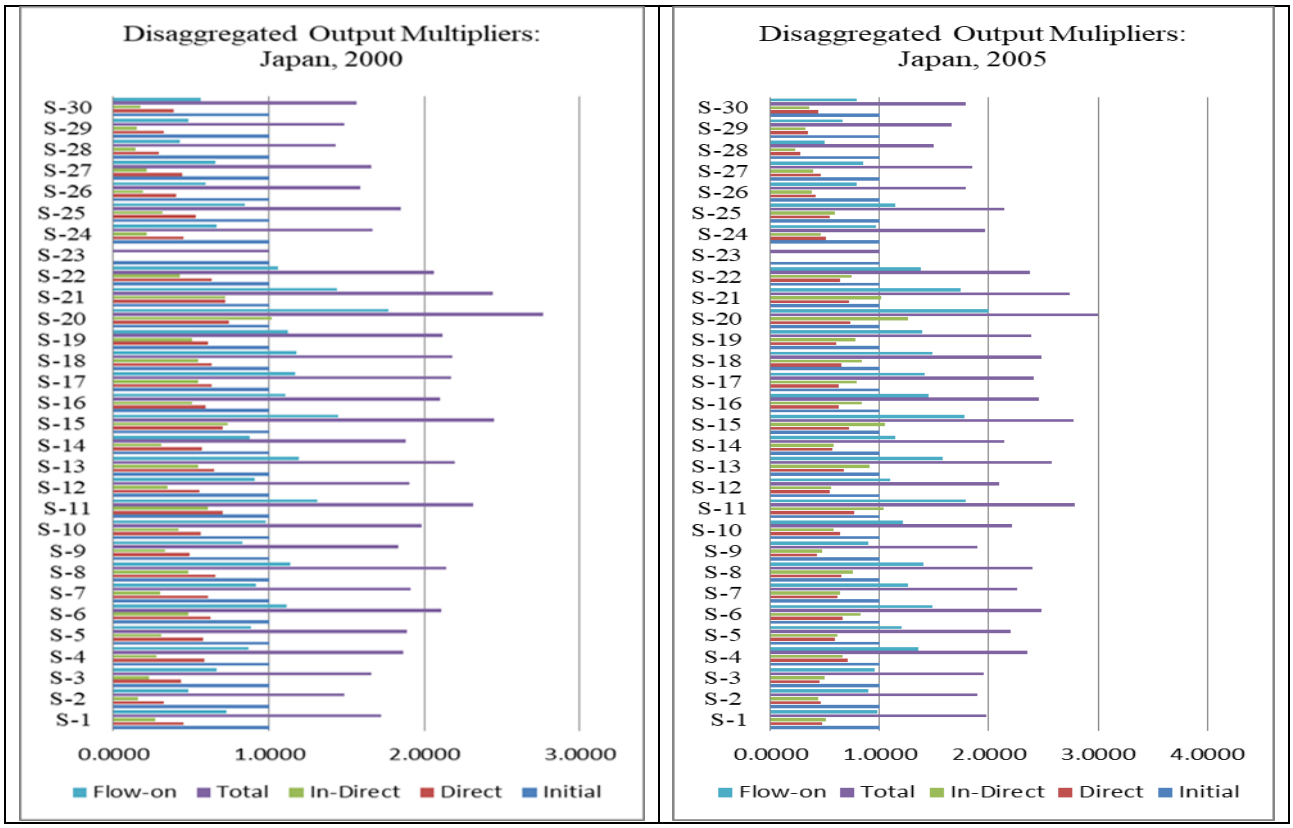

Figure 1. Disaggregated Output Multipliers in Japanese Economy: 2000 and 2005 (Source: Processed from WIOT, 2017)

In the year of 2014, in average at national level, total output multiplier was 2.2945; meaning that increasing final demand by 1.000 unit would increase total output by 2.2945, where 1.000 as intial effect, 1.1945 as flow-on effect which was the summation of direct and indirect effects. In this year, 22 sectors had total output multiplier more than 2, namely: Sector-1 (2.0710), Sector-3 (2.0746), Sector-4 (2.4606) , Sector-5 (2.2664), Sector-6 (2.4914), Sector-7 (2.3071), Sector-8 (2.5673), Sector-10 (2.2541), Sector-11 (3.2269), Sector-12 (2.1281), Sector-13 (2.8045), Sector-14 (2.2248), Sector-15 (3.1612), Sector-16 (2.7120), Sector-17 (2.5194), Sector-18 (2.8241), Sector-19 (2.4759), Sector-20 (3.0630), Sector-21 (2.5858), Sector-22 (2.5240), Sector-24 (2.2899), and Sector-25 (2.2086). As in average, indirect effect was higher than direct effect, many more sectors (25 sectors) in which indirect effects were higher than direct effect, mostly in sector with total multipliers more than 2.

3.1.2. Sector-Specific Multipliers

Table 1 provides sector-specific multipliers in Japanese economy for the year of 2000, 2005, 2010 and 2014. Sector-specific multipliers separate multipliers that occurred in own-sector and that occurred in other

sectors. In the year of 2000, average percentage multiplier occurred in own-sector was 63.35 per cent; 36.65 per cent of multiplier occurred in other-sectors. Sector with highest percentage of multipliers that occurred in own-sector was Sector-2 (98.57%). This sector had lowest percentage of multipliers that occurred in other-sector (1.43%). There were 18 sectors that percentage of multipliers occurred in-own sector more than 60 per cent, namely: Sector-1 (66.21%), Sector-2 (98.57%), Sector-3 (62.93%), Sector-5 (62.02%), Sector-6 (61.88%), Sector-8 (63.53%), Sector-9 (60.05%), Sector-11 (60.69%), Sector-15 (65.76%), Sector-17 (61.11%), Sector-20 (65.03%), Sector-24 (64.22%), Sector-26 (63.02%), Sector-27 (69.74%), Sector-28 (80.41%), Sector-29 (68.87%) and Sector-30 (66.48%). Sector with lowest percentage of multipliers that occurred in own-sector was Sector-22 (50.27%). This sector had highest percentage of multipliers that occurred in other-sector. There were 11 sectors that percentage of multipliers occurred in own -sector less than 60 per cent, namely: Sector-4 (58.27%), Sector-7 (59.01%), Sector-10 (53.88%), Sector-12 (55.19%), Sector-13 (56.25%), Sector-14 (58.64%), Sector-16 (54.54%), Sector-18 (52.54%), Sector-19 (55.02%), Sector-21 (50.27%), Sector-22 (51.48%) and Sector-25 (54.85%). Please note for Sector-23, as all cells in the table were zero, so all multipliers were initial effects as well as occurred in own sector and own country.

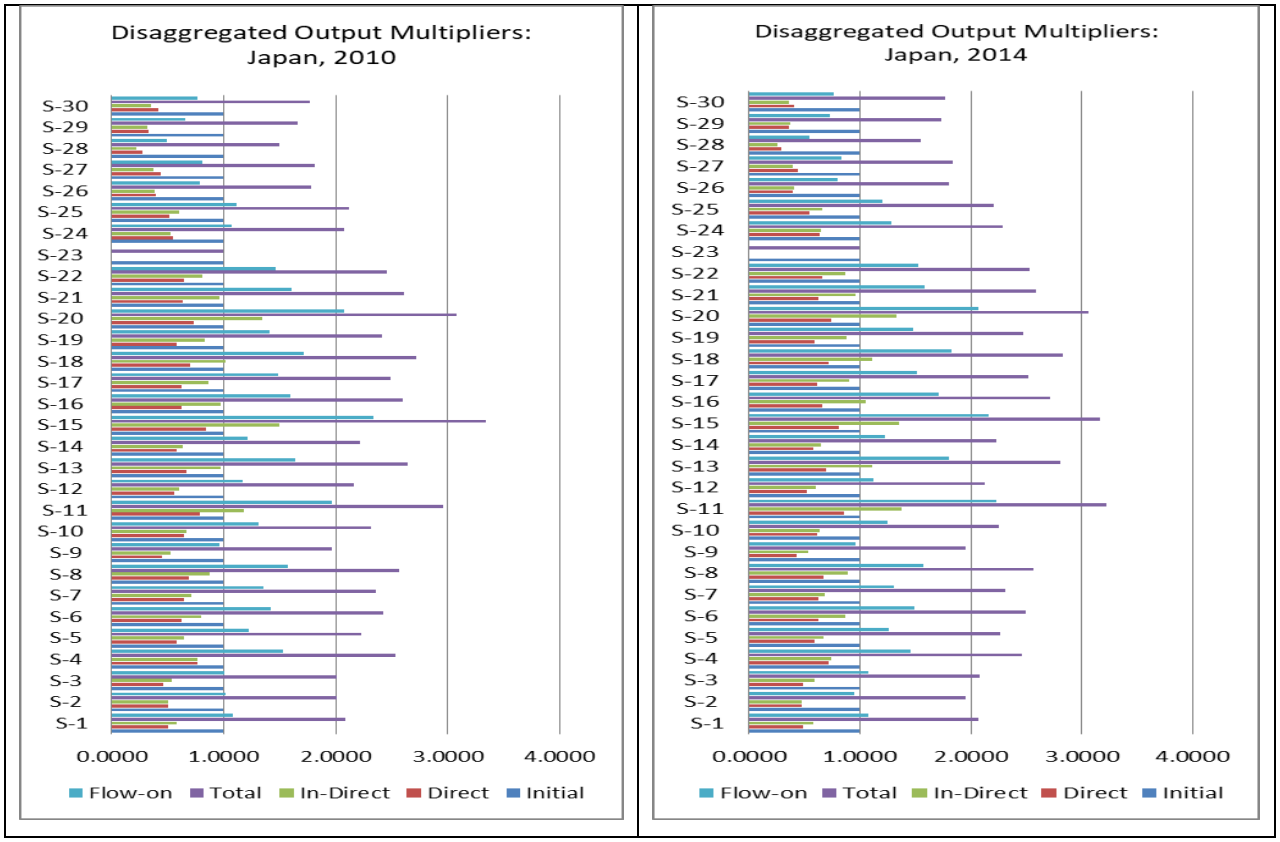

Figure 2. Disaggregated Output Multipliers in Japanese Economy: 2010 and 2014 (Source: Processed from WIOT, 2017)

In the year of 2005, average percentage multiplier occurred in own sector was 56.66 per cent; 43.34 per cent of multiplier occurred in other sectors. Sector with highest percentage of multipliers that occurred in

own-sector was Sector-28 (77.25%). This sector had lowest percentage of multipliers that occurred in other-sector (22.75%). There were 8 sectors that percentage of multipliers occurred in-own sector more than 60 per cent, namely: Sector-2 (62.02%), Sector-15 (65.50%), Sector-20 (61.52%), Sector-26 (62.32%), Sector-27 (63.78%), Sector-28 (77.25%) and Sector-29 (61.44%). Sector with lowest percentage of multipliers that occurred in own-sector was Sector-22 (44.59%). This sector had highest percentage of multipliers that occurred in other-sector (55.41%). There were 21 sectors that percentage of multipliers occurred in own-sector less than 60 per cent, namely: Sector-1 (59.05%), Sector-3 (53.60%), Sector-4 (57.72%), Sector-5 (54.77%), Sector-6 (54.11%), Sector-7 (52.16%), Sector-8 (56.36%), Sector-9 (55.80%), Sector-10 (48.38%), Sector-11 (55.43%), Sector-12 (49.82%), Sector-13 (49.42%), Sector-14 (50.72%), Sector-16 (47.03%), Sector-17 (57.48%), Sector-18 (44.49%), Sector-19 (49.51%), Sector-21 (45.34%), Sector-22 (44.59%), Sector-24 (55.16%), Sector-25 (47.51%) and Sector-30 (57.57%).

In the year of 2010, average percentage multiplier occurred in own-sector was 55.55 per cent; 44.45 per cent of multiplier occurred in other sectors. Sector with highest percentage of multipliers that occurred in own-sector was Sector-28 (77.04%). This sector had lowest percentage of multipliers that occurred in other-sector (22.96%). There were 5 sectors that percentage of multipliers occurred in own-sector more than 60 per cent, namely: Sector-2 (62.48%), Sector-26 (61.92%), Sector-27 (64.86%), Sector-28 (77.04%) and Sector-29 (61.63%). Sector with lowest percentage of multipliers that occurred in own-sector was Sector-18 (41.38%). This sector had highest percentage of multipliers that occurred in other-sector (58.62%). There were 24 sectors that percentage of multipliers occurred in own-sector less than 60 per cent, namely: Sector-1 (56.93%), Sector-3 (52.27%), Sector-4 (57.91%), Sector-5 (55.01%), Sector-6 (54.04%), Sector-7 (49.59%), Sector-8 (53.83%), Sector-9 (53.86%), Sector-10 (46.24%), Sector-11 (54.79%), Sector-12 (48.41%), Sector-13 (47.68%), Sector-14 (48.81%), Sector-15 (59.63%), Sector-16 (44.61%), Sector-17 (57.07%), Sector-18 (41.38%), Sector-19 (47.79%), Sector-20 (58.52%), Sector-21 (48.44%), Sector-22 (42.68%), Sector-24 (52.75%), Sector-25 (47.94%) and Sector-30 (58.31%).

In the year of 2014, average percentage multiplier occurred in-own sector was 54.97 per cent; 45.03 per cent of multiplier occurred in other-sectors. Sector with highest percentage of multipliers that occurred in own-sector was Sector-4 (64.74%). This sector had lowest percentage of multipliers that occurred in other-sector (35.26%). There were 5 sectors that percentage of multipliers occurred in own-sector more than 60 per cent, namely: Sector-2 (66.99%), Sector-4 (64.74%), Sector-26 (61.45%), Sector-27 (64.26%), and Sector-28 (75.07%). Sector with lowest percentage of multipliers that occurred in own-sector was Sector-18 (39.85%). This sector had highest percentage of multipliers that occurred in other-sector (60.15%). There were 24 sectors that percentage of multipliers occurred in own-sector less than 60 per cent, namely: Sector-1 (57.68%), Sector-3 (50.51%), Sector-5 (54.59%), Sector-6 (56.02%), Sector-7 (49.85%), Sector-8 (53.18%), Sector-9 (53.83%), Sector-10 (46.29%), Sector-11 (50.47%), Sector-12 (49.43%), Sector-13 (45.76%), Sector-14 (47.96%), Sector-15 (58.05%), Sector-16 (42.65%), Sector-17 (56.92%), Sector-18 (39.85%), Sector-19 (46.86%), Sector-20 (54.03%), Sector-21 (49.05%), Sector-22 (41.78%), Sector-24 (48.34%), Sector-25 (46.04%), Sector-29 (59.11%) and Sector-30 (58.18%).

Table 1. Sector-Specific Multipliers in Japanese Economy: 2000, 2005, 2010 and 2014

Year	2000		2005		2010		2014	
Sector	Own-Sector	Other-Sector	Own-Sector	Other-Sector	Own-Sector	Other-Sector	Own-Sector	Other-Sector
S-1	66.21%	33.79%	59.05%	40.95%	56.93%	43.07%	57.68%	42.32%
S-2	98.57%	1.43%	62.02%	37.98%	62.48%	37.52%	66.99%	33.01%
S-3	62.93%	37.07%	53.60%	46.40%	52.27%	47.73%	50.51%	49.49%
S-4	58.27%	41.73%	57.72%	42.28%	57.91%	42.09%	64.74%	35.26%
S-5	62.02%	37.98%	54.77%	45.23%	55.01%	44.99%	54.59%	45.41%
S-6	61.88%	38.12%	54.11%	45.89%	54.04%	45.96%	56.02%	43.98%
S-7	59.01%	40.99%	52.16%	47.84%	49.59%	50.41%	49.85%	50.15%
S-8	63.53%	36.47%	56.36%	43.64%	53.83%	46.17%	53.18%	46.82%
S-9	60.05%	39.95%	55.80%	44.20%	53.86%	46.14%	53.83%	46.17%
S-10	53.88%	46.12%	48.38%	51.62%	46.24%	53.76%	46.29%	53.71%
S-11	60.69%	39.31%	55.43%	44.57%	54.79%	45.21%	50.47%	49.53%
S-12	55.19%	44.81%	49.82%	50.18%	48.41%	51.59%	49.43%	50.57%
S-13	56.25%	43.75%	49.42%	50.58%	47.68%	52.32%	45.76%	54.24%
S-14	58.64%	41.36%	50.72%	49.28%	48.81%	51.19%	47.96%	52.04%
S-15	65.76%	34.24%	65.50%	34.50%	59.63%	40.37%	58.05%	41.95%
S-16	54.54%	45.46%	47.03%	52.97%	44.61%	55.39%	42.65%	57.35%
S-17	61.11%	38.89%	57.48%	42.52%	57.07%	42.93%	56.92%	43.08%
S-18	52.54%	47.46%	44.49%	55.51%	41.38%	58.62%	39.85%	60.15%
S-19	55.02%	44.98%	49.51%	50.49%	47.79%	52.21%	46.86%	53.14%
S-20	65.03%	34.97%	61.52%	38.48%	58.52%	41.48%	54.03%	45.97%
S-21	50.27%	49.73%	45.34%	54.66%	48.44%	51.56%	49.05%	50.95%
S-22	51.48%	48.52%	44.59%	55.41%	42.68%	57.32%	41.78%	58.22%
S-24	64.22%	35.78%	55.16%	44.84%	52.75%	47.25%	48.34%	51.66%
S-25	54.85%	45.15%	47.51%	52.49%	47.94%	52.06%	46.04%	53.96%
S-26	63.02%	36.98%	62.32%	37.68%	61.92%	38.08%	61.45%	38.55%
S-27	69.74%	30.26%	63.78%	36.22%	64.86%	35.14%	64.26%	35.74%
S-28	80.41%	19.59%	77.25%	22.75%	77.04%	22.96%	75.07%	24.93%
S-29	68.87%	31.13%	61.44%	38.56%	61.63%	38.37%	59.11%	40.89%
S-30	66.48%	33.52%	57.57%	42.43%	58.31%	41.69%	58.18%	41.82%
Average	63.35%	36.65%	56.66%	43.34%	55.55%	44.45%	54.97%	45.03%

Source: Calculated from WIOT, 2017

3.1.3. Spatial-specific multipliers

Table 2 presents spatial-specific multipliers in Japanese economy for the year of 2000, 2005, 2010 and 2014. Spatial-specific multipliers separate multipliers occurred in own-country and other-countries.

In the year of 2000, average percentage of multipliers occurred in own-country was 90.55 per cent, declined to 88.20 per cent in 2005, 86.50 per cent in 2010 and 81.22 per cent in 2014. More multipliers occurred in other-countries: 9.45 per cent in 2000, 11.80 per cent in 2005, 13.50 per cent in 2010 and 18.78 per cent in 2014. Average percentage of multipliers that occurred in own-country for the year of 2000 was 90.55 per cent; 9.45 per cent multipliers occurred in other-countries. Sector with highest multiplier hat

occurred in own-country was Sector-28 (97.04%). This sector had lowest percentage of multipliers that occurred in other-countries. Almost all sectors had percentage of multipliers that occurred in own-country were more than 80 per cent, except Sector-10 (70.55%).

Table 2. Spatial-Specific Multipliers in Japanese Economy: 2000, 2005, 2010 and 2014

Year	2000		2005		2010		2014	
Country	Own-Country	Other-Country	Own-Country	Other-Country	Own-Country	Other-Country	Own-Country	Other-Country
S-1	93.10%	6.90%	91.15%	8.85%	89.37%	10.63%	86.19%	13.81%
S-2	91.71%	8.29%	88.74%	11.26%	89.78%	10.22%	87.52%	12.48%
S-3	92.30%	7.70%	88.91%	11.09%	87.86%	12.14%	83.02%	16.98%
S-4	82.83%	17.17%	74.51%	25.49%	69.22%	30.78%	57.67%	42.33%
S-5	93.22%	6.78%	91.82%	8.18%	90.51%	9.49%	87.07%	12.93%
S-6	89.95%	10.05%	88.50%	11.50%	87.25%	12.75%	82.65%	17.35%
S-7	87.14%	12.86%	85.10%	14.90%	86.38%	13.62%	83.22%	16.78%
S-8	91.64%	8.36%	90.62%	9.38%	88.87%	11.13%	84.26%	15.74%
S-9	93.94%	6.06%	93.24%	6.76%	92.00%	8.00%	89.16%	10.84%
S-10	70.55%	29.45%	60.96%	39.04%	58.11%	41.89%	51.32%	48.68%
S-11	87.61%	12.39%	82.74%	17.26%	80.23%	19.77%	72.34%	27.66%
S-12	93.36%	6.64%	91.65%	8.35%	90.01%	9.99%	86.80%	13.20%
S-13	90.09%	9.91%	87.94%	12.06%	85.75%	14.25%	80.15%	19.85%
S-14	89.58%	10.42%	87.87%	12.13%	85.68%	14.32%	76.68%	23.32%
S-15	85.06%	14.94%	82.87%	17.13%	77.43%	22.57%	68.94%	31.06%
S-16	89.84%	10.16%	88.38%	11.62%	85.41%	14.59%	79.36%	20.64%
S-17	86.48%	13.52%	84.90%	15.10%	83.47%	16.53%	76.66%	23.34%
S-18	87.84%	12.16%	86.22%	13.78%	83.04%	16.96%	76.06%	23.94%
S-19	89.03%	10.97%	87.75%	12.25%	85.54%	14.46%	79.24%	20.76%
S-20	91.70%	8.30%	90.47%	9.53%	87.64%	12.36%	80.61%	19.39%
S-21	88.98%	11.02%	85.78%	14.22%	85.32%	14.68%	78.44%	21.56%
S-22	90.17%	9.83%	89.16%	10.84%	87.34%	12.66%	82.36%	17.64%
S-24	89.74%	10.26%	85.00%	15.00%	82.17%	17.83%	68.71%	31.29%
S-25	91.46%	8.54%	89.95%	10.05%	88.39%	11.61%	82.41%	17.59%
S-26	95.48%	4.52%	94.16%	5.84%	93.36%	6.64%	90.56%	9.44%
S-27	94.32%	5.68%	92.65%	7.35%	92.15%	7.85%	90.12%	9.88%
S-28	97.04%	2.96%	96.34%	3.66%	95.92%	4.08%	93.99%	6.01%
S-29	96.42%	3.58%	94.33%	5.67%	92.98%	7.02%	89.72%	10.28%
S-30	95.81%	4.19%	94.41%	5.59%	93.93%	6.07%	91.48%	8.52%
Average	90.55%	9.45%	88.20%	11.80%	86.50%	13.50%	81.22%	18.78%

Source: Calculated from WIOT, 2017

In the year of 2005, almost all sectors had percentage of multipliers that occurred in own-country were more than 80 per cent; expect Sector-4 (74.51%) and Sector-10 (60.96%). In the year of 2010, there were 3 sectors than had percentage of multiplier occurred in other-countries less than 80 per cent, namely: Sector-4 (69.22%), Sector-10 (58.11%) and Sector-15 (77.43%). In the year of 2014, more sectors had multipliers occurred in own-country less than 80 per cent, namely: Sector-4 (57.67%), Sector-10 (51.32%), Sector-11

(72.34%), Sector-14 (76.68%), Sector-15 (68.94%), Sector-16 (79.36%), Sector-17 (76.66%), Sector-18 (76.06%), Sector-19 (79.24%), Sector-21 (78.44%), and Sector-24 (68.71%).

In the year of 2010, average percentage of multiplier occurred in own-country was 86.50per cent; meaning that percentage of multiplier occurred in other-countries 13.50 per cent. The highest percentage of multiplier occurred in own-country was Sector-28 (95.92%) and the lowest percentage of multiplier occurred in own-country was Sector-10 (58.11%). Almost all sectors had percentage of multiplier more than 80 per cent; expect Sector-4 (69.22%), Sector-10 (58.11%), and Sector-15 (77.43%).

In the year of 2014, average percentage of multiplier occurred in own-country was 81.22 per cent; meaning that percentage of multiplier occurred in other-countries 18.78 per cent. The highest percentage of multiplier occurred in own-country was Sector-28 (93.99%) and the lowest percentage of multiplier occurred in own-country was Sector-10 (51.32%). Many sectors had percentage of multiplier more than 80 per cent; expect Sector-4 (57.67%), Sector-10 (51.32%), Sector-11 (72.34%), Sector-14 (76.68%), Sector-15 (68.94%), Sector-16 (79.36%), Sector-17 (76.66%), Sector-18 (76.06%), and Sector-19 (79.24%). All sectors had percentage of multiplier occurred in other-countries less than 40 per cent; expect Sector-4 (42.33%) and Sector-10 (48.68%).

3.2. Discussion

This section discusses important findings in this research. Firstly, total output multipliers disaggregated into initial, direct, indirect and total effects. Flow-on effect is the different between total effect and initial effect; or flow-on effect is the summation of direct effect and indirect effect. In all sectors with total output multipliers more than 2; flow-on effect was higher than initial effect; direct and indirect effects were higher than initial effect. Less initial effort will be needed to produce output. Otherwise, if all sectors with total output less than 2; flow-on effect was lower than initial effect. More initial effort will be needed to produce output. If the objective of economic development was to increase output with less effort, sectors with total output multipliers more than 2 should be prioritized in development activities.

Secondly, there was negative correlation between total output multiplier and percentage of that multiplier occurred in own-sector; the higher total output multipliers the smaller percentage of multiplier that occurred in own-sector. Regression analysis revealed that coefficients of correlation between total output multiplier and percentage of multiplier occurred in own-sector were negative and strong with r= -0.64 in the year of 2000, r= -0.63 in the year of 2005, r=-0.62 in the year of 2010 and r=-0.67 in the year of 2014. Coefficients of regression were statistically significant as calculated t-statistic (4.43 in the year of 2000; 4.29 in the year of 2005; 4.13 in the year of 2010; 4.73 in the year of 2014) were higher than critical value of t-distribution with n-1=29 (t-table = 1.699 at α =5% or 2.045 at α= 2.5%). Otherwise, there was positive correlation between total output multiplier with percentage of multipliers that occurred in other-sector; the higher total output multiplier the smaller percentage of multiplier that occurred in other-sector. Other important finding was all initial effects occurred in own-sectors. Percentage of multipliers occurred in own-sector was higher than percentage of initial effect. Direct effect of multipliers might be occurred in own-sector, but indirect effect might be not. Regression analysis showed that correlation between percentage of multiplier occurred in

own-sector and the percentage of initial effect of multiplier was strong in the year of 2000 (r =0.77), was very strong in the year of 2005 (r=0.81), was moderate in the year 2010 (r=0.57) and was strong in the year of 2014 (r=0.61). Regression coefficient was statistically significant as calculated t-statistic (6.35 in the year of 2000, 7.25 in the year of 2005, 3.67 in the year of 2010, 4.04 in the year of 2014) was higher than critical-value of t-distribution with n-1=29 (t-table= 1.699 at α=5% or 2.045 at α= 2.5%).

Thirdly, there was negative correlation between total output multiplier and percentage of multiplier occurred in own-country; the higher total output multipliers the smaller percentage of multiplier that occurred in own-country. Regression analysis revealed that coefficients of correlation between total output multiplier and percentage of multiplier occurred in own-country were negative and strong with r= -0.50 in the year of 2000, r= -0.47 in the year of 2005, r=-0.57 in the year of 2010 and r=-0.60 in the year of 2014. Coefficients of regression were statistically significant as calculated t-statistic (3.04 in the year of 2000; 2.86 in the year of 2005; 3.65 in the year of 2010; 3.99 in the year of 2014) were higher than critical value of t-distribution with n-1=29 (t-table = 1.699 at α =5% or 2.045 at α= 2.5%). Otherwise, there was positive correlation between total output multiplier with percentage of multipliers that occurred in other-countries; the higher total output multiplier the smaller percentage of multiplier that occurred in other-countries. Other important finding was all initial effects occurred in own-country. Percentage of multipliers occurred in own-country was higher than percentage of intial effect. Direct effect of multipliers might be occurred in own-country, but indirect effect might be not. Regression analysis showed that correlation between percentage of multiplier occurred in own-country and the percentage of initial effect of multiplier was moderate in the year of 2000 (r =0.55), 2005 (r=0.50), 2010 (r=0.57) and was strong in the year of 2014 (r=0.61). Regression coefficient was statistically significant as calculated t-statistic (3.47 in the year of 2000, 3.07 in the year of 2005, 3.67 in the year of 2010, 4.03 in the year of 2014) was higher than critical-value of t-distribution with n-1=29 (t-table= 1.699 at α=5% or 2.045 at α= 2.5%).

4. Conclusions

From discussion above, some conclusions could be drawn. Firstly, all sectors with total output multipliers more than 2; flow-on effect was more than initial effect. All sectors with total output multiplier less than 2; flow-on effect was less than initial effect. In order to increase output, priority should be given to those sectors with total output multipliers more than 2 as less initial effort will be needed to produce output. Secondly, total output multipliers had negative correlation with percentage of multipliers that occurred in own-sector, but total output multipliers had positive correlation with percentage of multipliers that occurred in other-sector. The higher total output multipliers, the smaller percentage of multipliers occurred in own-sector; the higher total output multipliers, the higher percentage of multipliers occurred in other-sector. All intial effects occurred in own-sector. Direct effects might be occurred in own-sector, but indirect effect might be not. Thirdly, total output multipliers had negative correlation with percentage of multipliers that occurred in own-country, but total output multiplier had positive correlation with percentage of multipliers that occurred in other-countries. The higher total output multipliers, the smaller percentage of multipliers occurred in own-country; the higher total output multipliers, the higher percentage of multipliers occurred in

other-countries. All intial effects occurred in own-country. Direct effects might be occurred in own-country, but indirect effect might be not.

There are two basic limitations of this paper. Firstly, the assumptions inherent in input-output model such as linearity, and divisibility. Secondly, manual calculations could make mistakes. Developing models that are more dynamic as well provides optimal solution such as computable general equilibrium model would provide more realistic calculation. Developing software for calculating sector-specific and spatial-specific multipliers also suggested and expected as it would make calculations much easier.

References

Ahiakpor, J.C.W. (2000), "Hawtrey on the Keynesian Multiplier: A Question of Cognitive Dissonance?", *History of Political Economy*, Vol. 32 No. 4, pp. 889-908.

Allianz (2015), "Allianz Global Wealth Report 2015", available at https://en.wikipedia.org/wiki/Allianz

Beemiller, R.M. (1990), "Improving Accuracy by Combining Primary Data with RIMS: Comment on Bourque", *International Regional Science Review*, Vol. 13 No. 1-2, pp. 99-101.

DiPasquale, D. and Polenske, K.R. (1980), "Output, Income and Employment Input-Output Multipliers" in S. Pleeter (Ed), *Economic Impact Analysis: Methodology and Applications*, Studies in Applied Regional Science, Boston: Martinus Nijhoff Publishing, pp. 85-113.

Dornbusch, R. and Stanley, F. (1994), *Macroeconomics*, Sixth Edition, International Edition, McGraw-Hill, New York.

Fortune (2017), "Fortune Global 500-2017", available at http://fortune.com/global500/

Fortune, (2013), "Fortune Global 500-2017", available at http://fortune.com/global500/

Grady, P. and Muller, R.A. (1988), "On the Use and Misuse of Input-Output based Impact Analysis in Evaluation", *The Canadian Journal of Program Evaluation*, Vol. 2 No. 3, pp. 49-61.

Hall, R. E. (2009), "By How Much Does GDP Rise if the Government Buys More Output?", NBER Working Paper 15496, National Bureau of Economic Research, available at http://www.nber.org/papers/w15496.pdf?new_window=1

Harris, P. (1997), "Limitations on the Use of Regional Economic Impact Multipliers by Practitioners: An Application to the Tourism Industry", *The Journal of Tourism Studies*, Vol. 8 No. 2, pp. 1-12.

Hughes, D. W. (2003), "Policy uses of economic multipliers and impact analysis", Choices Publication of the American Agricultural Economics Association, Second Quarter, available at http://www.choicesmagazine.org/2003-2/2003-2-06.htm

IMF (2013), "World Economic Outlook Database – October 2013", available at 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=

IMF (2015), "World Economic Outlook Database-October 2015", available at 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=

IMF (2016), "World Economic Outlook Database, April 2016 – Report for Selected Countries and Subjects", available at 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=

Isard, W. (1951), "Inter-regional and Regional Input-Output Analysis: A Model of a Space-Economy", *Review of Economics and Statistics*, Vo. 33 No. 4, pp. 318- 328.

Iwadare, Y. (2004) "Strengthening the Competitiveness of Local Industries: The Case of an Industrial Cluster Formed by Three Tokai Prefecters", Nomura Research Institute, pp. 16, available at http:// www.nri.com/global/opinion/papers/2004/pdf/np200475.pdf

Jensen, R.C., Mandeville, T.D., and Karunaratne, N.D., (1979), *Regional Economic Planning: Generation of Regional Input-Output Analysis*, Croom Helm, and London.

Kahn, R. (1931), "The Relation of Home Investment to Unemployment", *Economic Journal*, Vol. 41 No. 162, pp. 173-198.

Karan, P.P., and Gilbreath, D. (2005), *Japan in the 21st century*, University Press of Kentucky, pp. 18–21, 41.

Kodama, T. (2002), "Case study of regional university-industry partnership in practice", Institute for International Studies and Training, available at https://www.iist.or.jp/wf/magazine/0098/0098_E.html

Krugman, P. and Wells, R. (2009), *Economics*, Worth Publisher, pp. 393–396.

Leontief, W.W. (1951), The *Structure of American Economy 1919-1939*, Second Edition, Cambridge: Harvard University Press.

Mabuchi, M., (2001), "Municipal Amalgamation in Japan", World Bank, available at http://siteresources.worldbank.org/WBI/Resources/wbi37175.pdf

Mankiw, N.G. (2008), *Macroeconomics*, Eight Edition, South-Western Publishing, pp. 347–349.

McCargo, D., (2000), *Contemporary Japan*, Macmillan, pp. 8–11; 84-85.

McConnell, C, Brue, S, and Flynn, S. (2011), *Macroeconomics*, McGraw-Hill Series Economics, 19th Edition. ISBN-13: 978-0077337728, ISBN-10: 0077337727.

Miller, R.E. and Blair, P.D. (1985), *Input-output analysis: Foundations and extensions*, Englewood Cliffs, NJ: Prentice-Hall, Inc.

Mills, E. C. (1993), "The Misuse of Regional Economic Models", *Cato Journal*, Vo. 13 No. 1, pp. 29-39.

Moore, F.T, and Petersen, J. (1955), "Regional Analysis: An Inter-industry Model of Utah", *Review of Economics and Statistics*, Vol. 37, pp. 368-383.

Mori, J., Kajikawa, Y., and Sakata, I. (2010). "Evaluating the Impacts of Regional Cluster Policies using Network Analysis", *International Association for Management of Technology*, Proceeding on IAMOT 2010, pp. 1- 9, available at http://pari.u-tokyo.ac.jp/publications/paper/IAMOT2010_jmori_cluster.pdf (accessed 19 Desember 2017).

Morris, B. (2012). "What does the future hold for Japan's electronics firms?", BBC News, available at http://www.bbc.com/news/business-17688322

OECD (2013), "Country statistical profile: Japan", OECD iLibrary, available at http: http://www.oecd-ilibrary.org/economics/country-statistical-profile-japan_20752288-table-jpn

OICA (2013), "2013 Production Statistics – First 6 Months", OICA, available at http:// http://www.oica.net/category/production-statistics/2016-statistics/

Oosterhaven, J. and Stelder, D. (2007), *Regional and Interregional IO Analysis*, Faculty of Economics and Business University of Groningen, Groningen, the Netherlands.

Pindyck, R. and Rubinfeld, D. (2012), *Macroeconomics*, The Pearson Series in Economics, 8th Edition, New York.

Richardson, H.W. (1985), "Input-Output and Economic Base Multipliers: Looking Backward and Forward", *Journal of Regional Science*, Vol. 25 No. 4, pp. 607-661.

Tiebout, C.M. (1956), "A Pure Theory of Local Expenditures", *the Journal of Political Economy*, Vol. 64 No. 5, pp. 416-424.

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 No. 162*, University of Groningen, available at http://www.ggdc.net/publications/memorandum/gd162.pdf

Timmer, M.P. Dietzenbacher, E. Los, B. Stehrer, R. and de Vries, G.J. (2015), "An Illustrated User Guide to the World Input–Output Database: the Case of Global Automotive Production", *Review of International Economics*, Vol. 23 No. 3, pp. 575–605, DOI:10.1111/roie.1217.

West, G.R. (1990), "Regional Trade Estimation: A Hybrid Approach", *International Regional Science Review*, Vol. 13 No. 1-2, pp. 103-118.

WIPO, (2013), "Statistics on Patents", World Intellectual Property Organization, available at http: www.wipo.int/ipstats/en/index.html#data.