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Journal of Economic Structures (2022) 11:18
https://doi.org/10.1186/s40008-022-00278-4

Journal of Economic Structures

RESEARCH Open Access

Tourism-led economic contribution, interregional repercussion effects, and intersectoral propagation activities in Tokyo Metropolitan

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Abstract

This study aims to investigate the contribution of visitors' expenditure to Tokyo Metropolitan's economy including its decomposition, the interregional repercussion effect between Tokyo and the rest of Japan, and the intersectoral propagation activities between tourism and the other sector in Tokyo based on two-region interregional input–output model and Miyazawa's partitioned matrix multipliers. Measurement in tworegion model yielded to a higher value compared to single-region model, where domestic visitors lead the major contribution in overall, prominently on services sectors. The indirect and feedback effects to industries in Tokyo were strongly linked to tertiary sector, while spillover effect to the rest of Japan was more widely distributed. The economic activities in Tokyo were highly dependent on the industries in the rest of Japan, in similar manner as tourism on the other sectors within Tokyo. Tourism industries have strong inducible effects on the other sector. Considering these interregional and intersectoral interdependencies, improving the tourism sector in Tokyo may imply a promising effect to benefit the economy of Tokyo and subsequently other Japanese regions.

Keywords: Miyazawa's partitioned matrix multiplier, Interregional input–output, Tourism, Tokyo

1 Introduction

Tourism has been an important and evolving industry in Tokyo Metropolitan, Japan, the most populated megacity in the world (United Nations 2018). Tokyo remains the most visited region by overall origin and purpose of visit throughout Japanese prefectures in 2011–2019, whose visit rate ranged from 46% to 52% (Japan National Tourism Organization 2020a).

The number of foreign visitors to Tokyo has been increasing regularly in the same period as above where regional share to national in terms of the number of foreign guests at the accommodation was between 26% and 33%, with more than half of total visitors coming from East Asia (e.g., China, Taiwan, South Korea, and Hong Kong) and

the United States, which is similar to in overall Japan (Japan National Tourism Organization 2020b; see Fig. 1).

Furthermore, domestically, predominant overnight visitors came from Hokkaido, Aichi, and Osaka, while prevalent single-day visitors came from internal Tokyo, Shizuoka, and some prefectures in Tokyo Greater Area, such as Kanagawa, Saitama, Chiba, and Ibaraki. Regardless of the type of trip taken, internal Tokyo, Shizuoka, and Kanagawa dominated the visitors' origins category (Japan Tourism Agency 2018a).

Conventional studies on the economic impact of regional tourism mainly focus on measuring multipliers and their effects on inter-sectoral linkages in a specific, single administrative area. Only a few were discussed in a two-region (bi-regional) interregional input–output framework, such as in, but not limited to Balearic Island and the Rest of Spain (Soulie and Valle, 2014), Galicia and the Rest of Spain (Incera et al. 2015), and Northeast and the Rest of Brazil (Guilhoto et al. 2002). The same applies to Japan, e.g., Kyoto (Tsukui and Kagatsume 2017), Tokyo and Kyoto (Tsukui et al. 2017), and Shizuoka (Patandianan and Shibusawa 2020). Yet, fewer explained how tourism triggers repercussion effects on other regions back and forth, and describe the sectoral interdependency between two regions and two sectors. In light of the abovementioned situations, taking a case study in Tokyo Metropolitan, tourism-induced multiplier, spillover and feedback effects, sectoral interdependence, and regional self-sufficiency based on Miyazawa's partitioned matrix multipliers and interregional repercussion model (Miyazawa 1976) are explored.

In this study, visitors' expenditure in Tokyo is distinguished further into that of domestic visitors—referred to as non-residents of Tokyo—and that of inbound visitors. Besides, 'sector' represents a particular component of a region's economic activity

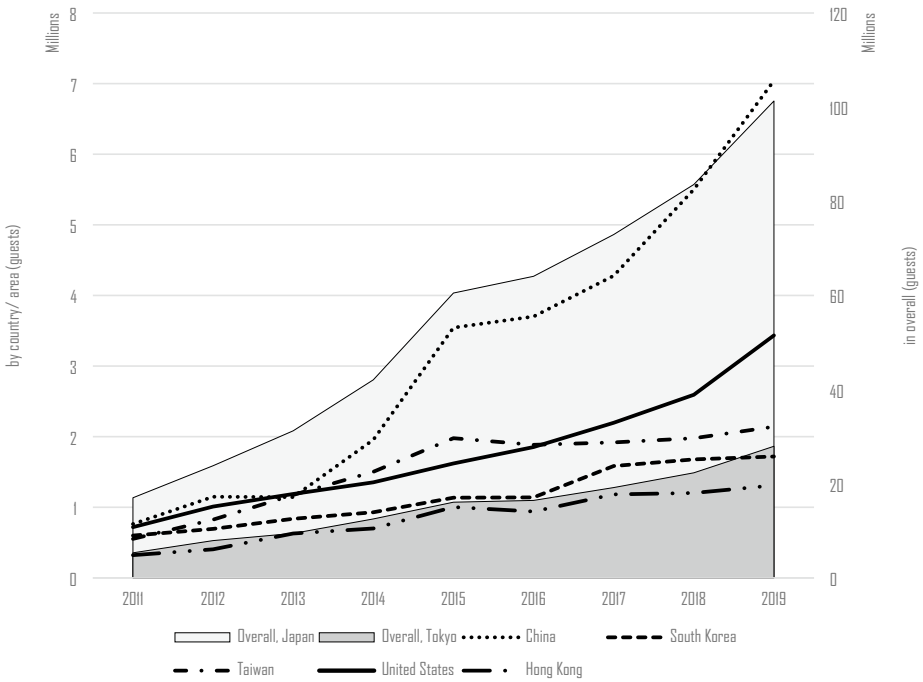

Fig. 1 Accumulated number of guests at accommodations. Source: Japan National Tourism Organization (2020b)

that is specified in the input–output table (e.g., agriculture, forestry and fishery), while 'industry' refers to those not literally enlisted in the studied input–output table including sectoral agglomeration (e.g., light industry, tourism industry). Furthermore, tourism-led multiplier, spillover, and feedback effects are evaluated in the abovementioned domestic-inbound setting.

On the above account, there are three main objectives of this study. First, to examine the total contribution of domestic and inbound visitors' expenditure in Tokyo by using a two-region interregional input–output (IRIO) framework in terms of output, income, value-added, and employment, as well as its multiplier decomposition to understand the transmission mechanism of tourism effects. Second, to explore the interregional repercussion effects between Tokyo and the rest of Japan. Finally, to investigate the interdependency between tourism-related sectors and other sectors in Tokyo. The internal and external matrix multipliers, sub-internal matrix multipliers, and inside propagation ratios based on Miyazawa's partitioned multiplier model were measured to achieve the two last goals.

The earliest applications of the interregional input–output model were pioneered by Isard (1951), Chenery (1953), and Moses (1955). Chenery in Yamada (1963), specifically, divides a national economy into two subnational economies and conducts a two-region interregional input–output study. Furthermore, Miyazawa (1976) develops partitioned matrix multipliers to assess the interdependency between the goods-producing sector and the service sector in Japan, further examining the interdependency of sectors between Hokkaido and the rest of Japan (ROJ). It is found that the goods-producing sector has more inducible power from one sector to another than the service sector and that there is a substantial dependence of Japan's service sectors on its goods-producing sectors. Moreover, the sub-multipliers indicate a high dependency of Hokkaido's activities on ROJ's industries, and that there has been a ripple effect from Hokkaido to ROJ, putting ROJ's industries in a favorable position. In addition, Miyazawa highlights that certain sectors in the light industry group (e.g., textiles, rubber products, leather and leather products, printing and publishing, and miscellaneous manufactured articles), as well as those in the non-manufacture industry (services, trade, and public utilities), are among Hokkaido's self-sufficient industries that are relatively least dependent on ROJ's activities. On the other hand, heavy industries (e.g., iron and steel, non-ferrous metal products) and resource industries (e.g., metal mining, non-metal mining, pulp, paper and paper products, fishing) are among those that are highly dependent on ROJ's activities (Miyazawa 1976).

Most recently, Patandianan and Shibusawa (2020) have evaluated the spillover effects of tourism demands in Shizuoka Prefecture using a municipality-level interregional input–output model, where they have found outstanding induced production values identified in the sectors of personal services; commerce, transport, and postal services; and food products and beverages, led by Shizuoka City, Hamamatsu, Ito, Atami, and Gotenba. Furthermore, some highest induced production coefficients have been identified in Higashi Izu Town, Atami, Izunokuni, and Shimoda, while smaller coefficients were observed in Mori Town, Fukuroi, Makinohara, and Koyama Town. Moreover, smaller towns are affected by other areas with higher sensitivity

ratios identified in smaller municipalities, while greater tourism demand was associated with bigger cities, such as Shizuoka, Hamamatsu, Numazu, and Fuji.

Incera et al. (2015) argue how spillover effects of tourist consumption include multipliers and leakages between Galicia and the rest of Spain in 2001–2007. The results highlight imbalanced spillover effects between the two regions. For example, a €1 consumption in final demand in Galicia creates €0.30 in the Rest of Spain, and yet creates only €0.013 the other way around. Furthermore, Galicia's economic structure relies more on the exploitation of natural resources with limited specialization in the production of outputs demanded by tourists, making it a non-favorable, non-specialized tourist destination. Moreover, Galicia's productive sector is highly dependent on the rest of Spain to meet its tourism demands, such as food products and beverages, transport and communication services, and real estate activities. The results also mention that in 2007 tourism consumption in Galicia constituted 4.1% of domestic output, 4.7% of gross value added, and created 47,286 full-time jobs, with 60% of tourism consumption coming from non-residents, followed by residents (18%) and foreigners (12%). Finally, commodity leakage from Galicia to the rest of Spain is estimated to be at about 20%.

Tourism-induced interaction between two regions has been researched thoroughly in the case of the Balearic Islands and the Rest of Spain (Soulie and Valle 2014). Unlike previous studies in Galicia, the Balearic Islands' economy is substantially entrenched in tourism. The most important finding of the study is that the Balearic Islands' industries have created higher multipliers than those of the Rest of Spain. For example, the contribution of a €1 expenditure in final demand to national output from the Balearic Islands and the Rest of Spain are €0.88 and €0.76, respectively. Furthermore, the transportation sector has distinguished itself to be the most outstanding sector in terms of net spillover effects, namely, water transportation (0.77) from the Balearic Islands to the Rest of Spain, and air transportation in vice versa (0.01).

A similar tourism case study on Japan is found in the 2005 inter-regional input–output table of Japan (METI 2010), discussing the production repercussion effects of consumption by foreigners visiting Hokkaido. The study finds that 44 billion yen in foreign visitors' consumption in Hokkaido can generate about 71 billion yen of domestic production inducement effect, with about 1.7 times in direct demand, causing an indirect effect of induced domestic products by the goods and construction-and-service sectors to be dominated by Hokkaido. Specifically, regional induced domestic products in the monetary unit show that Hokkaido's both goods sector (beverage and foods; and agriculture, forestry, and fisheries) and construction-and-service sectors (personal services, transport, and commerce) were leading compared to those of the other regions. In addition, Hokkaido's personal services sector, including accommodation as its leading subsector, was recognized as the most outstanding sector for the induced domestic product among all the 53 sectors in 9 Japanese regions, accounting for 31.5 billion yen.

Tsukui et al. suggest another perspective of analyzing tourism consumption impact, by employing a regional waste input–output approach to examine the repercussion effect of tourism consumption by Chinese, Taiwan, and South Korean Tourist in Kyoto City (Tsukui and Kagatsume 2017) and the comparison of such effect of

tourism consumption by Tokyo and Kyoto (Tsukui et al. 2017), which bring up the analysis beyond economic multipliers that include ecological adverse impacts, such as waste generation, landfilling, and greenhouse gases emissions.

This paper is organized into 4 sections and 3 subsections. First, the introduction covers the research background, problems, objectives, and literature review on the previous applications of the interregional input–output model in service and tourism-related sectors. Then, the methods include materials and methodology built upon Miyazawa's partitioned matrix multipliers on interregional repercussion and inter-sectoral interdependency model. Next, the results and discussion describe the contributions of Tokyo's domestic and inbound tourists, its decomposition, interregional repercussion effects in a two-region interregional input–output framework, and the inter-sectoral interdependency between tourism and other sectors. The paper will be resolved by the final section that provides the conclusions of the study.

2 Methods

Two main data sets used in this research originated from the 2011 Tokyo Metropolitan Input–Output Table published by Tokyo Metropolitan Government, where the interregional table (hereafter referred to as TMIRIOT) is used to achieve the first two objectives and the regional table (hereafter referred to as TMRIOT) to accomplish the third objective.

TMIRIOT divides Japan's economy into two major parts, namely, Tokyo Metropolitan and the rest of Japan (Tokyo Metropolitan Government 2016a). Integrated subclassification consists of 191×191 sector classification which is modified into 46×46 sectors emphasizing tourism-related sectors. Likewise, the employment vector is derived from the column of number of paid employees at the employment table with an integrated intermediate classification (109 sectors) for both Tokyo Metropolitan and the rest of Japan, which are then reaggregated following the 46-sector classification of the main table mentioned above. Moreover, this 46×46 sector classification includes headquarter or head office, a distinct independent category that is unique to Tokyo as many corporates nationwide have their head office in Tokyo. Head office production value is estimated by multiplying the expense of head office per capita with the number of employees who work in the head office building (Tokyo Metropolitan Government 2016b).

In addition, by referring to the 2011 Tourism Satellite Account of Japan (Japan Tourism Agency 2018b) whose framework was founded based on the International Recommendations for Tourism Statistics (IRTS) 2008 (United Nations 2010), eight tourism-related sectors were introduced and emphasized, namely, hotels, eating and drinking services, railway transport (passengers), road transport service, water transport, air transport, miscellaneous services relating to transport, and amusement and recreational services.

Furthermore, visitors' expenditure is distinguished between domestic (non-resident) and inbound visitors, where both vectors are derived from the 2011 TMIRIOT integrated subclassification table specifically on column P9212 Consumption expenditure of non-residents (others: tourism, education, medical care, etc.) and column P8012 Exports (direct purchase), respectively.

It is important to note that the domestic visitor expenditure mentioned here is strictly limited to non-resident's consumption in Tokyo and includes neither Tokyo Metropolitan

residents' tourism expenditure in-country nor outbound travel expenditure. Besides, unlike Tsukui et al. (2017), the account column P9211 Consumption expenditure of non-residents (commuting to work and study) is excluded due to the nature of domestic visitors that does not include remuneration activity and regular or frequent travel between vicinity for work or study purpose (United Nations and World Tourism Organization 1994).

Furthermore, domestic (non-resident) visitor expenditure (P9212) was estimated based on three categories overnight shopping tourism, daily shopping tourism, and others (education, medical care, etc.). The first two categories were measured by multiplying the results of the 2011 Surveys of travel and tourism consumption trends by the share of residents of other prefectures according to the 2011 Tourism visitor statistics. Meanwhile, as for the latter category, the whole household consumption in Tokyo was calculated by multiplying the ratio of household consumption to the output in the national table for 17 sectors, mainly in the personal services sector, and then the expenditure of Tokyo residents is deducted from it. Consequentially, this vector may also lead to overestimation because of other non-regular activities that are aggregated altogether with tourism. Moreover, P8012 Exports (direct purchase) represents foreign visitors' consumption in Tokyo excluding the consumption of foreign military personnel and their family who live in Tokyo, unlike a similar application in Hokkaido (METI 2010). It was estimated by using a ratio to the national figure based on the 2011 Survey of accommodation travel statistics. In addition, the estimation procedures for both visitors' expenditures mentioned above are inquired through email correspondence to the person in charge of the input–output table, Coordination Section, Statistics Division, Bureau of General Affairs, Tokyo Metropolitan Government (personal communication, June 23 and 27 and August 12, 2022).

Unlike national and regional input–output table, IRIO table consists of interregional trade which enables to analyze interregional spillover and feedback effects between two regions. The A table in two-region IRIO model is shown as follows:

$$A = \begin{bmatrix} A^{rr} A^{rs} \\ A^{sr} A^{ss} \end{bmatrix} \tag{1}$$

Furthermore, tourism economic impact analysis using IRIO model can provide more comprehensive quantitative results, due to its capability to embrace interregional spillover and feedback effect through the sectoral linkages between regions (Miller and Blair 2009). In this study, the contribution of tourism to regional output was analyzed based on a two-region IRIO and single-region approaches to shed a light on the gap.

Besides, the superscripts r and s represent Tokyo and the rest of Japan, respectively, while the subscripts S and T represent the single-region and two-region model, respectively. Aside from the output, Tokyo's tourism contribution on the value-added, income and employment was also assessed using a two-region IRIO model (Miller and Blair 2009; Klijs and Maris 2012), with a further distinction between the domestic and inbound tourist consumption patterns:

$$\Delta x_S^r = \left(I - A^{rr}\right)^{-1} \Delta f^r \tag{2}$$

$$\Delta x_T^r = \left[I - A^{rr} - A^{rs} T A^{sr}\right]^{-1} \Delta f^r \tag{3}$$

where Δx_S^r is the output change in Tokyo by single-region model; Δx_T^r is the output change in Tokyo by two-region model; I is the identity matrix; A^{rr} is the intra-regional input coefficient in Tokyo; A^{ss} is the intra-regional input coefficient in the Rest of Japan; $A^{rs}$is the interregional input coefficient from Tokyo to the Rest of Japan; A^{sr} is the inter-regional input coefficient from the Rest of Japan to Tokyo; B is the internal multiplier of Tokyo, that can be written also as $[I - A^{rr}]^{-1}$; T is the internal multiplier of the Rest of Japan, that can be written also as $[I - A^{ss}]^{-1}$; Δf^r is the change in visitor consumption in Tokyo.

Theoretically, the output change in Tokyo as generated by a two-region model (Δx_T^r) generates a higher value compared to that by a single-region model (Δx_S^r) (Oosterhaven and Hewings 2014), which emphasizes the importance to employ a two-region model in impact analysis (Miller and Blair 2009). The overall percentage error (OPE) provides information to determine the extent of underestimation, where if it is less than half of 1% could be interpreted as very limited interregional feedback effect. OPE is estimated as $\left[\left(i'x_T^r - i'x_S^r\right)/i'x_T^r\right]x100$, where i' is represented as a sum.

Using the two-region model, effects transmission yielded by tourists' expenditure can be assessed through multiplier decomposition and described in the following scenario. It is assumed that a change in the final demand driven by visitor expenditure in Tokyo created a new demand for output that was supplied not only by Tokyo (intraregional effect) but also by those produced in ROJ. A new demand for output at ROJ because of visitor consumption in Tokyo is known as a spillover effect. Consequently, to meet this new demand, ROJ is going to need some output from Tokyo which created a boomerang stimulus back to Tokyo called the feedback effect (see Fig. 2).

Using the two-region model, all net intraregional $\left(\overline{M}_1\right)$, spillover $\left(\overline{M}_2\right)$ and feedback effects $\left(\overline{M}_3\right)$ induced by tourists' expenditure in Tokyo were estimated by employing Stone's additive decomposition (Miller and Blair 2009). Mathematical expression for the multiplier decomposition model includes each submultiplier effects which are presented as follows, where f is defined as visitor expenditure:

$$x = Mf = If + \underbrace{(M_1 - I)f}_{\overline{M}_1} + \underbrace{(M_2 - I)M_1 f}_{\overline{M}_2} + \underbrace{(M_3 - I)M_2 M_1 f}_{\overline{M}_3} \tag{4}$$

$$\overline{M}_1 = M_1 - I = \begin{bmatrix} B - I & 0 \\ 0 & T - I \end{bmatrix} \tag{5}$$

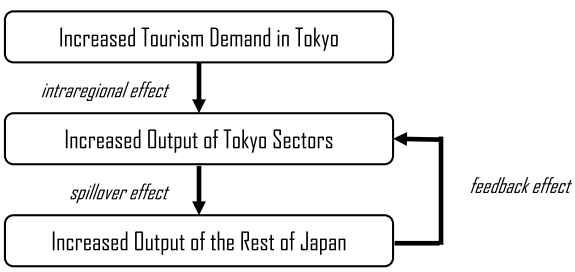

Fig. 2 Mechanism of tourism-led effects transmission. Source: Adapted from Miller and Blair (2009)

$$\overline{M}_2 = (M_2 - I)M_1 = \begin{bmatrix} 0 & S^{rs} \\ S^{sr} & 0 \end{bmatrix} \begin{bmatrix} B & 0 \\ 0 & T \end{bmatrix} = \begin{bmatrix} 0 & S^{rs}T \\ S^{sr}B & 0 \end{bmatrix} \tag{6}$$

$$\overline{M}_3 = (M_3 - I)M_2M_1 = \begin{bmatrix} F^{rr}B - B & F^{rr}S^{rs}T - S^{rs}T \\ F^{ss}S^{sr}B - S^{sr}B & F^{ss}T - T \end{bmatrix} \tag{7}$$

where

$$S^{rs} = BA^{rs} \tag{8}$$

$$S^{sr} = TA^{sr} \tag{9}$$

$$F^{rr} = \left[I - S^{rs}S^{sr}\right]^{-1} \tag{10}$$

$$F^{ss} = \left[I - S^{sr}S^{rs}\right]^{-1} \tag{11}$$

Furthermore, to explain the disjoined sectoral interdependence between Tokyo and the Rest of Japan, it is necessary to obtain the three aspects of propagations and intersectoral multipliers as follows: the internal multipliers of Tokyo (B) and the Rest of Japan sector (T), where both of them only function with the presence of other sector activity; the interregional propagation activities between Tokyo and ROJ's industries represented by B_1, B_2, T_1, and T_2, which explain the induced effects on output and input activities between the two regions, also referred to as the production-generating process in succession; and the external multipliers of Tokyo (L) and the Rest of Japan (K) based on the operation involving sub-multipliers. Mathematical expressions for the submultipliers and external multipliers are expressed as Eqs. 12–17. Each of the column sums of internal and external multipliers explains the pattern of the power of dispersion, while each of the row sums shows the sensitivity of dispersion of industries for each region (Miyazawa 1976). The total propagation effects in each of Tokyo and ROJ sectors were generated by its sector activities, which were reflected in each region's multiplication of internal and external matrix multiplier:

$$B_1 = A^{sr}B \tag{12}$$

$$B_2 = BA^{rs} \tag{13}$$

$$T_1 = A^{rs}T \tag{14}$$

$$T_2 = TA^{sr} \tag{15}$$

$$L = (I - B_2T_2)^{-1} \tag{16}$$

$$K = (I - T_2B_2)^{-1} \tag{17}$$

The matrix of output of both regions can be measured by multiplying Leontief inverse in terms of partitioned matrix multipliers (B^*) to the matrix of demand of both regions (see Eq. 18), where $M = \mathrm{KT}$ and $N = \mathrm{LB}$. The inside propagation ratios of Tokyo (IPR^r) can be calculated by dividing the elements of Tokyo's internal multiplier (B) by part of the elements of Leontief inverse (B^*) shown in Eq. 20. Furthermore, industries whose row elements have many higher value ratios suggest its relative independency toward its counterpart and the other way around (Miyazawa 1976):

$$B^* = (I - A)^{-1} = \begin{bmatrix} B + B_2MB_1 & B_2M \\ MB_1 & M \end{bmatrix} = \begin{bmatrix} N & NT_1 \\ T_2N & T + T_2NT_1 \end{bmatrix} \tag{18}$$

$$\begin{bmatrix} x_r \\ x_s \end{bmatrix} = \begin{bmatrix} B + B_2MB_1 & B_2M \\ MB_1 & M \end{bmatrix} \begin{bmatrix} f_r \\ f_s \end{bmatrix} = \begin{bmatrix} N & NT_1 \\ T_2N & T + T_2NT_1 \end{bmatrix} \begin{bmatrix} f_r \\ f_s \end{bmatrix} \tag{19}$$

$$\mathrm{IPR}^r = B/B^*_{11}. \tag{20}$$

Besides, the abovementioned partitioned matrix models are also applied to achieve the last objective of this study, i.e., to explain inter-sectoral interdependency between tourism-related sectors (hereafter referred to as the tourism sector) and non-tourism-related sectors (hereafter referred to as the other sector) in Tokyo using the 2011 Tokyo Metropolitan Regional Input–Output Table (single region). Particularly in this subsection, the subscripts r and s in partitioned matrix model represent the other sector (38×38) and the tourism sector (8×8), respectively.

3 Results and discussion

3.1 The implication of visitors' expenditure in Tokyo in the two-region model

The domestic and inbound visitors' spending in Tokyo in 2011 is worth of 4.4 trillion yen and 196.1 billion yen, respectively, where overall consumption regardless of type of visitor was predominantly supplied from within Tokyo (84%) as well as from the rest of Japan (16%). Specifically, the expenditure of domestic visitors that supplied internally was prominent in the sectors of finance and insurance, commerce, other personal services, and eating and drinking services, while inbound visitors' spending was dominant in the sectors of hotels, eating and drinking services, commerce, and road transport services (see Fig. 3 for detail). A similar remarkable consumption pattern of both visitors in eating and drinking services and commerce including retail (e.g., souvenir purchases) was observed. Moreover, unlike inbound visitors, even though domestic visitors' expenditure in hotel sectors is not too dominant, it was still above the average and scored even two times higher than its counterpart. Furthermore, the expenditure of domestic visitors in the railway transport sector was significantly high, just like that of the inbound visitors in the road transport services sector, which explains visitors' preference of mode of transport related to their travel in Tokyo. Despite the provision of Tokyo's regional output to meet visitors' demand is mostly sourced internally (especially from service industry), beverages and foods catered from the rest of Japan is remarkably high (60%) (see Fig. 4 for detail).

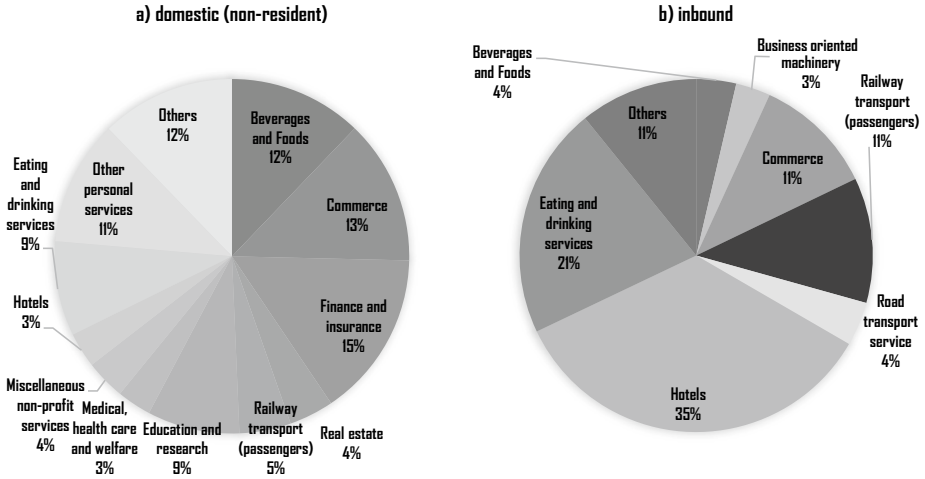

Fig. 3 Above-average domestic and inbound visitors' expenditure in Tokyo by sector. Source: Tokyo Metropolitan Government (2016a)

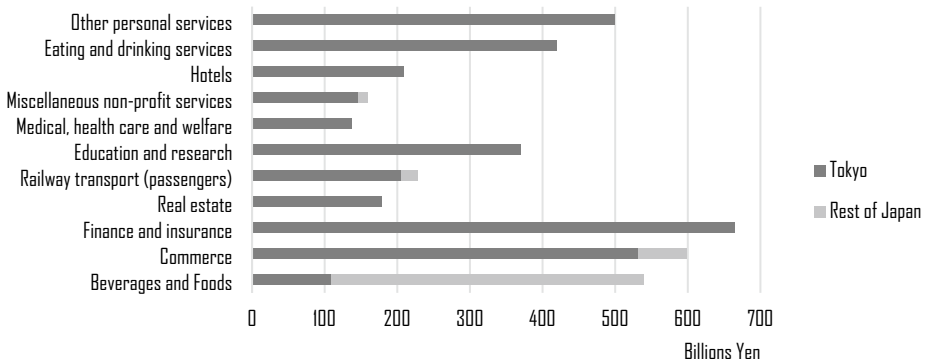

Fig. 4 Above-average visitors' expenditure in Tokyo by regional output. Source: Tokyo Metropolitan Government (2016a)

The domestic and inbound visitors' expenditure, respectively, stimulated ¥8.4 T and ¥414.4B of output, ¥4.4 T and ¥196.1B of value-added whose value is similar to total visitors' expenditure, ¥1.9 T and ¥89.8B of income, and 431,954 and 24,695 jobs. These numbers show that 95–96% of each parameter is driven by domestic visitors (96%) whose proportion in the total visitor expenditure is predominant, which is strategically advantageous to pursue. However, Japan's aging and shrinking population may affect domestic tourism performance before long, which should be addressed in the regional tourism planning.

Within Tokyo, the sectoral linkages of domestic tourism in terms of output, income, and value added were significant on finance and insurance; commerce; other personal services sector; and education and research. Likewise, hotels; eating and drinking services; and commerce were the three sectors most affected by inbound tourism. Meanwhile, in terms of job creation, a significant number of jobs were induced by domestic visitors' expenditure through the commerce sector (44,644 jobs) and eating and drinking services sector (43,262 jobs), and by inbound visitors' expenditure through the eating and drinking services sector (4749 jobs) and hotels sector (4180 jobs).

In the rest of Japan, on the other hand, beverages and foods; commerce; and headquarters were among the top 10% of impacted sectors in terms of output, income, value-added, and employment for both visitors' expenditures, with a remarkable contribution on output induced by domestic visitors' spending for beverages and foods (¥668.6B). Agriculture, forestry, and fishery was among the top three most impacted sector in terms of output and value-added driven by domestic visitor spending. While railway transport (passengers) was similarly for inbound visitors' contribution to output, income, and value added. Furthermore, the employment effects on headquarters, commerce, and beverages and foods in the rest of Japan which were stimulated by both visitors' expenditure in Tokyo were exceptional. Overall visitor expenditures made an outstanding contribution mainly to the tertiary industry, with an additional substantial contribution to the beverages and foods sector in the rest of Japan.

Furthermore, the overall percentage error of combined visitors' contribution (2.06%) was found higher than its criterion, i.e., one half of 1% (Miller and Blair 2009), which consequently highlights the importance of using a two-region (or inter-regional) model instead of a single-region model for economic impact analysis based on regional input–output framework. Moreover, a higher result in the former model was arising from the existence of an interregional feedback effect that could not be captured by the latter model.

By decomposing the multiplier ones may comprehend the mechanism of impacts transmission between Tokyo and the rest of Japan including the previously mentioned feedback effect. The total contribution was decomposed into four elements, namely, initial, indirect, spillover, and feedback effect whose overall value and proportion regardless of visitor type are ¥4.6 T (51.9%), ¥2.4 T (27.5%), ¥1.7 T (18.8%), and ¥159.5B (1.8%), respectively. Furthermore, about 95–96% of each effect was influenced by domestic tourism, thus, no distinction based on the type of visitor henceforth was made. Except for the initial shock that resembles visitor expenditure, the three last mentioned effects are discussed further as follows.

More than a quarter of the total contribution was distributed to other sectors intraregional. Sectors such as business services (¥299.9B); headquarters (¥202.3B); and information and communications (¥155.5B) are the top three affected sectors. Besides, the prominent indirect effect stimulates demand mainly for the services sector in Tokyo, e.g., commerce; finance and insurance; and real estate.

Moreover, the contribution also brought some spillover effect to the rest of Japan predominantly on headquarters (¥229.1B); beverages and foods (¥153.7B); chemical products (¥94.6B); agriculture, forestry, and fishery (¥94.5B); commerce (¥94.1B); business services (¥89.8B); other transport and postal services (¥83.1B); petroleum and coal products (¥82.1B); mining (¥78.4B); pulp, paper, and wooden products (¥63.8B); and electricity, gas, and heat supply (¥55.1B). The noteworthy spillover effects covered broader sectoral linkages beyond services, that may implicate robust interdependencies toward the overall sector in the rest of Japan.

Consequently, the effect was rippled back to Tokyo whose magnitude accounted for one-tenth of the spillover effect, preponderantly on services-related sectors such as but not limited to headquarters (¥42.5B); business services (¥22.2B); information and communications (¥13.2B); and commerce (¥11.7B).

Overall, finance and insurance (¥794.6B) benefitted the most from the total effect in Tokyo, followed by commerce (¥683.5B); other personal services (¥518.2B); and eating and drinking services (¥423.9B), while an outstanding total effect in the rest of Japan was identified at beverages and foods (¥693.6B). Therefore, the total influence of visitor expenditure in Tokyo on its internal economy is more service-oriented, yet more diverse interregional linkages to sectors in the rest of Japan, exceptionally on food producing and processing sectors.

3.2 Interregional repercussion effect of Tokyo and the rest of Japan

The average internal multiplier (B) and average external multiplier (L) of Tokyo are 1.5043 and 1.0407, respectively. On the other hand, the average internal multiplier (T) and the external multiplier of the rest of Japan (K) are 2.2514 and 1.0158, respectively (see Table 1). Based on the previous results, it is understood that the average internal multiplier of Tokyo (B) and the rest of Japan (T) were higher than the external multiplier for both regions, which the external repercussion through the rest of Japan's industrial activity (L) is higher than the round-about external multiplier (K) by an average of 4.1%-up and 1.6%-up, respectively. Moreover, the average total multiplier effect measured by multiplying each region's average internal and external multiplier shows that Tokyo is less self-contained with a lower score (1.565) compared to the rest of Japan (2.287). A similar trend was also discovered in Loop and North Side, West Side, and South Side (less Suburbs) region in Chicago, United States (Hewings et al. 2001), Hokkaido, Japan (Miyazawa 1976), and Kinki, Japan (Okuyama et al. 1999).

For Tokyo, in terms of the external multiplier (L), the coefficients of the sensitivity of dispersion in the sectors of headquarters (1.7111), business services (1.3259), commerce (1.2124), information and communication (1.1986), finance and insurance (1.1085), real estate (1.0559), and education and research (1.0295) are among the highest numbers, which even exceed their respective power of dispersions. The powers of dispersion are particularly high in the sectors of office supplies (1.1311), transportation equipment (1.0985), iron and steel (1.0976), and electronic components (1.0801). In terms of the internal multiplier (B), on the other hand, the coefficients of the sensitivity of dispersion are extremely high in the sector of business services (4.7769), while the coefficients of power of dispersion are high in the sectors of water transport (2.7218), non-ferrous metals (2.1050), and electricity, gas, and heat supply (1.9982).

As for the Rest of Japan, in terms of the external multiplier (K), the sensitivity of dispersion is high in sectors, such as headquarters (1.1394), business services (1.0531), pulp, paper, and wooden products (1.0418), iron and steel (1.0417), and mining (1.0360), while the power of dispersion is significantly high in the sectors of air transport (1.0320), information and communications (1.0276) and machinery-related sector, e.g., information and communication electronics equipment (1.0293), electrical machinery (1.0258), business-oriented machinery (1.0250), and electronic components (1.0244). Meanwhile, in terms of the internal multiplier (T), the coefficients of power of dispersion are tremendously high—and even higher compared to Tokyo's—in the sectors of business services (5.9498), headquarters (5.5849), mining (5.4417), iron and steel (5.1515), and other transport and postal services (4.8898). Overall, more internal multiplier of the rest of Japan has higher power of dispersion which is opposite to the external multiplier of

Table 1 Summary of internal and external multipliers of Tokyo and the rest of Japan

	Internal multiplier of Tokyo, B		External multiplier of Tokyo, L		Internal multiplier of the rest of Japan, T		External multiplier of the rest of Japan, K	
	Row sum	Column sum	Row sum	Column sum	Row sum	Column sum	Row sum	Column sum
Agriculture, forestry and fishery	1.0894	1.2817	1.0006	1.0327	1.8703	2.1467	1.0062	1.0056
Mining	1.8818	1.5909	1.0045	1.0155	5.4417	2.1598	1.0360	1.0133
Beverages and Foods	1.1528	1.3265	1.0032	1.0660	1.9092	2.3468	1.0036	1.0162
Textile products	1.3033	1.6465	1.0027	1.0604	1.6470	2.5474	1.0047	1.0158
Pulp, paper and wooden products	1.2410	1.3955	1.0132	1.0661	3.1179	2.5738	1.0418	1.0188
Chemical products	1.3367	1.5360	1.0123	1.0642	4.0659	2.7872	1.0327	1.0137
Petroleum and coal products	1.2457	1.2358	1.0018	1.0274	3.9670	2.7120	1.0331	1.0019
Plastic and rubber products	1.1851	1.3154	1.0077	1.0514	2.5390	2.6566	1.0207	1.0132
Ceramic, stone and clay products	1.0818	1.4948	1.0027	1.0554	1.6083	2.2259	1.0080	1.0130
Iron and steel	1.1527	1.2287	1.0104	1.0976	5.1515	3.5268	1.0417	1.0087
Non-ferrous metals	1.6777	2.1050	1.0083	1.0236	2.9381	2.9168	1.0153	1.0107
Metal products	1.1288	1.2772	1.0055	1.0461	1.9099	2.7490	1.0113	1.0182
General-purpose machinery	1.0589	1.4263	1.0025	1.0699	1.4065	2.5626	1.0055	1.0203
Production machinery	1.0510	1.4209	1.0019	1.0584	1.2823	2.4443	1.0052	1.0213
Business oriented machinery	1.0389	1.5155	1.0020	1.0597	1.2181	2.6016	1.0036	1.0250
Electronic components	1.5155	1.6046	1.0134	1.0801	2.4519	2.6628	1.0205	1.0244
Electrical machinery	1.1240	1.6054	1.0047	1.0675	1.4697	2.6561	1.0054	1.0258
Information and communication electronics equipment	1.0438	1.6544	1.0007	1.0737	1.0634	2.6849	1.0008	1.0293
Transportation equipment	1.2365	1.4069	1.0071	1.0985	2.5377	3.2941	1.0177	1.0211
Miscellaneous manufacturing products	1.6390	1.3983	1.0274	1.0533	1.9556	2.3306	1.0180	1.0217

Table 1 (continued)

	Internal multiplier of Tokyo, B		External multiplier of Tokyo, L		Internal multiplier of the rest of Japan, T		External multiplier of the rest of Japan, K	
	Row sum	Column sum	Row sum	Column sum	Row sum	Column sum	Row sum	Column sum
Construction	1.7346	1.3946	1.0130	1.0477	1.8699	2.2715	1.0054	1.0198
Electricity, gas and heat supply	1.6097	1.9982	1.0087	1.0230	2.9127	2.6823	1.0249	1.0099
Water supply	1.2027	1.6925	1.0026	1.0244	1.3762	2.0234	1.0015	1.0131
Waste management service	1.1063	1.3904	1.0013	1.0235	1.2374	1.6289	1.0021	1.0118
Commerce	2.8249	1.3605	1.2124	1.0108	4.3882	1.7292	1.0349	1.0211
Finance and insurance	2.3185	1.4349	1.1085	1.0102	2.0716	1.5511	1.0097	1.0224
Real estate	1.7078	1.3286	1.0559	1.0026	1.8723	1.3141	1.0079	1.0051
Railway transport (passengers)	1.0591	1.3199	1.0090	1.0161	1.2658	1.6434	1.0148	1.0081
Road transport service	1.0489	1.2261	1.0033	1.0186	1.1097	1.6921	1.0033	1.0135
Water transport	2.2668	2.7218	1.0000	1.0439	1.7296	3.5712	1.0000	1.0098
Air transport	1.0778	1.6431	1.0061	1.0551	1.1123	2.6738	1.0025	1.0320
Miscellaneous services relating to transport	1.3114	1.5258	1.0082	1.0094	1.6875	1.6227	1.0065	1.0144
Other transport and postal services	2.2131	1.5128	1.0258	1.0468	4.8898	2.1369	1.0351	1.0137
Information and communications	2.6532	1.6756	1.1986	1.0182	2.3600	1.8678	1.0345	1.0276
Public administration	1.3384	1.5237	1.0018	1.0158	1.3345	1.5623	1.0007	1.0102
Education and research	1.8493	1.3108	1.0295	1.0104	2.3175	1.4706	1.0129	1.0082
Medical, health care and welfare	1.0516	1.4801	1.0001	1.0315	1.0473	1.8446	1.0001	1.0094
Miscellaneous non-profit services	1.0573	1.4351	1.0021	1.0122	1.1463	1.7499	1.0018	1.0204
Business services	4.7769	1.5595	1.3259	1.0215	5.9498	1.8592	1.0531	1.0221
Hotels	1.0000	1.4845	1.0000	1.0322	1.0000	2.0285	1.0000	1.0131

Table 1 (continued)

	Internal multiplier of Tokyo, B		External multiplier of Tokyo, L		Internal multiplier of the rest of Japan, T		External multiplier of the rest of Japan, K	
	Row sum	Column sum	Row sum	Column sum	Row sum	Column sum	Row sum	Column sum
Eating and drinking services	1.0235	1.4325	1.0000	1.0464	1.0320	2.1565	1.0000	1.0132
Amusement and recreational services	1.0863	1.4132	1.0029	1.0151	1.0337	1.6127	1.0004	1.0155
Other personal services	1.0906	1.2887	1.0013	1.0128	1.0871	1.6261	1.0003	1.0103
Office supplies	1.0607	1.4958	1.0040	1.1311	1.1121	3.2161	1.0012	1.0268
Activities not elsewhere classified	1.4405	1.6758	1.0077	1.0224	1.4853	2.1014	1.0030	1.0075
Headquarters	3.1014	1.4056	1.7111	1.0032	5.5849	1.3424	1.1394	1.0108
(Average)	1.5043	1.5043	1.0407	1.0407	2.2514	2.2514	1.0158	1.0158

Source: Author's calculation based on Tokyo Metropolitan Government (2016a)

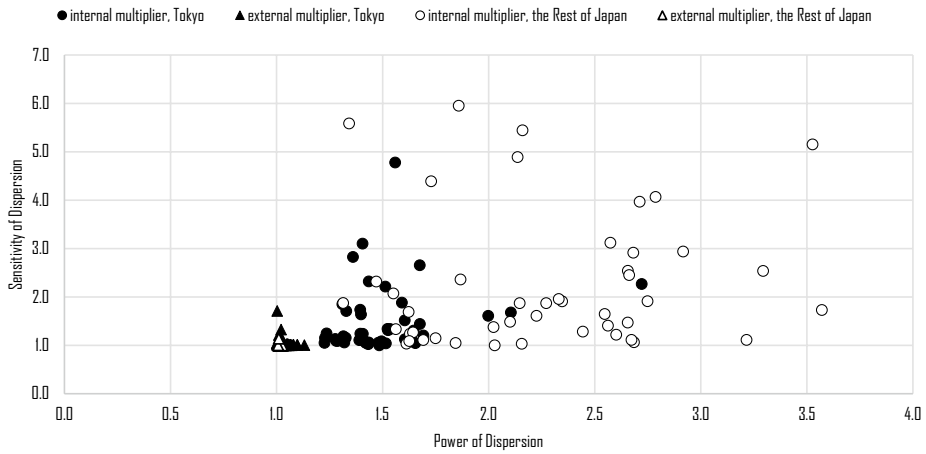

Fig. 5 Power and sensitivity of dispersion of partitioned multipliers in two-region. Source: Author's construction based on Tokyo Metropolitan Government (2016a)

Tokyo (see Fig. 5). The summary of rows and columns for both multipliers and regions are presented in Table 1.

Further analysis of the submatrices of the internal multiplier can shed a light on the interregional inducing dealings, whose coefficients can be distinguished between the inducement to input, consisting of a column sum of B_1 and T_1, and the inducement to production, consisting of a column sum of B_2 and T_2. Each row and column sum of elements of all submatrices comprise the receiving and giving induced effect sectors, respectively.

The average coefficient of T_2 (0.5852) is higher than that of B_2 (0.0752), in the same manner as the coefficient of B_1 (0.3197) is higher than that of T_1 (0.1162). This result portrays how the economic activities in Tokyo are highly dependent on the sectors in the rest of Japan and how any development in Tokyo will benefit sectors in the rest of Japan. For instance, the production of iron and steel in the rest of Japan (3.2125) is favorably high due to Tokyo's input, especially in raw material manufacturing sector (i.e., iron and steel) and steel-related manufacturing including transportation equipment, office supplies, general-purpose machinery, and electronic components. A similar finding is found also in Miyazawa's (1976) empirical work on the interregional repercussion model between Hokkaido and Honshu (the rest of Japan). In addition, a further investigation of the row sum elements of the iron and steel sector in the rest of Japan discovers that its exceptional coefficient value is contributed reasonably by heavy manufacturing including, but not limited to, iron and steel (1.3113); metal products (0.3653); general-purpose machinery (0.3547); transportation equipment (0.2120); and electrical machinery (0.1147). Further details of submultipliers' row and column sum elements, however, are not presented here due to limited space.

Besides headquarters, the tertiary industry in Tokyo, such as business service; information and communications; commerce; finance and insurance; and real estate has above-average induced effects on production by sectors in the rest of Japan including, but not limited to, information and communications; commerce; finance and insurances; and air transport. The high inputs in the sectors of headquarters; iron and steel; petroleum and coal products; and pulp, paper, and wooden products in the rest of Japan were induced by the internal production in Tokyo, such as in the sectors of office supplies; iron and steel; and water transport. On the other hand, the high inputs in the sectors of headquarters; business services; commerce; information and communications; and finance and insurance in Tokyo were stimulated by the internal propagation in the Rest of Japan, for instance in the sectors of office supplies; air transport; and information and communications (see Table 2).

Furthermore, the inside propagation ratios in Tokyo imply a high dependence trend on tourism and steel-related manufacturing industries in the rest of Japan. Specifically, hotels; headquarters; iron and steel; transportation equipment; production machinery; and electronic components are some sectors that are highly dependent on the rest of Japan, while public administration; petroleum and coal products; and mining are among the least dependent sectors.

3.3 Inter-sectoral propagation pattern of tourism and other sectors in Tokyo

In this subsection, the inter-sectoral interdependency between 8 tourism-related sectors and 38 other (non-tourism) sectors in Tokyo is explored using a partitioned matrix in a traditional single region input–output model. The sub-multiplier of internal matrices can explain the inter-sectoral production activities between sectors in tourism and other sectors in Tokyo. The results indicate that the sector of other transport and postal services has the largest overall inducible power among non-tourism sectors, and the inducement coefficients are especially large in the sectors of other transport and postal services (0.0669) and mining (0.0168) for both the sector of miscellaneous services relating to transport, followed by public administration for railways transport (passenger)

Table 2 Coefficients of interregional inducement relations

	Coefficients of inducement to production per unit of input in the other region				**Coefficients of inducement to input by internal propagation in the other region**			
	T_2		B_2		B_1		T_1	
	Row sum	**Column sum**	**Row sum**	**Column sum**	**Row sum**	**Column sum**	**Row sum**	**Column sum**
Agriculture, forestry, and fishery	0.5699	0.4567	0.0013	0.0231	0.3521	0.2248	0.0010	0.0724
Mining	1.7858	0.2258	0.0080	0.0932	0.0528	0.2132	0.0005	0.1280
Beverages and Foods	0.6250	1.0315	0.0106	0.0656	0.4822	0.5266	0.0145	0.1097
Textile products	0.2894	0.6983	0.0060	0.1054	0.2183	0.4170	0.0032	0.1668
Pulp, paper and wooden products	1.3858	0.8679	0.0218	0.0726	1.0141	0.4229	0.0336	0.1370
Chemical products	1.7903	0.8556	0.0198	0.0752	0.9244	0.4325	0.0344	0.1421
Petroleum and coal products	1.6430	0.4256	0.0034	0.0099	1.2107	0.2014	0.0008	0.1047
Plastic and rubber products	0.8503	0.7046	0.0131	0.0609	0.5611	0.3354	0.0228	0.1298
Ceramic, stone and clay products	0.4857	0.7306	0.0059	0.0633	0.3985	0.4008	0.0092	0.1095
Iron and steel	3.2125	2.1409	0.0102	0.0218	1.2573	0.6836	0.0221	0.1036
Non-ferrous metals	0.9127	0.3332	0.0125	0.0465	0.4490	0.2980	0.0159	0.1247
Metal products	0.5679	0.8540	0.0107	0.0649	0.4670	0.3412	0.0181	0.1162
General-purpose machinery	0.2690	1.1626	0.0074	0.0683	0.2204	0.5007	0.0107	0.1167
Production machinery	0.1468	0.9351	0.0053	0.0713	0.1250	0.4253	0.0077	0.1149
Business oriented machinery	0.1020	0.8094	0.0077	0.0985	0.0987	0.4213	0.0105	0.1515
Electronic components	0.9110	1.0400	0.0356	0.0871	0.7460	0.5245	0.0473	0.1471
Electrical machinery	0.2196	0.9271	0.0132	0.0876	0.1518	0.4808	0.0188	0.1429
Information and communication electronics equipment	0.0329	0.9548	0.0022	0.1039	0.0271	0.5147	0.0024	0.1603
Transportation equipment	0.9320	1.6212	0.0127	0.0498	0.5662	0.6245	0.0213	0.1332
Miscellaneous manufacturing products	0.4204	0.6807	0.0536	0.1143	0.3012	0.3611	0.0627	0.1541
Construction	0.2053	0.6965	0.0245	0.1126	0.0000	0.3464	0.0000	0.1447
Electricity, gas and heat supply	0.8630	0.3299	0.0161	0.0555	0.4151	0.2863	0.0000	0.1319
Water supply	0.0550	0.3206	0.0048	0.0524	0.0000	0.2435	0.0000	0.0925
Waste management service	0.0663	0.3168	0.0024	0.0936	0.0385	0.2009	0.0000	0.0994
Commerce	1.4952	0.1532	0.3964	0.1441	0.8219	0.1334	0.7235	0.1404
Finance and insurance	0.2676	0.1429	0.1958	0.1318	0.0020	0.1401	0.1252	0.1224

Table 2 (continued)

	Coefficients of inducement to production per unit of input in the other region				Coefficients of inducement to input by internal propagation in the other region			
	T_2		B_2		B_1		T_1	
	Row sum	Column sum	Row sum	Column sum	Row sum	Column sum	Row sum	Column sum
Real estate	0.2086	0.0411	0.1010	0.0342	0.0000	0.0652	0.0314	0.0431
Railway transport (passengers)	0.1535	0.2445	0.0149	0.0490	0.1471	0.1520	0.0208	0.0673
Road transport service	0.0453	0.2821	0.0057	0.1234	0.0282	0.1691	0.0044	0.1208
Water transport	0.0004	0.5862	0.0000	0.0439	0.0000	0.6834	0.0000	0.1432
Air transport	0.0370	0.8147	0.0113	0.1298	0.0183	0.4656	0.0105	0.1688
Miscellaneous services relating to transport	0.3161	0.1225	0.0325	0.0870	0.2969	0.1379	0.0455	0.0961
Other transport and postal services	1.6178	0.6657	0.0526	0.0867	0.9610	0.3544	0.0469	0.1202
Information and communications	0.3592	0.2360	0.4038	0.1654	0.2111	0.2145	0.5297	0.1674
Public administration	0.0253	0.2075	0.0034	0.0380	0.0000	0.1634	0.0000	0.0595
Education and research	0.4129	0.1317	0.0518	0.0335	0.0217	0.1080	0.0252	0.0500
Medical, health care and welfare	0.0035	0.3992	0.0003	0.0374	0.0000	0.2332	0.0001	0.0718
Miscellaneous non-profit services	0.0393	0.1472	0.0038	0.1051	0.0054	0.1341	0.0000	0.1189
Business services	1.3682	0.2514	0.5813	0.1263	0.3900	0.2027	0.7516	0.1346
Hotels	0.0000	0.4355	0.0000	0.0663	0.0000	0.2764	0.0000	0.1020
Eating and drinking services	0.0016	0.6469	0.0001	0.0515	0.0000	0.3659	0.0000	0.0987
Amusement and recreational services	0.0045	0.1923	0.0064	0.1011	0.0022	0.1476	0.0011	0.1039
Other personal services	0.0079	0.1676	0.0024	0.0564	0.0000	0.1148	0.0000	0.0733
Office supplies	0.0269	1.5751	0.0072	0.0771	0.0000	0.7403	0.0000	0.1880
Activities not elsewhere classified	0.1124	0.3193	0.0146	0.0274	0.0018	0.2097	0.0000	0.0727
Headquarters	2.0742	0.0370	1.2635	0.0450	1.7207	0.0669	2.6735	0.0503
(Average)	0.5852	0.5852	0.0752	0.0752	0.3197	0.3197	0.1162	0.1162

Source: Author's calculation based on Tokyo Metropolitan Government (2016a)

(0.0162) and the sector of information and communications for amusement and recreational services (0.0145). Yet, no inducible power of any other sectors to hotels is found (see Table 3).

The sector of eating and drinking services is found to have the highest inducible effect on other sectors in total. Its coefficients of inducement are exceptionally large in the sectors of beverages and foods (0.3022), followed by water transport for other transport and postal services (0.2595), and air transport for petroleum and coal products (0.2377) (see Table 4). Overall, the coefficients of B_2 are larger than those of B'_1, which indicates that the inter-sectoral inducible effect of tourism sectors is more powerful than that of other sectors.

The whole elements of the internal multiplier of the tourism sector (T) are found to be greater than or equal to its external multiplier elements (K), which implies a substantial dependence of the tourism sectors on the other sectors (see Table 5). This finding was in line with the low inside propagation ratios of Tokyo's tourism industries, except for the miscellaneous services relating to transport. Consequently, the high dependency of tourism sectors on the other sectors means that any growth in tourism industries in Tokyo can stimulate more benefits to other sectors intraregional.

Inside propagation ratios of other sectors in Tokyo show that all row elements in 31 sectors have higher value ratios, which suggests their least dependency on tourism industries. Moreover, though not all of the row elements are above 0.9, the following six sectors are also less dependent on the tourism sector, which are arranged in descending order, i.e., construction; miscellaneous manufacturing products; agriculture, forestry, and fishery; waste management service; beverages and foods; and petroleum and coal products. On the other extreme, transportation equipment is the sole and most dependent sector to tourism activities, with only 4 out of 38 of its row elements which possess higher value ratios.

In overall, the intersectoral submultipliers of B_2 have many higher coefficients compared to B'_1 in propagation activity (see Tables 3 and 4 for further details), whose share counted for more than three quarters. This suggests that the tourism sector has more inducible power to non-tourism sector than vice versa. The internal multiplier of tourism sector (T) is higher than its external multiplier (K), which implies a higher dependence of the tourism sector on the other sector (see Table 5). In addition, the gap of value between these two multipliers is relatively small which is observed under 0.25, except for two column elements in water transport and air transport. These results implicate the importance of the tourism sector to deliver and amplify impacts on the other sector in Tokyo through its strong inter-sectoral interdependency. Thus, any strategic policies to improve the tourism sector in Tokyo may result in a greater effect region-wide.

4 Conclusions

The economic contribution of domestic and inbound visitors' expenditure in Tokyo in 2011 are estimated using a two-region interregional input–output model. It is found that domestic and inbound visitors' expenditure in Tokyo made a total contribution of ¥8.4 T and ¥414.4B of output, ¥4.4 T and ¥196.1B of value-added, ¥1.9 T and ¥89.8B of income, and 431,954 and 24,695 jobs, respectively, with 95–96% of each contribution is driven by domestic visitors. The overall contribution of visitors' expenditure in terms of output, value-added, income, and employment are prominent in the service sectors, e.g.,

Table 3 Coefficient of tourism-input induced by internal propagation in other sector $\left(B'_1\right)$

	Railway transport (passengers)	Road transport service	Water transport	Air transport	Miscellaneous services relating to transport	Hotels	Eating and drinking services	Amusement and recreational services
Agriculture, forestry and fishery	0.0046	0.0013	0.0000	0.0013	0.0029	0.0000	0.0002	0.0004
Mining	0.0056	0.0047	0.0000	0.0031	0.0168	0.0000	0.0000	0.0006
Beverages and Foods	0.0041	0.0014	0.0000	0.0017	0.0041	0.0000	0.0088	0.0005
Textile products	0.0074	0.0029	0.0000	0.0044	0.0030	0.0000	0.0000	0.0007
Pulp, paper and wooden products	0.0051	0.0019	0.0000	0.0026	0.0040	0.0000	0.0000	0.0006
Chemical products	0.0071	0.0025	0.0000	0.0038	0.0031	0.0000	0.0001	0.0008
Petroleum and coal products	0.0017	0.0008	0.0000	0.0008	0.0034	0.0000	0.0000	0.0003
Plastic and rubber products	0.0046	0.0018	0.0000	0.0022	0.0020	0.0000	0.0000	0.0005
Ceramic, stone and clay products	0.0057	0.0022	0.0000	0.0025	0.0074	0.0000	0.0000	0.0008
Iron and steel	0.0045	0.0016	0.0000	0.0022	0.0060	0.0000	0.0000	0.0005
Non-ferrous metals	0.0047	0.0020	0.0000	0.0021	0.0065	0.0000	0.0000	0.0006
Metal products	0.0036	0.0017	0.0000	0.0017	0.0030	0.0000	0.0000	0.0004
General-purpose machinery	0.0062	0.0029	0.0000	0.0032	0.0037	0.0000	0.0000	0.0007
Production machinery	0.0063	0.0031	0.0000	0.0032	0.0030	0.0000	0.0000	0.0007
Business oriented machinery	0.0074	0.0028	0.0000	0.0032	0.0031	0.0000	0.0000	0.0007
Electronic components	0.0084	0.0039	0.0000	0.0030	0.0038	0.0000	0.0000	0.0009
Electrical machinery	0.0086	0.0031	0.0000	0.0041	0.0034	0.0000	0.0000	0.0009
Information and communication electronics equipment	0.0108	0.0034	0.0000	0.0033	0.0035	0.0000	0.0000	0.0009

Table 3 (continued)

	Railway transport (passengers)	Road transport service	Water transport	Air transport	Miscellaneous services relating to transport	Hotels	Eating and drinking services	Amusement and recreational services
Transportation equipment	0.0052	0.0021	0.0000	0.0025	0.0038	0.0000	0.0000	0.0007
Miscellaneous manufacturing products	0.0056	0.0017	0.0000	0.0026	0.0056	0.0000	0.0000	0.0008
Construction	0.0049	0.0019	0.0000	0.0019	0.0034	0.0000	0.0000	0.0007
Electricity, gas and heat supply	0.0062	0.0030	0.0000	0.0025	0.0103	0.0000	0.0000	0.0009
Water supply	0.0073	0.0017	0.0000	0.0025	0.0026	0.0000	0.0000	0.0017
Waste management service	0.0075	0.0037	0.0000	0.0045	0.0042	0.0000	0.0000	0.0007
Commerce	0.0083	0.0028	0.0000	0.0047	0.0018	0.0000	0.0000	0.0008
Finance and insurance	0.0140	0.0047	0.0000	0.0021	0.0011	0.0000	0.0000	0.0012
Real estate	0.0030	0.0010	0.0000	0.0008	0.0005	0.0000	0.0000	0.0004
Other transport and postal services	0.0040	0.0014	0.0000	0.0019	0.0669	0.0000	0.0000	0.0010
Information and communications	0.0066	0.0024	0.0000	0.0051	0.0018	0.0000	0.0000	0.0145
Public administration	0.0162	0.0064	0.0000	0.0032	0.0023	0.0000	0.0000	0.0010
Education and research	0.0086	0.0021	0.0000	0.0036	0.0015	0.0000	0.0000	0.0008
Medical, health care and welfare	0.0073	0.0015	0.0000	0.0024	0.0020	0.0000	0.0099	0.0009
Miscellaneous non-profit services	0.0096	0.0043	0.0000	0.0043	0.0016	0.0000	0.0000	0.0011
Business services	0.0054	0.0020	0.0000	0.0037	0.0020	0.0000	0.0000	0.0036
Other personal services	0.0049	0.0018	0.0000	0.0023	0.0016	0.0000	0.0000	0.0020
Office supplies	0.0061	0.0022	0.0000	0.0032	0.0066	0.0000	0.0000	0.0007
Activities not elsewhere classified	0.0100	0.0031	0.0001	0.0081	0.0052	0.0000	0.0000	0.0015

Table 3 (continued)

	Railway transport (passengers)	Road transport service	Water transport	Air transport	Miscellaneous services relating to transport	Hotels	Eating and drinking services	Amusement and recreational services
Head-quarters	0.0111	0.0036	0.0000	0.0039	0.0010	0.0000	0.0000	0.0008

Source: Author's calculation based on Tokyo Metropolitan Government (2016a)

commerce in the first three mentioned contributions as well as eating and drinking services in the latter contribution.

The estimation using the two-region model yields a higher result compared to the single-region model due to the interregional feedback effect that is not covered in the latter model, where the overall percentage error of output contribution for visitors' spending (2.06%) is above standard.

Overall, the proportion of initial, intraregional, spillover and feedback effects to the total effect driven by visitors' expenditure, regardless of the type, are 51.9%, 27.5%, 18.8%, and 1.8%, respectively. The indirect and feedback effects are outstanding on the tertiary industry, exceedingly in commerce, while the sectoral linkage comprised in the spillover effect to the rest of Japan is more widely distributed.

The submatrices of the internal multiplier indicate that the economic activities in Tokyo were highly dependent on the industries in the rest of Japan, e.g., tourism and steel-related manufacturing industries, and therefore, any development in Tokyo will generate more benefit to the industries in the rest of Japan.

Likewise, in the two-sector model, the tourism sector had a strong dependency on other (non-tourism) sectors, but not necessarily contrariwise except for the transportation equipment sector. Particularly, the sector of other transport and postal services has the largest overall inducible power on tourism industries and likewise for the sector of eating and drinking services on the other sectors. In addition to their substantial dependencies on other sectors, tourism industries are found to have more powerful inter-sectoral inducible effects on the other sectors than the other way around, hence, this research highlights the importance of tourism on the Tokyo Metropolitan economy.

The analysis based on a two-region input–output framework provides more comprehensive results including interregional and intersectoral interdependencies between two regions. Specifically, tourists' expenditure in Tokyo brings out a positive contribution to other sectors within (through its higher inducible power yet higher dependence on other sectors) and across the region, prominently toward tertiary industry and food-related sectors, respectively. This result highlights Tokyo's service-oriented economic structure including its distinguished headquarters activity, yet heavily dependent on food supply from the rest of Japan which is opposite to the previous study in the Galicia-rest of Spain (Incera et al. 2015); that is unique and reasonable for a capital region. Eventually, our findings suggest to regional authorities the importance to build an interregional input–output table in addition to the existing RIOT and to be benefitted from the more comprehensive analysis it offers.

Table 4 Coefficient of internal propagation in other sectors induced by input in tourism (B_2)

	Railway transport (passengers)	Road transport service	Water transport	Air transport	Miscellaneous services relating to transport	Hotels	Eating and drinking services	Amusement and recreational services
Agriculture, forestry and fishery	0.0005	0.0002	0.0003	0.0007	0.0016	0.0592	0.1073	0.0077
Mining	0.0147	0.0076	0.0126	0.0241	0.0079	0.0267	0.0182	0.0143
Beverages and Foods	0.0002	0.0001	0.0001	0.0002	0.0027	0.1323	0.3022	0.0018
Textile products	0.0032	0.0021	0.0022	0.0043	0.0046	0.0153	0.0042	0.0117
Pulp, paper and wooden products	0.0072	0.0037	0.0072	0.0080	0.0138	0.0184	0.0231	0.0159
Chemical products	0.0061	0.0032	0.0053	0.0127	0.0065	0.0209	0.0254	0.0175
Petroleum and coal products	0.0151	0.0699	0.1397	0.2377	0.0110	0.0247	0.0279	0.0222
Plastic and rubber products	0.0061	0.0015	0.0033	0.0106	0.0047	0.0116	0.0136	0.0107
Ceramic, stone and clay products	0.0040	0.0009	0.0015	0.0046	0.0032	0.0054	0.0045	0.0033
Iron and steel	0.0183	0.0019	0.0039	0.0286	0.0086	0.0067	0.0089	0.0054
Non-ferrous metals	0.0059	0.0008	0.0013	0.0095	0.0032	0.0038	0.0041	0.0024
Metal products	0.0060	0.0014	0.0023	0.0043	0.0056	0.0066	0.0104	0.0038
General-purpose machinery	0.0013	0.0005	0.0006	0.0022	0.0019	0.0007	0.0008	0.0008
Production machinery	0.0006	0.0006	0.0006	0.0018	0.0017	0.0007	0.0008	0.0007
Business oriented machinery	0.0005	0.0004	0.0004	0.0012	0.0012	0.0007	0.0009	0.0036
Electronic components	0.0027	0.0013	0.0013	0.0057	0.0037	0.0017	0.0020	0.0027
Electrical machinery	0.0029	0.0007	0.0006	0.0052	0.0021	0.0008	0.0009	0.0013
Information and communication electronics equipment	0.0007	0.0002	0.0002	0.0012	0.0005	0.0003	0.0006	0.0004
Transportation equipment	0.0907	0.0008	0.0055	0.1909	0.0042	0.0029	0.0044	0.0013
Miscellaneous manufacturing products	0.0079	0.0044	0.0039	0.0096	0.0197	0.0118	0.0124	0.0245
Construction	0.0410	0.0054	0.0074	0.0072	0.0394	0.0168	0.0140	0.0191
Electricity, gas and heat supply	0.0343	0.0070	0.0071	0.0167	0.0175	0.0658	0.0421	0.0331
Water supply	0.0057	0.0020	0.0021	0.0014	0.0054	0.0120	0.0137	0.0055
Waste management service	0.0101	0.0011	0.0007	0.0013	0.0044	0.0322	0.0124	0.0081
Commerce	0.0205	0.0168	0.0288	0.0337	0.0245	0.1064	0.1723	0.0427
Finance and insurance	0.0451	0.0217	0.0193	0.0239	0.0374	0.0411	0.0241	0.0219
Real estate	0.0122	0.0133	0.0130	0.0150	0.0363	0.0245	0.0266	0.0194
Other transport and postal services	0.0221	0.0120	0.2595	0.0314	0.0155	0.0454	0.0454	0.0297
Information and communications	0.0267	0.0253	0.0213	0.0531	0.0794	0.0490	0.0504	0.0687

Table 4 (continued)

	Railway transport (passengers)	Road transport service	Water transport	Air transport	Miscellaneous services relating to transport	Hotels	Eating and drinking services	Amusement and recreational services
Public administration	0.0042	0.0008	0.0012	0.0054	0.0039	0.0022	0.0027	0.0013
Education and research	0.0164	0.0061	0.0041	0.0166	0.0091	0.0079	0.0094	0.0067
Medical, health care and welfare	0.0002	0.0000	0.0004	0.0001	0.0002	0.0001	0.0002	0.0001
Miscellaneous non-profit services	0.0006	0.0013	0.0006	0.0010	0.0012	0.0015	0.0024	0.0064
Business services	0.0663	0.0740	0.0786	0.2134	0.2151	0.0810	0.0939	0.0934
Other personal services	0.0030	0.0009	0.0003	0.0010	0.0009	0.0164	0.0043	0.0041
Office supplies	0.0018	0.0013	0.0008	0.0013	0.0020	0.0024	0.0018	0.0017
Activities not elsewhere classified	0.0178	0.0034	0.0050	0.0232	0.0164	0.0093	0.0116	0.0055
Headquarters	0.1006	0.1758	0.0664	0.0874	0.1248	0.0877	0.0805	0.0820

Source: Author's calculation based on Tokyo Metropolitan Government (2016a)

Table 5 Internal multiplier (T) and external multiplier (K) of tourism sector in Tokyo

	Multiplier	Railway transport (passengers)	Road transport service	Water transport	Air transport	Miscellaneous services relating to transport	Hotels	Eating and drinking services	Amusement and recreational services
Railway transport (passengers)	Internal	1.0030	0.0027	0.0041	0.0041	0.0036	0.0052	0.0061	0.0061
	External	1.0024	0.0023	0.0017	0.0025	0.0028	0.0031	0.0033	0.0021
Road transport service	Internal	0.0011	1.0012	0.0017	0.0015	0.0020	0.0014	0.0015	0.0019
	External	0.0008	1.0008	0.0006	0.0009	0.0010	0.0012	0.0012	0.0008
Water transport	Internal	0.0002	0.0000	2.2659	0.0001	0.0000	0.0000	0.0000	0.0000
	External	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Air transport	Internal	0.0028	0.0011	0.0020	1.0048	0.0021	0.0022	0.0020	0.0045
	External	0.0010	0.0009	0.0008	1.0014	0.0014	0.0014	0.0016	0.0011
Miscellaneous services relating to transport	Internal	0.0217	0.0196	0.1173	0.2563	1.0222	0.0495	0.0072	0.0086
	External	0.0018	0.0012	0.0175	0.0026	1.0016	0.0036	0.0037	0.0024
Hotels	Internal	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000
	External	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000
Eating and drinking services	Internal	0.0000	0.0000	0.0000	0.0000	0.0000	0.0009	1.0076	0.0000
	External	0.0000	0.0000	0.0000	0.0000	0.0000	0.0009	1.0021	0.0000
Amusement and recreational services	Internal	0.0005	0.0004	0.0009	0.0012	0.0013	0.0035	0.0010	1.0451
	External	0.0004	0.0004	0.0004	0.0009	0.0013	0.0008	0.0008	1.0010

Source: Author's calculation based on Tokyo Metropolitan Government (2016a)

Acknowledgements
The authors are grateful for the data provision from and correspondence with the person(s) in charge of Tokyo Metropolitan Input–Output Table, the Coordination Section, Statistics Division, Bureau of General Affairs, Tokyo Metropolitan Government. We thank the anonymous reviewers for their constructive comments and suggestions, which greatly improved the manuscript.

Author contributions
OT designed, analyzed data, interpreted results, and was a major contributor in writing and revising the manuscript. TS supervised the work. Both authors read and approved the final manuscript.

Funding
The authors are supported by Tokyo Human Resources Fund for City Diplomacy.

Availability of data and materials
The data sets analyzed during the current study (the 2011 Tokyo Metropolitan Input–Output Table) are available online from the associate(s) in charge of the Input–Output Table, the Coordination Section, Statistics Division, Bureau of General Affairs, Tokyo Metropolitan Government. The data sets and website are subject to copyright, and, therefore, protected by copyright laws and international treaties. [https://www.toukei.metro.tokyo.lg.jp/sanren/2011/sr11t1.htm].

Declarations

Competing interests
The authors declare that they have no competing interests.

Received: 11 September 2020 Revised: 18 September 2022 Accepted: 19 September 2022
Published online: 03 October 2022

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