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Comparing the tourism carbon footprint performance between Taiwan and Japan

Dr. Ya-Yen Sun[1]

Abstract

Purpose of this study is to use the linkage and leakage concepts to measure a destination competitiveness in tourism carbon performance in the bilateral travel context. Using the Environmentally Extended Input-Output Model, the distribution of economic and environmental effects from the inbound tourism receipts in the global value chains can be evaluated. This allows the direct assessment of a country's ability to minimize carbon emissions per dollar GDP in the domestic value chain, and the ability to outsource the high polluting, low economic linkage products abroad. In the example of bilateral travel flow between Taiwan and Japan, both regions secure 70% of the tourism GDP in the global value chains but Japan outsourced 70% of their carbon footprint to foreign production while Taiwan only outsourced about 40%. This analysis allows individual country to identify its weakness in tourism efficiency performance and to seek possible solutions through international trade.

KEYWORDS: Tourism Carbon Footprint, Tourism Linkage, Tourism Leakage, Environmentally Extended Input-Output Model

[1] Associate Professor, Department of Transportation & Communication Management Science, National Cheng Kung University, Taiwan.
yysun@ncku.edu.tw

Introduction

In 2015, over one billion international visits were recorded and each trip involved movements of people, goods, services, and monetary transactions across border. From an economic perspective, each international trip represents an injection of foreign receipts, support local business activities and jobs, and contribute a positive balance of payments for destination countries. Concurrently, for tourist generating regions, each outbound travel also signals a loss of revenue abroad, creating a difficulty to balance the national payments through international trade. As a result, the net inbound travel flow and tourism surpluses in current accounts are frequently used as yardsticks to measure a country's tourism performance (World Tourism Organization, 2016). However, the influences of tourism foreign receipt go much deeper to our systems than these two indicators can convey. These cross-border travel activities function through economic linkages as well as economic leakages, spreading the tourism economic influences and the related carbon emissions beyond the direct-affected tourism industries and the destination itself.

The concept of tourism linkage describes the inter-sectoral relationships between the tourism industries and their suppliers, domestically and internationally. The functions of the tourism services require wide range supports from other firms for providing the intermediate inputs (such as agriculture products, energy or bedding) and services (such as marketing, telecommunication or legal consulting). The linkage of the tourism industry with other economic sectors is perceived to be deep and diverse, creating a strong indirect economic effect in revenue, job and value added for the suppliers, and contributing the diversification of the economic structure (United Nations, 2010). The UN World Tourism Organization (WTO) and World Travel and Tourism Council (WTTC) all recognize the importance of this rippling effect and on every occasion when the significance of the tourism is mentioned both direct and secondary effects are placed side by side. A rich literature to document the indirect influences of tourism development based on individual destinations, events, specific visitor types or tourism crisis has long been established, demonstrating the economic contribution of tourism through linkage effects is well acknowledged.

The same linkage concept also applies when the tourism carbon emission is under consideration. When addressing and calibrating this environmental externality, both energy consumption for the tourism industry directly serving visitors, as well as indirect and induced materials and services are taken into account – presenting a complete picture of a carbon footprint (CF) concept (Gossling, 2000). Such approach reveals the carbon emission responsibility by the tourism industries and their suppliers for the provision of tourism services. Empirical applications of the tourism CF analysis have documented the scale of direct and indirect carbon emissions. Depending on the type of tourist consumption considered, the indirect effect in carbon emissions can match or far exceed the size of direct tourism emissions (Dwyer, Forsyth, Spurr, & Hoque, 2010; Kelly & Williams, 2007; Konan & Chan, 2010; Meng, Xu, Hu, Zhou, & Wang, 2016; Patterson & McDonald, 2004; Sun, 2014; Whittlesea & Owen, 2012).

Tourism leakage on the other hand describes the process where tourism foreign receipts do not reach and stay at the local destination but rather leak out to the tourist-generating region or third countries. International trade is one of the main factors for tourism leakage, as the world moves towards reducing trading barriers, both primary factors - labor and capital, and secondary factors- materials and services, of the current production structure are easily provided by foreign sources. As a result, the leakage phenomenon can occur at the production process of the tourism industries as well as during the supply chain stage. Although global value chains enhance the economic and resource efficiency, it also signals the revenue loss for the individual country due to the imported products and service of the direct and indirect use by the tourism industry cannot be avoided.

While economic leakage generally leads to challenges of revenue retention, the adoption of imported products and services equate to an export of CO_2 for destinations, transferring the carbon emissions, which should have been produced domestically, to foreign countries- referred as carbon leakage. Under the tourism context, this reduces the scale of the tourism carbon footprint and the responsibility of mitigation for the destination by relying on the foreign production. The empirical studies found that the foreign sourced emission plays a critical part in the tourism supply chain. Emissions from imports are estimated to be 17% of the national tourism carbon footprint for Australia (Dwyer et al., 2010), and 25% for Taiwan (Sun, 2014). Such dependence on foreign productions and the resulting carbon leakage is expected to be much significant for small countries and island destinations due to a limited industrialization scale and scarce natural resources.

In sum, linkage and leakage effects reveal a more complete picture of the economic influences and environmental consequences for the tourism development. The linkage effect describes the production patterns, quantifying the interrelationship between tourism industry and suppliers, while the leakage effect explains the trade pattern, differentiating the ultimate benefits or pollution individual region (host nation, origin nation, or third countries) receives.

The linkage and leakage concepts in essence highlight an important truth, which is, no destination can claim 100% of the tourism revenue from the global value chains as the world continues to become globalization. Similarly, no destination holds the full responsibility for their total tourism carbon footprint. In other words, when one destination aims to maximize tourism receipts, other regions receive the spillover of both economic and environmental effects.

Tourism services, especially the international travel, is an energy-intensive product. Per dollar tourism GDP was found to be generated at a higher environmental cost on the GHG emissions than the national average, and a deterioration of tourism carbon efficiency was also documented for some countries (de Bruijn, Dirven, Eijgelaar, & Peeters, 2014; Dwyer et al., 2010; Sun, 2014, 2016). The current tourism carbon footprint literature focuses extensively on examining the relationship between economic consumption and carbon emissions within the destination. Few has attempted to address the role of international trade in the tourism supply chain, and to further explore the possibility of utilizing imports to improve the overall tourism carbon efficiency both domestically and globally. Given the fact that tourism is supported under a global economic system in which countries are closely inter-connected and the design, production, assembly, package, transport, marketing or management are easily sourced from the global value chains, incorporating the component of "international trade" provides a possible channel to facilitate the transition to the green economy (International Institute for Sustainable Development & United Nations Environment Programme, 2014).

Through the lenses of leakage and linkage concepts, this provides a possible channel to improve a national's tourism carbon efficiency while at the minimum cost of revenue leakage. This can be achieved by providing a combination of domestic and foreign-sourced products and services, of which every dollar of foreign tourism receipt would generate the largest amount of gross domestic product (GDP) while minimize the environmental externality that is imposed on a nation. In other words, products and services that carry the largest energy consumption intensities with a minimum economic linkage effect in the domestic supply chain should be outsourced to foreign producers. This creates a local optimization solution as it reduces the scale of regional tourism carbon footprint while lessen the revenue leakage problem in economic output. If these imports are produced with a lower energy intensity comparing to that of the original producing country, a global carbon footprint base can also be relived as these goods and services are produced at a lower cost of environmental pollution. From these perspectives, a destination's comparative advantage in tourism carbon performance can be evaluated based on 1) its ability to minimize carbon emissions per dollar GDP in the domestic value chain, 2) its ability to outsource the high polluting, low economic linkage products abroad, and 3) whether these imports have a lower carbon footprint content than that if these are produced domestically.

The study purpose of this paper is first to provide a tourism evaluation framework to analyse tourism receipts, revenue retention and carbon efficiency from the linkage and leakage perspectives. The model provides a systematic approach to portray the distribution of value added and carbon emissions by the global segments at the home country, origin country, and third countries, in serving inbound tourism. We clarify the economic and environmental linkage and leakage measurements in the tourism context and provide a set of indicators to identify a destination's comparative advantage in carbon emissions.

The second purpose is to apply this framework to the bilateral travel between Taiwan and Japan. Japan and Taiwan are island countries, sharing several commonalities in tourism development. Both destinations reply extensively on aviation services for international travel where aviation is energy intensive and critical for the tourism emissions. Also, both areas experience a fast tourism growth rate annually, and have a high level of bilateral visits each year, over one million visitors from Japan to Taiwan or vice versa. These two areas ranked as one of the fastest growing destinations worldwide where Taiwan embraces an annual growth rate of 23.6% while Japan reports a 29.4% growth rate of international visitors in 2014 (World Tourism Organization, 2015). These factors are critical in tourism carbon footprint measurement, and at the same time, demonstrate that tourism energy use at both regions will be expected to increase substantially. We use this example to give an illustration that market force measurements (such as net inbound travel flow and positive tourism surpluses) share little information regarding the carbon competitiveness of a country, rather, the tourism linkage and leakage patterns provide clear insight to where the national tourism carbon efficiency can be improved.

Evaluation framework

Bilateral tourism

This study builds the analysis based on a bilateral tourism evaluation framework, which involves the outbound travel flow between a pair of countries. In this context, both countries serve as a departure point for their residents travelling abroad and a host country for inbound visits. This symmetrical relationship in tourism receipts outflow for outbound travel and receipts inflow from inbound visits provides a suitable context to analyze their relative comparativeness in tourism carbon efficiency due to following consideration. First, the carbon footprint of an international trip start from the moment when visitors leave their residences for the destination. The complete measurement and mitigation of a trip emission therefore should not be limited to the final destination; rather, the departure country plays a critical role to provide tourism products and services (mainly transportation) right before and after the international trip, and their association with emissions cannot be overlooked. The bilateral framework puts departure and destination countries into the scope simultaneously, not only presenting a complete picture in the carbon footprint but also allowing both regions to collectively seeking solutions in order to reduce the trip emissions. Secondly, two countries with a large volume of mutual travels are typically a close trade pattern to each other, bearing the largest share in value added and carbon emissions in the international trade between two sides. For example, while destination country receives a lion's share of inbound tourism receipts, the indirect economic and environmental impacts will spill over to the departure country through the function of global supply chains. Using the bilateral tourism framework allows us to focus on this two-side trading relationship and describes the economic and environmental consequences for the origin and destination country respectively. Lastly, to assess the comparative advantage in tourism carbon performance of a country requires a clear partner to benchmark. Using the scenario of two countries as a starting point allows us to compare and evaluate the performance of tourism carbon efficiency from the country perspective. Of course, the pair comparison can be expanded and performed for all important inbound markets, allowing the destination to rank its own performance against the individual countries in the further analysis.

Analysis framework

The analysis framework consists of following steps: 1) provide a clear definition on tourism linkage and leakage from the international travel perspective; 2) adopt the top-down approach to calculate tourism linkage and leakage ratio by industries based on the environmentally-extended input-output (EEIO) model; 3) propose a set of indicators regarding the tourism carbon performance.

Step 1 : Definition of tourism linkage and leakage

In the literature on interindustry linkages, backward linkages (BL) is a widely accepted concept to measure the relationship between the directly-affected industry and its upstream suppliers. Although the measurements of BL remain as an important discussion topic, the commonly accepted method is to use the Leontief supply-driven multiplier (LSD) (Cai, Leung, & Mak, 2006), which measures the transaction volume occurred at the upstream suppliers when one industry receives one-dollar demand. The scale of this LSD multiplier depends on the inter-industry relationship for a given economy in terms of how much intermediate input is needed in producing one dollar of final product.

Similar to the concept of tourism linkage, the academic is not agree of the definition and measurement of tourism leakage (Mitchell & Ashley, 2007). In this study, we will adopt the United Nations definition (2010), for which tourism leakage can occur at two stages. Structure leakage occurs when outbound tourism services are provided by domestic business at the country of origin (Figure 1). The structure leakages captures revenue retained by national-registered airlines and domestic travel agencies serving outbound travel customers at the origin place. This leakage pattern is mainly determined by the travel pattern of the local residents in their preferences for choosing national airlines over the consideration of routes availability, price differences, and flight frequency and timing over competitors. It is also a matter of the proportion of travelers who prefer package tours (PT) over free and independent travel (FIT) as PT format requires travel agencies to provide intermediary services (booking and guiding) for a risk-minimization experience for which language, space orientation, and cultural barriers will be assisted. A share of international tourism expenditure will not reach the destination country in this regard.

Economic leakage, on the other hand, occurs due to the limited capacity of local tourism industries at the destination country to provide adequate quantity or proper quality of products for their customers, resulting in an imports of products and services, such as food, bedding or consulting service, etc. In essence, tourism receipts have reach local tourism business to create the direct economic impacts on income, jobs, value added and tax dollar. It is the secondary effect, transactions through the supply chains that may take the revenue out of the local economy as certain inputs and services are imported from either the departure country or the third countries. How big the economic leakage ratio is will dependent on 1) type of products & services that are purchased by inbound visitors, 2) the imported ratio for that respective product and service, and 3) the regional trade pattern between the bilateral countries and rest of world (RoW).

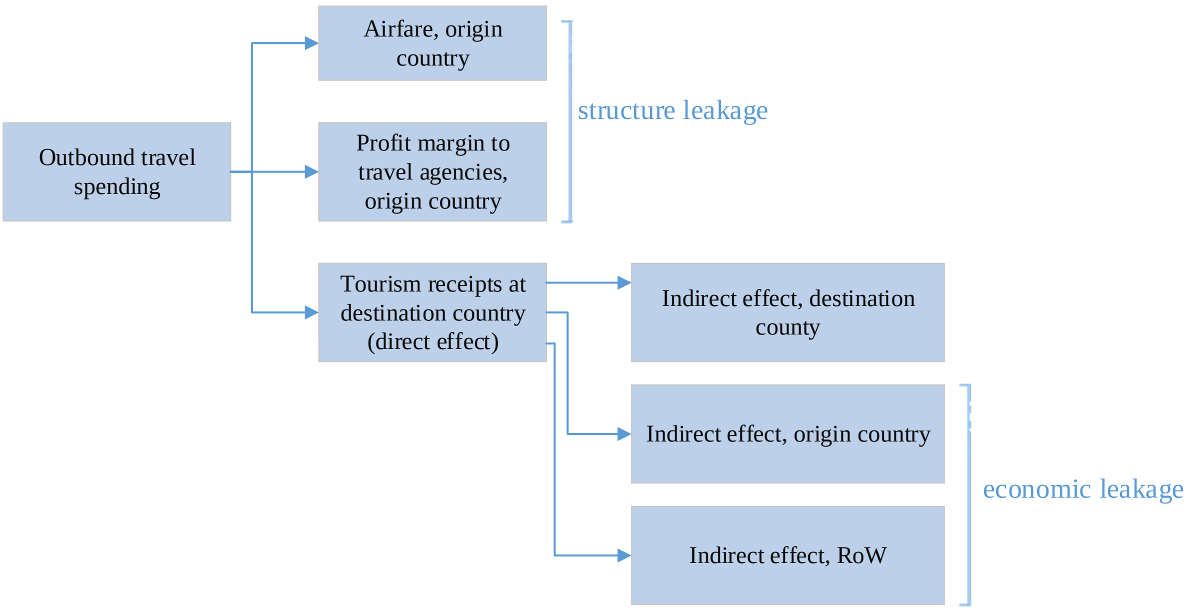

Figure 1. Two types of tourism leakage effect

In the bilateral tourism context (country A and B), both structure leakage and economic leakage create monetary flow to the country of origin and RoW when destination country receive the tourism receipts from the inbound visitors (Figure 2). The process starts with the first-round leakage, as the up-stream transaction may take the revenue away due to the imported intermediate services from the destination country and RoW. This then triggers further up-stream transactions across borders between country of origin, destination country, and RoW, for supplying additional intermediate goods and services for producing the first-round imported products. For example, visitors from country A enjoy the local food at country B, which is produced using sun-dried tomatoes imported from country A and rice from RoW. This then leads to the first-round leakage for a proportion of tourism receipts leaving country B. The production of sun-dried tomato in country A may require the airtight container from country B, and wrapping paper from RoW in order to complete packaging, representing the second round leakage and additional revenue for country B and other regions. In figure 2, a complex international trade pattern is used to describe all cross-border transactions as a result to support the one-way international travel activity. Each international trade signals the inter-industries linkages across countries, and represents a form of leakage as it monetary transactions leave the pre-defined region. These complex trade patterns can be measured both in GDP and GHG, providing a parallel comparison between economic and environmental linkage and leakage.

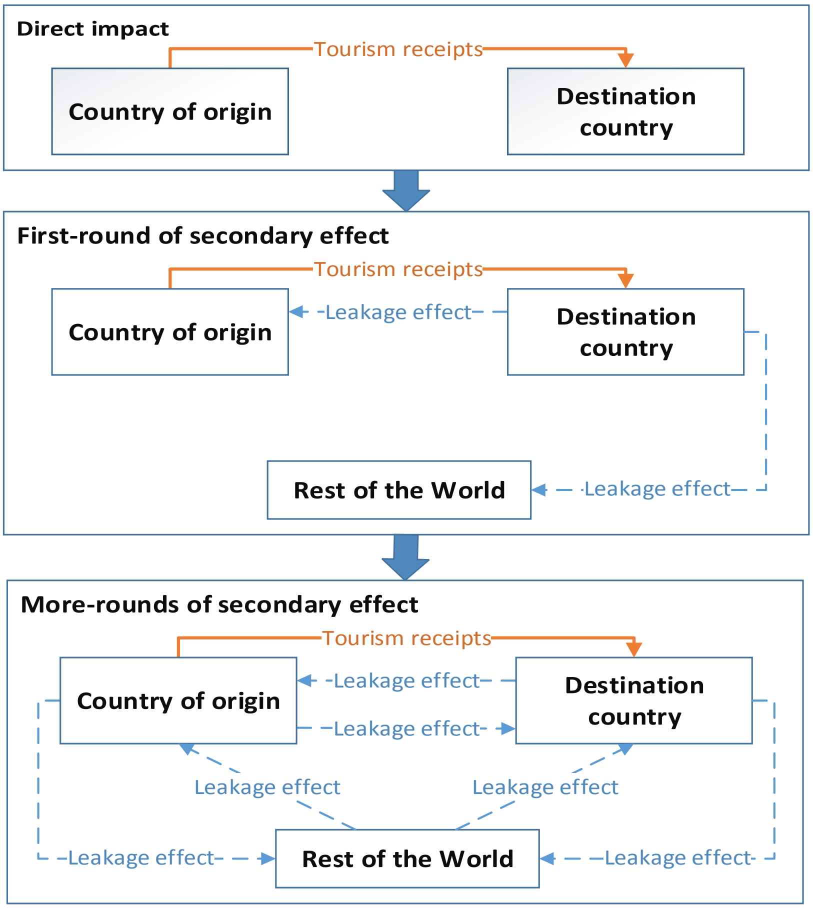

Figure 2. Process of the leakage effect for the international travel between origin, destination and RoW

Step 2: Computation formula

To quantify the effect of tourism linkage and leakage in both economic and environmental index, Environmentally Extended Input-Output Model (EEIO) is perceived as a suitable tool from a macro-level approach which traces the resource consumption and waste production flow from a general equilibrium perspective. EEIO first calibrates the direct economic and environmental effects for industries who directly serving final demand, and then presents the indirect effect, tracing the transactions throughout the supply chains, domestically and internationally, by differentiating the origin of imported products or services. In the case of tourism evaluation, the EEIO provides the GDP and carbon emissions estimates by the tourism characteristic industries at the destinations (the direct effect). The embedded multi-country trade structure further allows EEIO to calibrate the transaction from the suppliers at the destination country, departure country, and RoW (Reis & Rua, 2009).

Under the EEIO model, the direct and indirect GHG emissions are calculated as follows (Miller & Blair, 2009):

Direct value added effect = VAY

Direct GHG effect = CAY

Direct and indirect value added effect = V $(I-A)^{-1}$Y = VBY

Direct and indirect GHG effect = C $(I-A)^{-1}$Y = CBY

Where

V is the value added matrix, the diagonalized value added coefficient per unit monetary output for n industry of m country

C is the GHG emission intensity matrix, the diagonalized CO2 emission coefficient per unit monetary output for n industry of m country

Y is the total amount of final demand change (*a scaler*) = inbound visitor consumption from country Taiwan to Japan, and from Japan to Taiwan, respectively

A is the production technical matrix from the WIOD multiregional IO transaction table

$(I-A_d)^{-1}$ or B is the Leontief inverse matrix from the WIOD multiregional IO transaction table

Step 3: Calculate indicators

In this study, three indicators are presented to compare the comparative advantages of tourism services in a bilateral tourism context. These three indicators are measured from the perspective of a destination country where one's gain is typically a loss for the departure country or vice versa. The first indicator is the structure leakage effect, measuring the proportion of transactions retained at the departure country for the international trip. The larger the ratio represents that the departure country captures the most share in the international transportation and local travel agency margins for the outbound travel. The second indicator, overall leakage effect, measures the proportion of global transactions occurred outside the destination country. This is a proxy to present how much share the local destination receive the global value chain. Both these two indicators can be measured both in GDP and GHG. The last indicator, tourism GHG efficiency gauges the GHG emissions level for supporting one dollar GDP at the destination country for serving the inbound demand from the specified departure country.

Assume the bilateral tourism flow between country A and B, and for country A, three sets of indicators can be defined as flowing. The same measurement can also be developed for country B.

- Structure leakage effect =
$$\frac{\text{Direct trip spending by country B residents at their home country}}{\text{Direct trip spending by country B residents for the visit to country A}}$$

- Overall leakage effect in GDP for country A =
$$\frac{\text{total GDP generated by country B residents outside country A}}{\text{total GDP generated by country B for the visit to country A}}$$

- Overall leakage effect in GHG emission for country A =
$$\frac{\text{total GHG emissions generated by country B residents outside country A}}{\text{total GHG emissions generated by country B for the visit to country A}}$$

- Tourism GHG efficiency for country A =
$$\frac{\text{total GHG emissions generated in country A for serving country B residents travelling to country A}}{\text{total GDP generated in country A by country B residents travelling to country A}}$$

Data

Three types of parameters are used to calculate the indicators: 1) visits and visitor spending profile, differentiated by items and by regions where the money is spent, 2) bilateral flight service by national and foreign airlines, and 3) global multinational input-output table. Both Taiwan and Japan reported detailed inbound visitor spending profiles. Besides the standard spending information on local transportation, lodging, dining, and recreational services, Japan and Taiwan also report shopping information on 10 major categories of items (Japan Tourism Agency, 2015; Taiwan Tourism Bureau, 2012). This rich dataset allows us to identify the economic and environmental linkage pattern for the individual product, such as pastry, t-shirt or electronic appliance, as each production process and energy content is very different. Breaking down the shopping expenditure by items has greatly improved the estimation accuracy.

To calculate structure leakage, travel agency commissions and international airfare are treated separately. For the first perspective, travel agency commission is determined by the number of PT visitors travelling outbound, the average tour fee per person, and the profit margin of travel agencies (Japan Tourism Agency, 2015; Taiwan Tourism Bureau, 2012).

While the profit margin of travel agencies is not disclosed in the public information for both countries, we use the average profit ratio, 10%, reported by the American Society of Travel Agents (ASTA, 2014) to give a ballpark estimate.

To calibrate the airfare retained at the departure country, we obtain total number of the bilateral passengers served by the Taiwan and Japan airlines, respectively, for their mutual visits. This information also portray the flight capacity, flight frequency, routes availability and loading factors of the aviation industry from both-sides (Civil Aeronautics Administration, 2012). Coupled with the average spending on international airfare per passenger, the proportion of airfare that is incurred to national airlines versus foreign airlines can be identified. Whether to include international flight service into the economic and GHG impact estimation has been treated differently in the literature (Sun, 2014). Based on the Kyoto Protocol concept, emissions that are produced outside the defined territory is not included in a country responsibility for mitigation. This concept excludes emissions produced by international aviation and international marine transportation when a country calculates its total annual carbon emission (IPCC, 2006). The same philosophy however will lead to a large error margin of underestimation in the environmental cost as air transportation accounts for more than 40% of total trip emissions on average (WTO-UNEP-WMO, 2008). Considering both Taiwan and Japan are island destinations, international aviation cannot be easily displaced for developing international travel, and their significance in emissions should not be overlooked either. In this regard, economic and environmental impacts for international aviation between two countries are calculated and assigned to countries where the airlines are registered. This approach not only highlights the sheer influence of aviation but also reveals the hidden cost in our travel consumption.

In this study, the World Input-Output Database (WIOD) is adopted as the backbone source to describe the multinational trading pattern. This dataset includes the input-output tables for forty countries and a model for the rest-of-the-world, covering the period from 1995 to 2011 (Timmer, Dietzenbacher, Los, Stehrer, & de Vries, 2015). Besides the monetary transaction, WIOD also supply environmental accounts, documenting energy use, carbon emission, water use, land use and material use. We use year 2011 as the reference year for this study as this is the latest year that is available.

Results

Visitor spending

In 2011, there was around 1.3 million visitors travelling from Japan to Taiwan while 1 million of Taiwan residents have made the visits to Japan. Japanese visitors to Taiwan has spent a total of US$ 2,286 million, of which, 29% is for local lodging expense, 22% for international airfare, 17% for shopping expenses, and 11% for dinning. In contrast, the largest share of Taiwanese trip expenses goes to international air far (30%), followed by shopping (26%), lodging (19%) and dinning (14%). A significant shopping difference was also observed as Japanese visitors highly preferred food products (70% of their shopping expense goes to pastries and Chinese tea) while Taiwanese visitors enjoyed purchasing clothing, cosmetics, electronic appliances and sweets. The overall spending pattern indicates that Japanese visitors preferred to stay at high-quality hotels, pay for entertainment services, and purchase the pastries and Chinese tea in Taiwan while Taiwanese visitors bear more financial burdens on air fares, but are relatively gourmet seekers and more intend to purchase electronic appliances, clothing, shoes, and manga in Japan.

The flight capacity of air transportation between two countries was not equally shared by two-side airlines due to an open-air policy initiated in 2011. In 2011, 54% of the passengers were served by Taiwan-registered airlines, 25% by Japan-based airlines and 21% by the third-country carriers (Civil Aeronautics Administration, 2012). This leads to a proportional high flight revenue to the Taiwan-based airlines than Japanese-based carriers. Revenue to the Taiwan-based airlines is estimated to be US$ 485 million and Japan-based airlines is US$223 million of the two-side service. Third-country carriers, such as Cathay Pacific, United airline, Delta airline and Jet Star, received a total of $293 million.

Due to a higher inbound volume from Japan and their higher spending power in Taiwan, a gross net tourism foreign earning, US$1114 million, was reported for Taiwan in the bilateral tourism context in 2011.

Table 1. Bilateral tourism spending between Japan and Taiwan

Segment	Japan visitors to Taiwan (US$ millions)	%	Taiwan visitors to Japan (US$ millions)	%	Net tourism spending (to Taiwan)
Number of visitors (000's)	1,295		994		301
International airfare	510	22%	391	30%	263
Taiwan airline	274	12%	211	16%	
Japanese airline	126	6%	97	7%	
Other airline[1]	109	5%	84	6%	
Tour commission at departure country	54	2%	34	3%	20
Spending at destination					
Hotel	662	29%	244	19%	417
Restaurant	252	11%	180	14%	71
Transportation	171	7%	85	6%	86
Entertainment	232	10%	32	2%	200
Miscellaneous	29	1%	6	0%	22
Shopping	378	17%	344	26%	34
Food products	267	12%	71	5%	
textiles products	39	2%	131	10%	
manga, DVDs, anime etc.	0	0%	8	1%	
cosmetics, medicine	16	1%	72	5%	
consumer electronics	0	0%	28	2%	
Others	56	2%	33	3%	
Sub total	1,722	75%	891	68%	831
Grand total	2,286	100%	1,316	100%	1,114

[1] This includes Cathay Pacific airline, Delta airline, United airline, and Jetstar.

The economic and environmental impacts of visitor spending to the destination countries are reported in Table 2, differentiated by origin, destination and RoW. From the perspective of Japan travelling to Taiwan, the $2286 million spending has a total economic impacts of $4,463 million in sales, and $2,238 million in value added. Sectors that received the highest value added are “hotels and restaurants”, “entertainment services” and “real estate activities” in Taiwan. Concurrently, Japan receive 426 million in total sales, and 197 million in value added, mainly going to the air transportation and travel agencies. To support the provision of 2286 million of tourism products and services, the tourism industries are estimated to produce 992 kilotons of CO_2 or 1597 kilotons of CO_2 globally if emissions from the suppliers are taken into account. Around 59% of the total carbons are emitted in Taiwan, for which, sectors that are responsible for the largest carbon emission are “air transportation” (19%), “hotels and restaurants”(10%), and “entertainment services” (8%).

Table 2. Economic and environmental impacts of the bilateral tourism travel between Japan and Taiwan

	Direct spending (US$ millions)	Total sales (US$ millions)	Total VA (US$ millions)	Direct CO_2 (Kilotons)	Total CO_2 (Kilotons)
Japan visitors to Taiwan					
origin	191	450	208	79	114
destination	1,996	2,934	1,571	759	943
RoW	98	1,080	459	154	540
total	2,286	4,463	2,238	992	1,597
Taiwan visitors to Japan					
origin	245	360	140	238	279
destination	996	1,902	914	117	250
RoW	75	589	246	154	337
total	1,316	2,851	1,300	509	866

The inbound visitors from Taiwan to Japan generated $2851 million of total sales and $1300 million of value added. The top three sectors that benefited the most on value added are “hotels and restaurants” and “retail trade” in Japan, and “air transportation” in Taiwan. This reflects the fact that over half of the flight capacity is served by Taiwan-based carriers, therefore securing a higher proportion of Taiwan outbound visitors spending at the home country. To support the travel services consumed by Japan visitors, a total effect of 866 kilotons of carbon emissions is produced, of which 279 kilotons is produced in the territory of Taiwan, 250 kilotons in Japan and 337 kilotons in RoW. Sectors that produced the most carbon emissions are “air transportation” in Taiwan, “air transportation” in China and “air transportation” in Japan. This result indicates the dominances of air services by carriers from Taiwan and China (Cathay Pacific airline) for serving the route, and the high carbon intensity nature for their air services in delivering one-dollar output.

The development of the two-side travel activities of Japan and Taiwan also benefit other regions economically. In total, RoW receive the $1688 million of sales and $704 million of value added. The top three countries that received the highest value added are US, China and Australia, who have close trade relationships with Taiwan and Japan. These countries are benefited by supplying intermediary products and services, especially agricultural and dairy products, and mining and quarrying products. The value added generated at RoW are found to be higher than country of origin, indicating a stronger economic leakage effect than the structure leakage effect. Of course, this bears an environmental cost on carbon emissions, as the total effect of carbon emission at RoW is estimated to be 877 kilotons.

Using information in Table 3, leakage ratios can be calculated and discussed from the perspectives of destinations. For Taiwan, the structure leakage of inbound Japan visitors is around 13%, of which 8% stays in Japan and 4% to RoW. This is a relatively good performance if comparing to the 24% structure leakage for Japan, of which 19% to Taiwan and 6% to RoW. The difference is a result primary from the flight capacity between two sides. In 2011, over half of the two-side passenger flows is served by Taiwan-based airlines, and only a quarter of the service is by Japan-based carriers. This leads to a higher structure leakage ratio for Japanese outbound travel.

Table 3. Leakage results for the bilateral tourism travel between Japan and Taiwan

For destination	Taiwan (JP visitors travelling to TW)	Japan (TW visitors travelling to JP)
Structure leakage of direct trip spending	13%	24%
to origin country	8%	19%
to RoW	4%	6%
Overall leakage		
GDP	30%	30%
to origin country	9%	11%
to RoW	21%	19%
CO_2	41%	71%
to origin country	7%	31%
to RoW	34%	39%

The overall leakage, measured by the global transactions that occurred outside the destination country, is estimated in GDP and carbon emissions. Both Japan and Taiwan face 30% of GDP leakage through the value chains of tourism services, approximately 10% of GDP flowing back to the origin country while 20% going to RoW. Although the economic performance is similar, the environmental leakage pattern is quite different for these two destinations. In terms of GHG emissions, Taiwan reports a 41% carbon leakage in total tourism carbon footprint, of which 7% is emitted in Japan and 34% at RoW (the top three countries: China, USA, and Russia). In other words, Taiwan is holding the responsibility for 59% of the total carbon footprint for the inbound visits from Japan. In contrast, 71% of the total carbon footprint from the Taiwan visitors to Japan are emitted outside the destination, of which 31% is categorized to Taiwan, and 39% to RoW (the top three countries: China, USA, and Russia). In other words, Japan secured 70% of the GDP but only holds responsibility for 29% of the total carbon footprint for the inbound visits from Taiwan. This has clearly demonstrated Japan's advantage over Taiwan in delivering the travel service, as it has the same capacity to retain revenue and value added while allowing most energy-intensive products and services to be imported, reducing this destination's burden in carbon emissions.

Last, we present the carbon efficiency performance for the bilateral tourism travel between Japan and Taiwan, respectively. To serve the outbound travel of Japanese visitors to Taiwan, the origin country (Japan) generates 0.55 kg CO2 to deliver one dollar GDP output; Taiwan also has an excellent carbon performance, reporting 0.6 kg CO2 per GDP, leaving the energy-intensive products and services to foreign productions (RoW). In a parallel analysis, when Taiwan visitors to Japan, the destination itself (Japan) produces the products and services at the least environmental cost (0.27 kg /GDP), leaving the high polluting air transportation to Taiwan and other country. As a result, the largest carbon inefficiency is reported for Taiwan (origin) costing about 1.99 kg CO2 to generate one dollar GDP, followed by RoW, 1.37 kg/GDP.

Table 4. Carbon efficiency for the bilateral tourism travel between Japan and Taiwan

	Direct spending (US$ millions)	Total CO_2/ Total VA (kg/US$ GDP dollar)
Japan visitors to Taiwan		
Origin	191	0.55
Destination	1,996	0.60
Third-country	98	1.18
Taiwan visitors to Japan		
Origin	245	1.99
Destination	996	0.27
Third-country	75	1.37

Table 1 and 4 provide a clear contrast to judge who is the major beneficiary in the bilateral tourism development context. Table 1 documents the sheer scale of economic spending and the net balance of payments, which seems like Taiwan is the winner as it receives the dominant share of inbound visits, receipts, and even air transport capacity. However, when the leakage and linkage effects, both in economic and environmental impacts, enter the picture, Japan has surpassed Taiwan in terms of its ability to produce a clean and carbon efficient services in domestic production lines as well as to rely on foreign suppliers for energy-intensive products and services (including air transportation). In this regard, Japan has a clear winning comparative advantage in its destination production structure, which minimize the carbon emissions while maintain a good share of local economic revenue on their tourism services.

Conclusion

Developing international tourism is recommended by UNEP as one way to enhance a country's performance in mitigating carbon emissions while maintain the economic output and prosperity of a country (International Institute for Sustainable Development & United Nations Environment Programme, 2014). This paper aims to build on this concept but to pinpoint the relative tourism carbon performance can be further evaluated and bench-marked using the concepts of tourism linkage and leakage. Analyzing the distribution of GDP and emissions in the global value chain for its pursue of inbound tourism, a country's comparative advantage can be judged based on its ability to minimize carbon emissions per dollar GDP in the domestic value chain, and its ability to outsource the high polluting, low economic linkage products abroad.

In the example of Japan and Taiwan, Japan clearly outperformed Taiwan as it secures 70% of the tourism GDP in the global value chain and outsourced 70% of their carbon footprint to foreign production. Taiwan, in contrast, secured 70% of the tourism GDP but only outsourced 40% of the carbon emissions. Although Taiwan receives net inbound travel flow and positive tourism surpluses in this bilateral travel flow to Japan, using the linkage and leakage concepts demonstrate Japan is the one with a comparative advantage in balancing economic and environmental consequences.

References

ASTA. (2014). *Making tough business decisions: indispensable research for measuring travel agency success*. Alexandria, VA, US: American Society of Travel Agents.

Cai, J., Leung, P., & Mak, J. (2006). Tourism's forward and backward linkages. *Journal of Travel Research, 45*(1), 36-52.

Civil Aeronautics Administration. (2012). *Annual Report of Civil Aeronautics*. Retrieved from Taipei, Taiwan:

de Bruijn, K., Dirven, R., Eijgelaar, E., & Peeters, P. (2014). *Travelling large in 2013: The carbon footprint of Dutch holidaymakers in 2013 and the development since 2002*. Breda, Netherlands: NHTV Breda University of Applied Sciences.

Dwyer, L., Forsyth, P., Spurr, R., & Hoque, S. (2010). Estimating the carbon footprint of Australian tourism. *Journal of Sustainable Tourism*, *18*(3), 355-376.

Gossling, S. (2000). Sustainable tourism development in developing countries: Some aspects of energy use. *Journal of Sustainable Tourism, 8*(5), 410 - 425.

International Institute for Sustainable Development & United Nations Environment Programme. (2014). *Trade and Green Economy: A Handbook*. Retrieved from Geneva:

IPCC. (2006). *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. IGES, Japan: The Intergovernmental Panel on Climate Change.

Japan Tourism Agency. (2015). Consumption Trend Survey for Foreigners Visiting Japan. Retrieved from http://www.mlit.go.jp/kankocho/en/siryou/toukei/syouhityousa.html

Kelly, J., & Williams, P. W. (2007). Modelling tourism destination energy consumption and greenhouse gas emissions: Whistler, British Columbia, Canada. *Journal of Sustainable Tourism, 15*(1), 67 - 90.

Konan, D. E., & Chan, H. L. (2010). Greenhouse gas emissions in Hawaii: Household and visitor expenditure analysis. *Energy Economics, 32*(1), 210-219.

Meng, W., Xu, L., Hu, B., Zhou, J., & Wang, Z. (2016). Quantifying direct and indirect carbon dioxide emissions of the Chinese tourism industry. *Journal of Cleaner Production*.

Miller, R. E., & Blair, P. D. (2009). *Input-output analysis: Foundations and extensions*. Cambridge, UK: Cambridge University Press.

Mitchell, J., & Ashley, C. (2007). Leakage'claims: muddled thinking and bad for policy. *ODI Opinion, 81*(1), 1-2.

Patterson, M., & McDonald, G. (2004). *How clean and green is New Zealand tourism? Lifecycle and Future Environmental Impacts*. Retrieved from Lincoln, NZ:

Reis, H., & Rua, A. (2009). An Input–Output Analysis: Linkages versus Leakages. *International Economic Journal, 23*(4), 527-544.

Sun, Y.-Y. (2014). A framework to account for the tourism carbon footprint at island

destinations. *Tourism Management, 45*, 16-27.
Sun, Y.-Y. (2016). Decomposition of tourism greenhouse gas emissions: Revealing the dynamics between tourism economic growth, technological efficiency, and carbon emissions. *Tourism Management, 55*, 326-336.
Taiwan Tourism Bureau. (2012). Annual Survey Report on Visitors Expenditure and Trends in Taiwan. Retrieved from http://admin.taiwan.net.tw/english/statistics/File/200912/98citizen.pdf
Timmer, M. P., Dietzenbacher, E., Los, B., Stehrer, R., & de Vries, G. J. (2015). An Illustrated User Guide to the World Input–Output Database: the Case of Global Automotive Production. *Review of International Economics, 23*(3), 575-605.
United Nations. (2010). *The contribution of tourism to trade and development*. Paper presented at the United Nations Conference on Trade and Development, Geneva.
Whittlesea, E. R., & Owen, A. (2012). Towards a low carbon future – the development and application of REAP Tourism, a destination footprint and scenario tool. *Journal of Sustainable Tourism, 20*(6), 845-865.
World Tourism Organization. (2015). *UNWTO Tourism Highlights, 2015 Edition*. Madrid, Spain: UNWTO.
World Tourism Organization. (2016). *Compendium of Tourism Statistics, Data 2010 – 2014, 2016 Edition*: World Tourism Organization,.
WTO-UNEP-WMO. (2008). *Climate Change and Tourism: Responding to Global Challenges*. Retrieved from Spain: