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# Repercussion effects of consumption by Chinese, Taiwanese, and Korean tourists in Kyoto: using a regional waste input–output approach

Makiko Tsukui<sup>1\*</sup>  and Masaru Kagatsume<sup>2</sup>

\*Correspondence:

makiko@tiu.ac.jp

<sup>1</sup> School of Business and Commerce, Tokyo International University, 1-13-1 Matoba-Kita, Kawagoe-shi, Saitama 350-1197, Japan

Full list of author information is available at the end of the article

## Abstract

Since the 2003 launch of the Visit Japan Campaign by Tourism Agency, the number of foreign visitors to this nation has climbed significantly, reaching 19.7 million people in 2015, a number 3.8 higher than 2003. The increase in tourists from China, Taiwan, and Korea was especially significant, accounting for 74% of Japan's total visitors. Although the increased tourism yielded considerable economic benefits, it also stimulated direct and indirect environmental loads. In this study, we evaluated the direct and repercussion effects of visitors from China, Taiwan, and Korea to Kyoto, both economically and environmentally, using a regional waste input–output approach. For this purpose, we first estimated the direct effects which are the visitors' consumption activities in Kyoto in 2000 and 2014. We found that direct consumption by those tourists increased 10-fold during that period, accounting for ¥134 billion in 2014, while repercussion effects of consumption on production values by those same visitors increased from ¥16 billion in 2000 to ¥176 billion in 2014. As for waste generation and greenhouse gas (GHG) emissions, induced waste requiring treatment increased from 2809 (2000) to 26,856 tonnes (2014), and accompanying GHG emissions increased from 12,000 ton-CO<sub>2</sub> (eq.) (2000) to about 144,000 ton-CO<sub>2</sub> (eq.) in 2014. To depress the level of waste generation increase and the treatment that accompanies the promotion of tourism, environmental efficiency improvements in the two main industrial sectors related to tourism, "eating and drinking locations" and "lodging," will be crucial. Additionally, encouraging "food waste," "waste paper," and "plastic bag" recycling activities could also prove effective. The results implied that imported goods from other parts of Japan were purchased by Kyoto visitors, which means that visitor consumption in Kyoto stimulated production activities in other parts of Japan, especially in the manufacturing industries.

**Keywords:** Regional waste input–output approach, Kyoto tourism, Chinese tourists, Korean tourists, Taiwan tourists

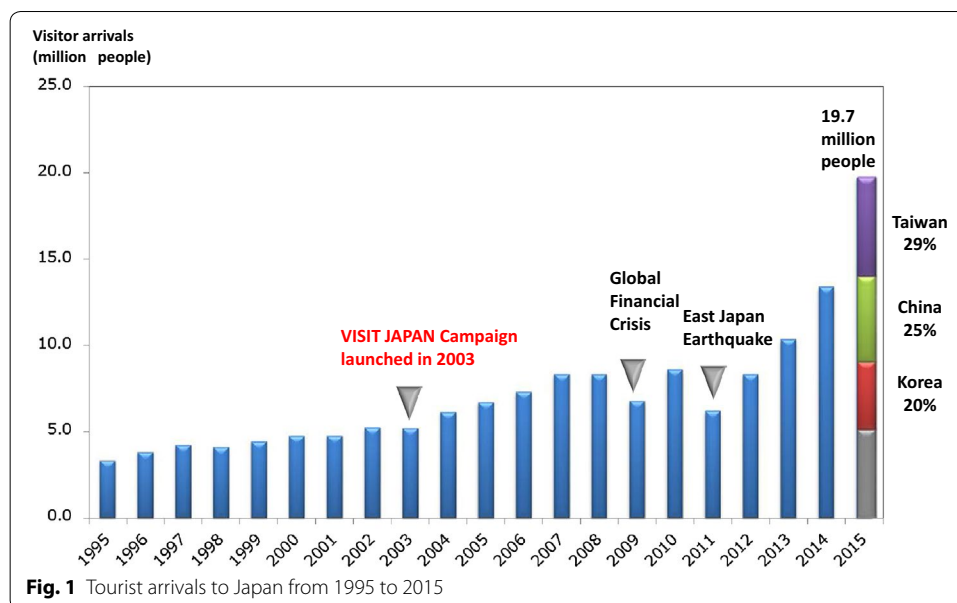
## 1 Background

Although tourism is an important economic sector and was responsible for 10% of gross domestic product (GDP) of the world in 2015 (United Nations World Tourism Organization (UNWTO) 2016), the Japanese government's campaign to revitalize the tourism industry by inviting visitors to Japan started late. Faced with increasing globalization, a dwindling birth rate, an aging population, and an increasing shift from manufacturing to service industries, the Japanese government cast around for a new leading industry and began to focus on encouraging inbound tourism (Japan Tourism Agency (JTA) 2017a, b).

In the years since the launch of the JTA's Visit Japan Campaign in 2003, the number of overseas tourists arriving has grown significantly, as shown in Fig. 1. This campaign was launched in conjunction with efforts by private companies, regional governments, and diplomatic missions abroad, as part of a combined effort to increase the number of visitors to Japan (JTA 2016b) by promoting Japan to overseas consumers and tourism companies. In conjunction with the campaign, the Japanese government also initiated a visa-exemption program and encouraged the establishment of tax-free shops. The results were mainly positive, and despite the occurrence of the global financial crises and natural disasters such as the Great East Japan Earthquake, the number of foreign visitors in Japan grew to 19.7 million people in 2015, which was about 3.8 times more than the 2003 total (Japan National Tourism Organization (JNTO) 2017). In 2014, consumption by foreign tourists exceeded ¥2 trillion yen.

The success of the government's campaign to revitalize the nation's tourism-related industries can be seen in Fig. 1. At the start of the Visit Japan Campaign, the Japanese government initially specified 12 priority markets: Korea, China, Taiwan, Hong Kong, Thailand, Singapore, Australia, United States (USA), Canada, United Kingdom, France, and Germany. Later, Malaysia, Indonesia, Philippine, Vietnam, India, Italia, Russia, and Spain were added as eight additional primary markets.

Sumi (2011) applied the dynamic panel data model and showed that visitors from the Visit Japan Campaign priority markets statistically significantly increased in number,



while also clarifying that the number of visitors from a priority market was positively related to an increase in the following year. This, in turn, implies an increase in repeat visitors and the effectiveness of word-of-mouth publicity.

However, it is problematic to judge the success of the Visit Japan Campaign solely by the increase in the number of visitors. While the original objectives of the campaign, as defined in the Tourism Nation Promotion Basic Law enacted in 2007 (JTA 2016d), focused on economic development, very few studies have investigated the repercussion effects of tourism-related consumption.

Therefore, it is important to consider both the quantity and quality of visitor consumption activities. For example, if an increase in the number of visitors results in less consumption than before, the economic effects of tourism decline, so it is important to identify the consumption activities which enlarge the economic effects of tourism because such information is useful when supporting tourist promotion policymaking efforts. According to the statistical data, visitor consumption per person differs in countries and regions (JTA 2016a). It would be advisable to enhance promotion efforts in the higher-consumption markets. Another important issue is the environmental point of view. Although increased tourism typically yields considerable economic benefits, it is also associated with a marked increase in waste generation and direct and indirect environmental loads in the sightseeing areas (Lenzen 2008). The present Tourism Nation Promotion Basic Law lacks such a viewpoint.

In consideration of these issues, this study seeks to evaluate the direct and repercussion effects of foreign visitors to Japan, both economically and environmentally. For the first step of this research project, we used a regional waste input–output approach (WIOA) focusing on Kyoto for the years of 2000 and 2014, and then evaluated the repercussion effects of consumption by visitors from China, Taiwan, and Korea.

The breakdown of visitors to Japan in 2015 shown in Fig. 1 indicates that visitors from Taiwan, China, and Korea accounted for 29, 25, and 20% of all visitors, respectively, and that the combined percentage total is about 74%. Huang (2011) pointed out that the Japanese campaign mainly targeted East Asian countries and economies that have been heavily influenced by Japanese popular culture, such as Korea, Taiwan, China, and Hong Kong. Yoshida (2013) investigated visitor arrivals to Japan from 2002 to 2010 and also pointed out that the increase in visitors was primarily caused by the campaign directed at Asia and that visitors from Europe and/or the USA did not contribute much to the increase. However, since the consumption activities of Chinese, Taiwanese, and Korean visitors were found to differ from each other, we decided to compare the consumption activities of tourists from these three countries in 2000 and 2014 and see how drastically they vary in terms of quantity and quality.

We selected Kyoto as the target region for this study because many of Japan's most famous tourist sites are located within the city and because tourism is one of the most important industries in this region. Additionally, Kyoto compiles and provides an abundance of tourism-related statistics, including data on visitor consumption activities. For example, since 2010 (after the start of the Visit Japan Campaign), the JTA has been conducting yearly detailed surveys of foreign visitors to Japan named the "Consumption Trend Survey for Foreigners Visiting Japan," which investigates consumption activities based on their departure places. Additionally, Kyoto has been conducting its own survey

of tourism from 1991, which is before the Visit Japan Campaign was launched. By utilizing these statistics, we could estimate and compare the consumption activities of visitors from China, Taiwan, and Korea in 2000 and 2014.

In this Kyoto-based study, we used a regional WIO table for the year 2000 (hereafter KWIO2000) which was compiled by Ichikawa et al. (Ichikawa et al. 2011; Kagatsume et al. 2011; Tsukui et al. 2011). Note that while most early tourism input–output studies focused primarily on economic benefits (Fletcher 1989; Johnson and Moore 1993; Adams and Parmenter 1995; Archer and Fletcher 1996; Zhou et al. 1997; Dwyer et al. 2000; Tyrrell and Johnston 2001; Dwyer et al. 2004; Blake and Sinclair 2003; Cai et al. 2006), more recent studies have begun examining the environmental loads that accompany tourism. For example, Cline and Seidl (2010) examined the economic impact of these environmental changes on open space and water quality values in Colorado, USA, using a combination of non-market valuation and input–output approaches. However, the environmental factors considered in their studies were also the tourist attractions, and it was only later that Lenzen (2008) pointed out that an increase in tourism itself is always accompanied by an increase in waste generation, which must inevitably be treated within the target tourist site.

For its part, the Kyoto urban area entices visitors with its historical and cultural attractiveness. According to a 2015 questionnaire conducted by the Kyoto City government (Kyoto City Industry and Tourism Bureau 2015), most tourists come to see the city's temples, shrines, and historical sites. Because Kyoto was the capital of Japan from 794 to 1868, more than 1000 years, there are numerous historical places to enjoy, including 17 temples, shrines, and castles, all of which are historically important and which have resulted in Kyoto being designated a World Cultural Heritage Site by the United Nations Educational, Scientific and Cultural Organization (UNESCO). Most of those Kyoto City tourist attractions are located within a 3–4-km radius.

Kyoto is also well known as the birthplace of many forms of Japanese cuisine, which is another enticement that draws visitors to the city. In such an urban tourist environment, the primary industrial sectors that are stimulated by tourist consumption are restaurants and hotels, which primarily generate food, paper, and plastic wastes. In this study, since we sought an appropriate method for estimating the repercussion effects of visitor consumption in an urban tourist setting, we were drawn to the study by Tsukui et al. (2017), which investigated the repercussion effects of consumption by domestic tourists in Tokyo and Kyoto using an interregional WIOA. We then adopted the same basic analysis method in order to investigate the repercussion effects of consumption by visitors from China, Taiwan, and Korea.

The remainder of the present paper is structured as follows. Section 2 describes the regional WIO models used in our analysis. Section 3 presents the expenditure results for Kyoto visitors from China, Taiwan, and Korea in 2000 and 2014 estimated using a non-survey method. Section 4 presents the repercussion effects for the production values, waste generation amounts, waste treatment amounts, and greenhouse gas (GHG) emissions. Finally, our conclusions and issues for future consideration are presented in Sect. 5.

## 2 Model and data

### 2.1 Regional WIOA model

In this study, we investigate the repercussion effects resulting from expenditures by foreign tourists using a regional WIOA, which is considered to be well suited for simultaneously analyzing the effects of final demand on economics and the environment.

Table 1 shows the basic structure of the regional WIO table used in this study, which is the expansion of the conventional regional IO model of Isard (1951) and the WIO model of Nakamura and Kondo (2002).  $Z_I$  and  $Z_{II}$  denote the intermediate inputs of goods and services in the industrial and waste treatment sectors, respectively, in a specific region (i.e., Kyoto in this study). Subscripts I and II denote the industrial sectors and waste treatment sectors, respectively.  $W$  denotes waste generation, and  $V$  is a matrix denoting the value added.  $F_I$  is a final demand vector, and  $F_W$  is a vector denoting the amount of waste generated.  $E_I$  is a vector denoting the international exports of goods and services, and  $-E_W$  indicates the transport of waste resources from Kyoto to foreign countries.  $E_f$  is a vector denoting the final demands of the Chinese, Taiwanese, and Korean tourists visiting in Kyoto that were examined in this study.  $E_{wf}$  is a vector denoting the amount of waste which is disposed by tourists from these countries and areas. Because of the data issue, we assumed  $E_{wf}$  as zero in this study and tourists were assumed to dispose of their waste through industrial sectors such as hotels, restaurants, temples, and museums.  $M_I$  is a vector denoting the international imports of goods and services, and  $-M_W$  indicates the transportation of waste resources from foreign countries to Kyoto.  $N_I$  is a vector denoting the imports of goods and services from other regions of Japan, and  $-N_W$  indicates the transportation of waste resources from other regions of Japan to Kyoto.  $X_I$  and  $X_{II}$  denote the production value of the industrial and waste treatment sectors, respectively. The terms  $n_x$ ,  $n_z$ , and  $n_w$  indicate the numbers of industrial sectors, waste treatment sectors, and waste categories, respectively.

**Table 1 Framework of regional waste input–output table**

		Output			Waste treatment			Final demands			Production value or amount of waste generation
		1	...	$n_x$	1	...	$n_z$	Final demands	Final demands by foreign tourists	Exports to other regions and abroad	
Inputs	1	$Z_{I,I}$	$Z_{I,II}$	$F_I$	$E_f$	$E_I$	$-M_I$	$-N_I$	$X_I$		
	...										
	$n_x$										
Waste generation	1	$W_I$	$W_{II}$	$F_w$	$E_{wf}$	$-E_w$	$M_w$	$N_w$	$W$		
	...										
	$n_w$										
Value added		$V_I$	$V_{II}$								
Environmental loads		$E_{vI}$	$E_{vII}$								
Production value or amount of waste		$X_I$	$X_{II}$								

$$\bar{A} = \begin{bmatrix} A_I & A_{II} \\ SG_I & SG_{II} \end{bmatrix}, \bar{X} = \begin{bmatrix} X_I \\ SW \end{bmatrix} \quad (1)$$

$$\begin{aligned} \bar{F} &= \begin{bmatrix} F_I \\ SF_W \end{bmatrix}, \bar{E}_f = \begin{bmatrix} E_f \\ O \end{bmatrix}, \bar{E} = \begin{bmatrix} E_I \\ -SE_W \end{bmatrix}, \bar{M}_I = \begin{bmatrix} -M_I \\ O \end{bmatrix}, \\ \bar{M}_{II} &= \begin{bmatrix} O \\ SM_W \end{bmatrix}, \bar{N}_I = \begin{bmatrix} -N_I \\ O \end{bmatrix}, \bar{N}_{II} = \begin{bmatrix} O \\ SN_W \end{bmatrix}. \end{aligned} \quad (2)$$

$A_I$  denotes the coefficient matrix of intermediate inputs per unit production value from the industrial sectors;  $A_{II}$  is the coefficient matrix of intermediate inputs per unit amount of waste generated by the industrial sectors;  $G_I$  is the coefficient matrix of waste generation per unit production value from industrial sectors; and  $G_{II}$  is the coefficient matrix of the waste generated by the waste treatment sectors. These coefficient matrices are defined following Nakamura and Kondo (2002) and Kagawa and Kondo (2007).  $S$  is the allocation matrix, which is the ratio of the amount of waste that is treated by each waste treatment activity.  $\bar{A}$  is the extended coefficient matrix,  $\bar{F}$  is the vector of the row sum of the domestic final demand,  $\bar{E}_f$  is the vector of consumption by foreign tourists,  $\bar{E}$  is the vector of the row sum of international exports, and  $\bar{X}$  is the vector of the row sum of the production value and waste treatment value. By applying Eqs. (1) and (2), the vector of the effect of consumption by foreign tourists  $\bar{X}_f$  can be represented as follows:

$$\bar{X}_f = (I - (I - \hat{M} - \hat{N})\bar{A})^{-1}\bar{E}_f \quad (3)$$

where  $\hat{M}$  is an international import coefficient matrix, and  $\hat{N}$  is a coefficient matrix denoting the transaction of goods and services between Kyoto and other regions. In this study, we estimated  $\bar{X}_f$  for Kyoto and evaluated the effects of consumption by tourists from China, Taiwan, and Korea on industrial sectors, waste generation sectors, waste treatment sectors, and the environmental loads of each sector. Environmental loads were estimated by multiplying the coefficient matrices by  $\bar{X}_f$ .

## 2.2 Data

As previously mentioned, we adopted the regional KWIOT2000 table for this study. KWIOT2000 has 104 industrial sectors, eight value-added sectors, 11 final demand sectors, 92 waste categories, and 11 waste treatment sectors. Although the detailed compilation method is shown in Ichikawa et al. (2011), Kagatsume et al. (2011) and Tsukui et al. (2017), we used the “Year 2000 Kyoto Prefecture Input–Output Table,” published by Kyoto Prefecture (2004), Ministry of the Environment Secretariat, Waste/Recycling Measures Department (2002), New Energy and Industrial Technology Development Organization (NEDO) (2005) and Matsuto (2005) for estimations of waste generation and waste treatment, and the Embodied Energy and Emission Intensity Data for Japan Using Input–Output Tables (3EID) database (Nansai et al. 2008) for the estimation of GHG emissions. The advantage of the KWIOT2000 is that the industrial sector classification is sufficiently detailed to make it possible to allow correspondences with the item categories for goods in the Kyoto City survey.

Since the Visit Japan Campaign was initiated in 2003, this study attempted to compare visitor consumption for the years 2000 (which is the base year for the WIO table) and 2014 consumption levels (for which we have up-to-date statistical data). We estimated

consumption levels by visitors from China, Taiwan, and Korea for both years using this statistical data, which were provided by the Japanese government, Kyoto City, and Kyoto Prefecture. The detailed estimations of visitor consumption activities, which are the direct effects of tourism, will be shown in Sect. 3.

### 3 Direct effects of visitor consumption in Kyoto

According to the statistical data provided by the Kyoto City (Kyoto City Industry and Tourism Bureau 2002, 2008, 2015) and the Kyoto Prefectural Government (2015), the number of Chinese visitors to Kyoto increased tenfold from 2000 to 2014, while visitors from Taiwan and Korea increased five- and twofold, respectively. As the number of visitors surged, visitor consumption levels also increased drastically. Tables 2 and 3 show the estimated consumption levels for Chinese, Taiwanese, and Korean tourists in Kyoto.

According to the “Consumption Trend Survey for Foreigners Visiting Japan for Year 2014” (JTA 2016a), foreign visitor expenditures in Japan by tourist destination prefectures are quite different, and consumption activity by tourists in their departure places is quite different as well. Furthermore, while consumption activity of tourists from different homelands is quite different depending on their destinations (Tsukui and Kagatsume 2016), there are no statistical data in Japan which surveyed consumption activity of tourists both by different homelands and by tourists destination simultaneously.

We estimated the visitor consumption due to tourism using the Kyoto City Annual Tourism Study Report for years 2001 and 2014 (Kyoto City Industry and Tourism Bureau 2002, 2015) and the Kyoto City Foreign Tourists Behavior Survey Report (Kyoto City Industry and Tourism Bureau 2008). These reports provided survey data for tourist expenditures by homelands for lodging, souvenirs, transportation, eating and drinking establishments, and other purposes such as entrance fees. They also provided detailed purchase data by tourist homeland for souvenirs based on goods category and means of transportation. Although we could not obtain unit price data for expenditures by goods and services from the Kyoto City survey, we could apply the unit price for goods and services expenditures provided by JTA (2016a) to fill the remaining gaps.

Table 3 shows that consumption by tourists from China, Taiwan, and Korea increased dramatically over the period from 2000 to 2014. For example, consumption by Chinese tourists increased from about ¥1 billion to ¥18 billion, consumption by Taiwanese tourists increased from ¥8 billion to ¥112 billion, and consumption by Korean tourists increased from ¥2 billion to ¥4 billion. However, the estimated results for consumption per person in Table 2 show that the total consumption increase by visitors from China and Korea was due to the increased number of visitors and that Taiwanese tourist consumption per person in 2014 was more than three times larger than in 2000. Consumption per visitor from China increased only 20% and that from Korea decreased 15% in

**Table 2** Estimated results for the number of visitors and consumption per person in Kyoto

	2000			2014		
	China	Taiwan	Korea	China	Taiwan	Korea
The number of visitors	31,494	164,263	45,697	364,431	746,775	106,575
Consumption per person (yen)	48,771	52,165	52,686	58,375	169,598	44,422

**Table 3 Direct effects of visitors' consumption in Kyoto 2000 and 2014 (Unit: 10<sup>5</sup> yen)**

No.	Sector classification	Item of goods in Kyoto City survey	2000			2014		
			China	Taiwan	Korea	China	Taiwan	Korea
10)	Foods	Sweets, and other foods	142	2180	564	7141	52,850	2984
11)	Refined sake	Japanese sake	19	237	66	1135	6697	407
12)	Japanese tea	Japanese tea	36	262	139	2421	8420	973
16)	Silk textile	Kimono	22	217	33	1281	6164	205
17)	Wearing apparel and other textile products	Wearing apparel and other textile products	146	1341	401	8339	36,944	2410
22)	Printing and publishing	Comic, DVD, cartoon film related product	4	29	3	230	716	17
29)	Medicaments	Medicaments	38	322	18	2342	9536	117
30)	Final chemical prod- ucts	Cosmetics and supple- ment	181	1529	86	10,885	44,322	544
35)	Leather, fur skins and miscellaneous leather products	Bags and shoes	29	269	80	1631	7228	471
38)	Pottery, china and earthenware	Pottery, china and earthenware	81	605	127	4338	15,610	713
52)	Household electric appliances	Household electric appliances	116	149	4	15,902	9848	52
64)	Miscellaneous manu- facturing products	Other souvenirs	19	108	30	1112	2976	182
78)	Railway transport	Railway transport	830	5005	1395	9233	114,795	2170
79)	Road transport	Road transport	1002	4463	1991	11,152	102,378	3097
89)	Education	Entrance fee, participa- tion fees, etc.	1528	7185	1965	15,057	120,249	4346
100)	Eating and drinking places	Eating and drinking places	2124	10,921	3899	42,657	260,753	10,272
101)	Lodging	Lodging	8635	46,029	12,628	48,480	320,441	11,140
Total			14,953	80,853	23,429	183,336	1119,928	40,098

2014 prices adjusted to 2000 values

2014 from 2000 levels. One reason for the higher consumption by Taiwanese visitors than those of the other two nations is the duration of stay. According to the Kyoto City survey data (2015), about 40% of tourists from China and Korea visited Kyoto without staying overnight, while more than 75% of the Taiwanese tourists stayed two or more nights. One of the reasons for the decrease for consumption per visitor among Korean tourists is that Japan is the most accessible destination for foreign travel for Koreans (JTA 2017b): the flight time from Korea to Japan is only approximately 2 h. JTA (2017b) reported based on its analysis that most Korean tourists stay in Japan less than 3 days and that 67% of their visits to Japan in 2016 were revisits. Thus, the increase in the number of Korean tourists actually reflects an increase in the frequency of visits by individual tourists (Korea Culture and Tourism Institute 2017).

A breakdown of the consumption data showed another significant shift. Tourists from China, Taiwan, and Korea spent 58, 57, and 54%, respectively, of their total expenditures on "lodging" in 2000, but only 26, 29, and 28%, respectively, in 2014. In addition, tourists seem to be consuming more in order to enjoy Kyoto. For example, consumption of Japanese cuisine, which is categorized as "eating and drinking" and Japanese sweets, which is categorized as "foods," showed increases among all visitors. Tourists from China spent more on home electronics and cosmetics than those from Korea and Taiwan, while



Korean tourists spent more money on western-style fashions (not kimonos), which were categorized as “textiles.”

#### 4 Repercussion effects of visitor consumption in Kyoto

Table 4 shows a breakdown of the indirect and repercussion effects on production values resulting from consumption by Chinese, Taiwanese, and Korea visitors for the years 2000 and 2014. In this study, the term “indirect effects” indicates the value of production induced by direct effects, and the term “repercussion effects” indicates the summation of direct effects and indirect effects. As the number of visitors from those three nations and economies to Kyoto increased, the repercussion effects of consumption by Chinese and Taiwanese tourists on 2014 production values soared more than 10 times higher than 2000 levels in tandem with consumption. Korean visitor levels were also increase two times larger in 2014 than in 2000. Consumption in Kyoto by visitors from China, Taiwan, and Korea resulted in production values of ¥16 billion in 2000 and ¥176 billion in 2014. The repercussion effects of Chinese, Taiwanese, and Korean visitor consumption on Kyoto production values were only ¥2 billion, ¥11 billion, and ¥3 billion, respectively in 2000, but increased to ¥24 billion, ¥147 billion, and ¥5 billion, respectively, in 2014.

As shown in Table 4 and Fig. 2, “100) Eating and drinking places,” “101) Lodging,” and “89) Education” are industrial sectors which showed relatively large repercussion effects. In both 2000 and 2014, production activities in “75) Finance and insurance,” “74) Commerce,” “76) Real estate agencies and rental services,” “86) Communication,” and “70) Electricity” were indirectly stimulated by consumption by visitors from China, Taiwan, and Korea. In 2014, consumption by visitors from China also indirectly stimulated a large production value in “90) Research,” which accounted for 4% of the total, relative to those from Taiwan (2%) and Korea (2%); this was because tourists from China spent more on home electronics and cosmetics than did those from Korea and Taiwan, as shown in Sect. 3. Although Chinese, Taiwanese, and Korean tourists enjoyed shopping in Kyoto, that activity does not stimulate the production activities of Kyoto’s manufacturing industries. In fact, more than 70% of the total indirect effects induced by visitor consumption were observed in the tertiary industries in both 2000 and 2014 for all three countries and economies. Note that “74) Commerce” and “75) Finance and insurance” accounted for more than 30%. The predominant industries in Kyoto are “74) Commerce,” “75) Finance and insurance,” and “76) Real estate agencies and rental services” and the total production values of those industries are 9, 4, and 7%, respectively. Kyoto Prefecture imports goods and services of “30) Final chemical products” and “52) Household electric appliances” from other Japanese regions in amounts 2.4 times and 1.4 times the total production value, respectively. This implies that visitor consumption in Kyoto for these sectors brings about positive indirect and repercussion effects in other parts of Japan.

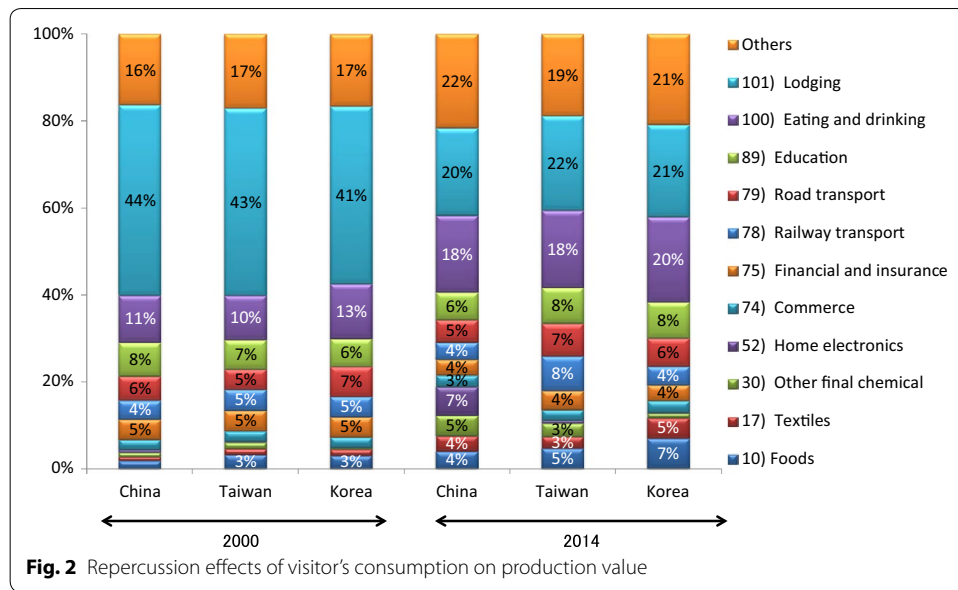
Table 5 shows the repercussion effects of visitor consumption on value added. Both in 2000 and 2014, the value added in “101) Lodging,” “100) Eating and drinking,” and “79) Road transport” are induced by consumption by visitors from China, Korea, and Taiwan. Although “89) Education” also has a large induced value added, that is an over-estimation. As we show in Table 3, the direct effects related to “89) Education” are “Entrance fees, participation fees, etc.” in the Kyoto City survey data used, which are entrance fees

**Table 4 Indirect effects and repercussion effects of visitor's consumption on production value (Unit: 10<sup>5</sup> yen)**

Sector classification	2014											
	2000						2014					
	Indirect effects			Repercussion effects			Indirect effects			Repercussion effects		
	China	Taiwan	Korea	China	Taiwan	Korea	China	Taiwan	Korea	China	Taiwan	Korea
10) Foods	233 (5%)	1296 (5%)	385 (5%)	375	3476	949	2720 (5%)	17,421 (5%)	702 (6%)	9862	70,271	3686
12) Japanese tea	7 (0%)	40 (0%)	12 (0%)	44	302	151	99 (0%)	576 (0%)	27 (0%)	2520	8996	1001
15) Textile products	30 (1%)	247 (1%)	70 (1%)	30	247	70	1335 (2%)	6040 (2%)	362 (3%)	1335	6040	362
17) Wearing apparel and other textile products	28 (1%)	153 (1%)	43 (1%)	174	1495	444	246 (0%)	1489 (0%)	59 (0%)	8585	38,433	2468
30) Final chemical products	15 (0%)	93 (0%)	19 (0%)	195	1622	105	384 (1%)	1742 (0%)	42 (0%)	11,269	46,065	586
38) Pottery, china and earthenware	5 (0%)	27 (0%)	8 (0%)	86	632	134	53 (0%)	302 (0%)	11 (0%)	4391	15,912	724
52) Household electric appliances	1 (0%)	2 (0%)	0 (0%)	117	151	4	88 (0%)	69 (0%)	1 (0%)	15,990	9917	53
67) Repair of construction	166 (3%)	899 (3%)	253 (3%)	166	899	253	1807 (3%)	13,380 (4%)	413 (3%)	1807	13,380	413
70) Electricity	217 (5%)	1197 (5%)	335 (4%)	217	1197	335	2362 (4%)	16,043 (5%)	520 (4%)	2362	16,043	520
73) Water supply	156 (3%)	827 (3%)	238 (3%)	156	827	238	1450 (3%)	9543 (3%)	341 (3%)	1450	9543	341
74) Commerce	472 (10%)	2589 (10%)	762 (10%)	472	2589	762	6394 (11%)	35,848 (10%)	1413 (11%)	6394	35,848	1413
75) Finance and insurance	919 (19%)	5061 (19%)	1429 (19%)	919	5061	1429	8610 (15%)	64,396 (18%)	1934 (16%)	8610	64,396	1934
76) Real estate agencies and rental services	259 (5%)	1391 (5%)	400 (5%)	259	1391	400	2506 (4%)	15,560 (4%)	560 (5%)	2506	15,560	560
78) Railway transport	29 (1%)	156 (1%)	45 (1%)	858	5160	1440	387 (1%)	2289 (1%)	83 (1%)	9620	117,084	2254
79) Road transport	91 (2%)	516 (2%)	148 (2%)	1093	4979	2139	1359 (2%)	7648 (2%)	300 (2%)	12,511	110,026	3396
80) Self-transport by private cars	183 (4%)	994 (4%)	278 (4%)	183	994	278	1649 (3%)	10,279 (3%)	383 (3%)	1649	10,279	383
85) Services relating to transport	143 (3%)	747 (3%)	225 (3%)	143	747	225	1097 (2%)	8238 (2%)	260 (2%)	1097	8238	260
86) Communication	245 (5%)	1315 (5%)	384 (5%)	245	1315	384	2770 (5%)	17,348 (5%)	605 (5%)	2770	17,348	605
89) Education	8 (0%)	48 (0%)	13 (0%)	1536	7232	1979	113 (0%)	822 (0%)	21 (0%)	15,170	121,071	4367
90) Research	54 (1%)	348 (1%)	62 (1%)	54	348	62	2475 (4%)	8370 (2%)	206 (2%)	2475	8370	206
95) Advertising, surveillance and information services	124 (3%)	693 (3%)	190 (3%)	124	693	190	1858 (3%)	9939 (3%)	337 (3%)	1858	9939	337
97) Repair of motor vehicles and machine	157 (3%)	816 (3%)	264 (4%)	157	816	264	1944 (3%)	13,007 (4%)	448 (4%)	1944	13,007	448

**Table 4 continued**

Sector classification	2014											
	2000						2014					
	Indirect effects			Repercussion effects			Indirect effects			Repercussion effects		
	China	Taiwan	Korea	China	Taiwan	Korea	China	Taiwan	Korea	China	Taiwan	Korea
98) Other business services	204 (4%)	1113 (4%)	318 (4%)	204 (4%)	1113 (4%)	318 (4%)	2405 (4%)	15,516 (4%)	533 (4%)	2405 (4%)	15,516 (4%)	533 (4%)
100) Eating and drinking places	0 (0%)	0 (0%)	0 (0%)	2124 (0%)	10,921 (0%)	3899 (0%)	0 (0%)	0 (0%)	0 (0%)	42,657 (0%)	260,753 (0%)	10,272 (0%)
101) Accommodations	0 (0%)	0 (0%)	0 (0%)	8635 (0%)	46,029 (0%)	12,628 (0%)	0 (0%)	0 (0%)	0 (0%)	48,480 (0%)	320,441 (0%)	11,140 (0%)
102) Other personal services	135 (3%)	719 (3%)	201 (3%)	135 (3%)	719 (3%)	201 (3%)	931 (2%)	6088 (2%)	214 (2%)	931 (2%)	6088 (2%)	214 (2%)
Other	873 (18%)	4833 (19%)	1382 (19%)	1005 (19%)	6015 (22%)	1612 (22%)	12,930 (22%)	68,786 (20%)	2611 (21%)	20,661 (21%)	102,104 (21%)	4009 (21%)
Total	4755 (100%)	26,116 (100%)	7464 (100%)	19,708 (100%)	106,970 (100%)	30,893 (100%)	57,975 (100%)	350,741 (100%)	12,387 (100%)	241,310 (100%)	1,470,668 (100%)	52,485 (100%)



**Table 5** Repercussion effects of visitor's consumption on value added (Unit: 10<sup>5</sup> yen)

	2000			2014		
	China	Taiwan	Korea	China	Taiwan	Korea
10) Foods	134	1246	340	3536	25,194	1322
17) Textiles	68	586	174	3368	15,077	968
30) Other final chemical	64	532	34	3696	15,108	192
52) Home electronics	30	39	1	4103	2545	14
74) Commerce	333	1826	537	4510	25,283	997
75) Financial and insurance	648	3570	1008	6073	45,422	1364
78) Railway transport	458	2756	769	5137	62,530	1204
79) Road transport	775	3528	1515	8866	77,966	2407
89) Education	1322	6225	1703	13,056	104,202	3759
100) Eating and drinking	968	4978	1777	19,443	118,850	4682
101) Lodging	4416	23,537	6457	24,790	163,856	5696
Others	1716	9676	2716	26,243	142,508	5445
Total	10,933	58,499	17,032	122,821	798,540	28,048

of museums and other cultural facilities. However, wages accounted for the most of the value added in “89) Education” and most employees for “89) Education” are educators such as teachers and lecturers. For a more accurate estimation of the repercussion effects on “89) Education,” we need to find additional statistics to estimate employees by a more detailed industrial category.

As for negative repercussion effects, such as waste generation and GHG emissions, Table 6 shows the induced amounts of waste treatment by year and by tourist homeland. Here, it can be seen that the repercussion effects on waste treatment are nearly proportional to the direct effects. The total amount of waste to be treated due to consumption by visitors from China, Taiwan, and Korea increased from 2809 tonnes in 2000 to 26,856 tonnes in 2014, of which 34–37% was disposed of landfills.

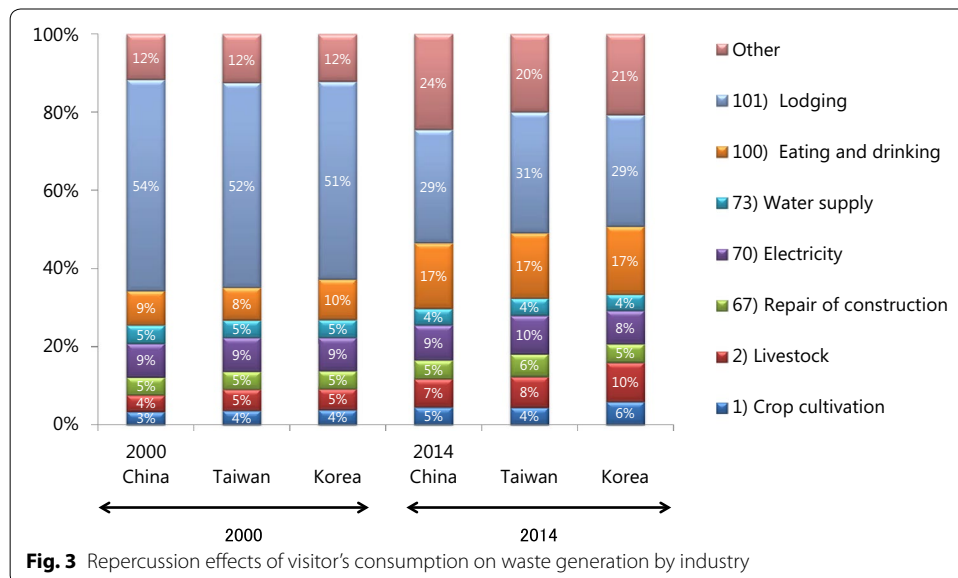
**Table 6 Repercussion effects of visitor consumption on waste to be treated**

Tonnes	2000			2014		
	China	Taiwan	Korea	China	Taiwan	Korea
Incineration	229	1257	360	2255	14,112	551
Landfill	120	658	186	1349	8291	298
Total	349	1915	545	3604	22,403	848

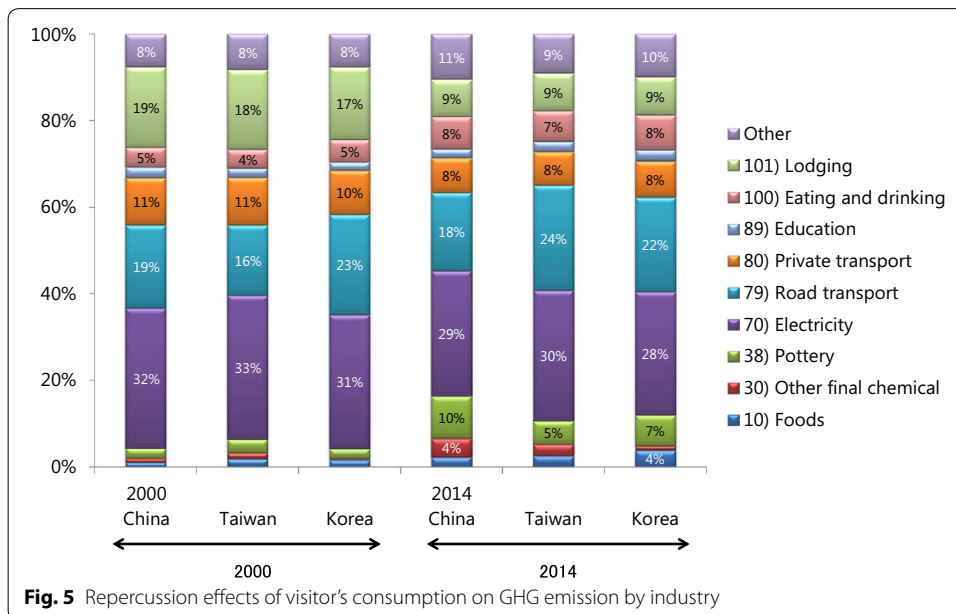
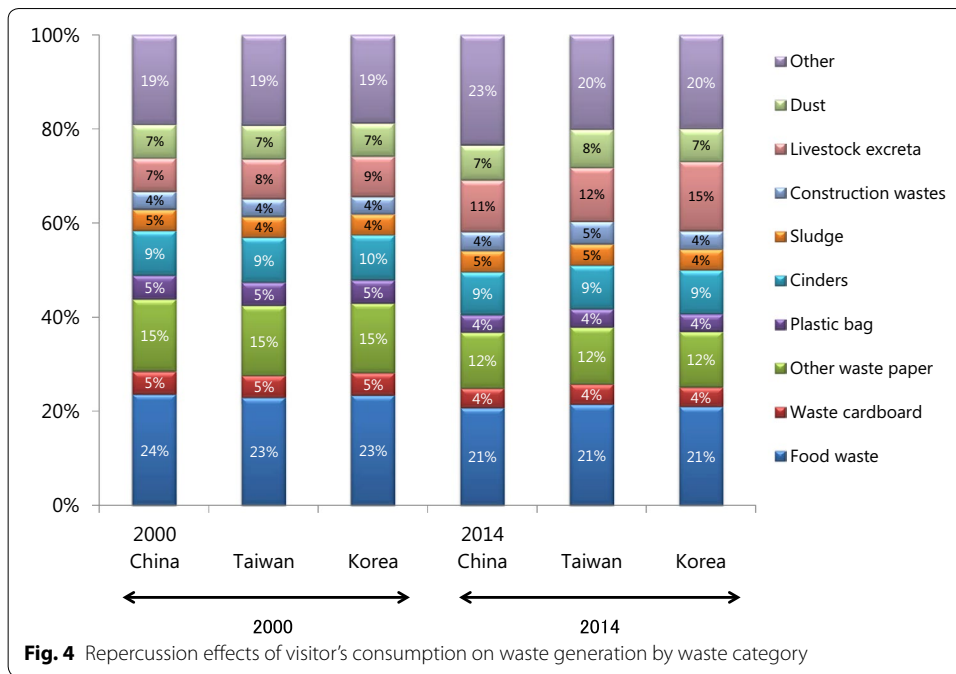
Figure 3 shows a breakdown of induced waste generation by industry. Here, “101) Lodging,” “100) Eating and drinking,” “2) Livestock” and “70) Electricity” consumption induced the most waste generation. Although the repercussion effects on production values in “75) Finance and insurance” and “74) Commerce” are the largest, the waste generation coefficients of these sectors are small, 2 and 7 tonnes/yen. Specifically, these are small relative to those of “101) Lodging” (20 tonnes/yen) and “100) Eating and drinking” (13 tonnes/yen). In Kyoto, the industries which were stimulated by visitor consumption were tertiary industries, which restrained the induced waste generation.

Figure 4 shows the breakdown by waste category. In this figure, the “food waste” shown in the blue bars, “waste paper” shown in the green bars, and “livestock excreta” shown in the pink bars are primarily due to consumption by visitors to Kyoto. “Food waste” and “waste cardboard” were mainly generated from “101) Lodging” and “100) Eating and drinking.” “Dust” and “cinders” were mainly generated from “70) Electricity,” which was stimulated by visitor consumption in “101) Lodging” and “100) Eating and drinking,” and “78) Railway transport.” “Livestock excreta” was generated from “2) Livestock,” which was stimulated by visitor consumption in “10) Foods.”

Figure 5 shows the estimated results of induced GHG emissions. As can be seen in the figure, induced GHG emission increased about 12,000 ton-CO<sub>2</sub> (eq.) in 2000 to about 144,000 ton-CO<sub>2</sub> (eq.) in 2014. These GHG emissions are mainly induced by “70) Electricity” in purple bars, “79) Road transportation,” and “80) Private transportation” shown

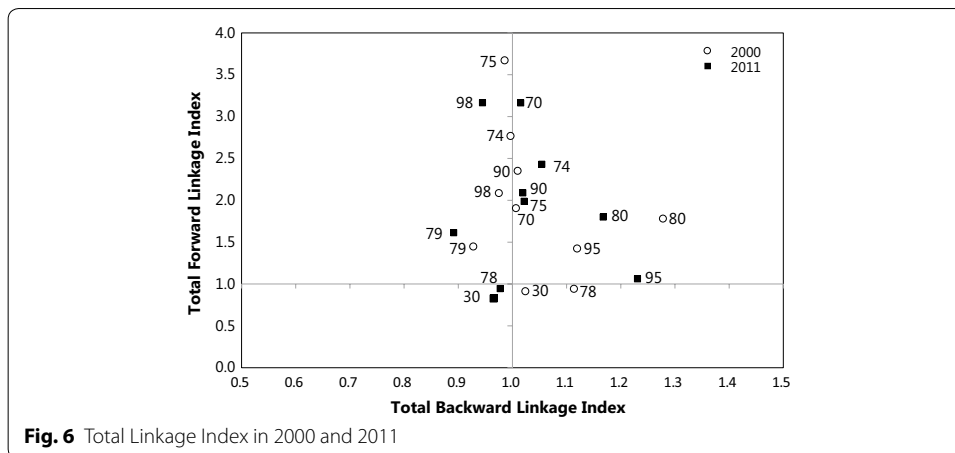


**Fig. 3** Repercussion effects of visitor's consumption on waste generation by industry



in light blue and orange bars, “101) Lodging” shown in light green bars, “100) Eating and drinking,” shown in pink bars, and “38) Pottery” in green bars. Thus, it can be seen that the industries that are most affected by tourist consumption activities all have relatively low GHG emission coefficients.

In this study, we have compared the repercussion effects of visitor consumption in 2000 and 2014 using KWIOT2000. However, there is reason to be concerned that the economic structure in Kyoto might have changed between 2000 and 2014. Figure 6 shows the total backward linkage index and the total forward linkage index in the year 2000 and the



year 2011 (Miller and Blair 2009). As the latest version of the regional input–output tables of Japanese local governments is for 2011, we used the 2011 table to represent the 2014 table. In the figure, the white round dots indicate the total backward linkage index and the total forward linkage index of 2000, and the black square dots indicate those of 2011. The numbers show the industries as listed in Table 4. The figure shows the top 10 industries in terms of relative change in either index between 2000 and 2011. “70) Electricity” changed most drastically because of the Great East Japan Earthquake in 2011. Kyoto previously imported electric power from Fukui Prefecture, which had nuclear power plants. However, due to the shutdown of nuclear power plants after the earthquake, the import rate of electric power decreased drastically from 0.38 to almost zero, and Kyoto began to depend on the Maizuru power plant in Kyoto Prefecture, which used coal for electricity generation (Kansai Electric Power Co., Inc. 2017). This fact implies that the results in Fig. 5 might be underestimated. The change in “75) Finance and insurance” seems to be a temporary effect due to the earthquake. In 2011, many major insurance companies made large insurance payouts to the Tohoku region, but local insurance companies in Kyoto did not need to make such payouts. Although Fig. 6 shows the possibility of a structural change between 2000 and 2011, as 2011 was an extraordinary year, it would be better to utilize the next regional input–output table for Kyoto, which will be for the year 2015 and be published around 2019, and then compile KWIOT2015 to conduct a structural decomposition analysis for clarifying simultaneously the contributions of changes in technology and those in final demand over the period.

## 5 Conclusion

Roughly 14 years have passed since the Japanese government launched the massive Visit Japan Campaign to entice foreign visitors to Japan. In that period, the number of foreign visitors to this nation has increased drastically despite two significant damaging events, the global financial crisis in 2007 and the Great East Japan Earthquake in 2011. Although the Visit Japan Campaign was aimed at increasing visitor consumption as well as the number of foreign visitors, stakeholders, especially local governments, are still focusing primarily on increasing the number of foreign visitors. However, considering the results

in this study, we believe the time has come to contemplate not only the objectives of tourism promotion but also the total effects of tourism itself.

In this paper, which focused on Kyoto City, we showed differences in consumption by comparing Chinese, Taiwanese, and Korean tourism activities. The number of tourists visiting Kyoto from those countries and economies all increased dramatically from 2000 to 2014, which caused increases in the direct and repercussion effects of consumption. However, the results of our analysis show that the increase in visitor consumption was not proportional to the number of visitors. For example, tourists from Taiwan spent three to four times more money than those from China and Korea, primarily because Taiwanese tourists seem to enjoy staying in Kyoto longer than those of the other two countries.

Recently, the face of tourism in Japan has been changing, and the Chinese tourists that had previously enjoyed shopping and were once known for their “explosive” buying habits are now spending less money (Nikkei Asian Review 2016), which means that the consumption levels of Chinese tourists have begun decreasing. To maintain or increase the level of Chinese tourist consumption, tourism promotion efforts will need to be modified to reflect a more Taiwanese style of Japan visitation. This form of tourism promotion has already been launched (JTA 2016b, c, d), but the results of this study imply that the following issues will need to be addressed concurrently.

As stay durations become longer, waste generation and associated GHG emissions will increase as well. To depress the level of waste generation increase and the treatment that accompanies the promotion of tourism, environmental efficiency improvements in the two main industrial sectors related to tourism, “eating and drinking places” and “lodging,” will be crucial.

Additionally, encouraging “food waste,” “waste paper,” and “plastic bag” recycling activities could also prove effective. To depress increases in the GHG emissions that accompany tourism promotion, enhanced efficiency in the “electricity” and “road transport” sectors, including “private transport,” “eating and drinking locations,” and “lodging,” will also be important. Unfortunately, ecological awareness is not high in Japan’s “lodging” industry, and while there have been some attempts aimed at reducing “lodging” waste (Tachibana et al. 2009), few studies have seriously taken up the issue. We hope that the Visit Japan Campaign will be upgraded in the future to more seriously consider ecological aspects.

Another important aspect is the effect of tourism on other parts of Japan. In the previous section, we reported that visitor consumption in Kyoto primarily stimulated the tertiary industries in that city. However, the direct effect results showed that numerous visitors from Taiwan, Korea, and especially China enjoyed shopping in Kyoto. This implies that imported goods from other parts of Japan were purchased by Kyoto visitors, which means that visitor consumption in Kyoto stimulated production activities in other parts of Japan, especially in the manufacturing industries.

Furthermore, as is well known, the waste generation and GHG emission coefficients of the manufacturing industries are higher than those of the tertiary industries. So, it is possible that policies aimed at encouraging inbound tourists can cause increased environmental loads on other parts of Japan. Therefore, since it is important to clarify the interregional relationship between the 47 prefectures in Japan in order to estimate the



repercussion effects of tourism, we would like to conduct an analysis using the WIO table for the entire nation to clarify those relationships, economically and environmentally, in the near future.

#### Abbreviations

GHG: greenhouse gas; JTA: Japan Tourism Agency; JNTO: Japan National Tourism Organization; KWIOT2000: regional WIO table for the year 2000 for Kyoto; NEDO: New Energy and Industrial Technology Development Organization; UNESCO: United Nations Educational, Scientific and Cultural Organization; UNWTO: United Nations World Tourism Organization; WIO: waste input–output; WIOA: WIO analysis; 3EID: Embodied Energy and Emission Intensity Data for Japan Using Input–Output Tables.

#### Authors' contributions

MT was responsible for data collection, performing calculations, and generating the quantitative results. MT and MK interpreted the results and drew the conclusions. Both authors read and approved the final manuscript.

#### Author details

<sup>1</sup> School of Business and Commerce, Tokyo International University, 1-13-1 Matoba-Kita, Kawagoe-shi, Saitama 350-1197, Japan. <sup>2</sup> Division of Natural Resource Economics, Graduate School of Agriculture, Kyoto University, Yoshida-honmachi, Sakyo-ku, Kyoto 606-8501, Japan.

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#### Competing interests

The authors declare that they have no competing interests.

#### Availability of data and materials

The datasets during and/or analyzed during the current study available from the corresponding author on reasonable request.

#### Ethics approval and consent to participate

Not applicable.

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