Economic Impacts of Transport & Tourism in New Zealand
An Input-output Multipliers Approach[1]

Tantri Tantirigama
Ministry of Transport
t.tantirigama@transport.govt.nz
&
Mei Taniguchi-Singh
Ministry of Tourism
Mei.Taniguchi-Singh@tourism.govt.nz

(The paper to be presented at NZAE conference 2009)

Abstract

Most of the applications of the supply-use tables to date have been to highlight inter-industry flows and to estimate the main aggregate national accounts, such as GDP, gross output and final demand categories. However, industry-wise multipliers have hardly been explored as yet in New Zealand context. Some sectors, like transport and tourism, have particularly significant roles and their economic impacts can be quantified using these tables. This experimental study utilises the supply-use tables to compile an inter-industry transaction table and Leontief matrix, and then to derive industry-wise Type I and Type II multipliers for the transport and tourism industries. Type I multiplier takes into account the direct and indirect effects. Type II multiplier is able to capture, in addition to direct and indirect effects, the effects of expenditure by employees (induced effects). Supply–use tables for 2003 relating to 85 industries were sourced from Statistics New Zealand. We have been able to derive Type I and Type II multiplier coefficients in respect of all important transport and tourism-related industries. The study revealed Type I multiplier coefficient of 2.30 and Type II multiplier coefficient of 4.73 when all transport industries are added together. Multiplier coefficients for tourism industries all added together are 2.15 and 4.56 for Type I and Type II respectively.

---

[1] The views expressed in this paper are those of the authors and do not necessarily reflect the views of the New Zealand Ministry of Transport or Ministry of Tourism.
The authors would like to express their sincere thanks to Joanne Leung, Michael Bealing, Ian Duncan, Neil Hay, Freya Hill, Mike Chan, Claire Maslin and Mondher Sahli for their valuable comments.

Keywords: Economic Impacts, Supply-Use Tables, Type I and Type II multipliers
JEL Codes: C67, D57, L91

1. Introduction

Input-output analysis is one of the most useful techniques to measure economic impacts, with the most important advantage being the ability to numerically measure indirect and induced impacts. In most economic analysis these are discussed in descriptive or in qualitative terms. This technique was first introduced by Wasily Leontief (1905-1999) and now the technique has been developed into many branches. The existence of multiplier effects was initially proposed by early 20th century economists such as Ralph George Hawtrey and Richard Kahn (cited in Lütkepohl 2008). It is particularly associated with Keynesian economics. It is defined as the change in equilibrium GDP divided by the change in capital stock[2] (-the change is the investment) (Baumol & Blinder 2003). The multiplier effect has been used as an argument for the efficacy of government spending or taxation relief to stimulate aggregate demand. One of the best known results of input-output analysis is its ability to derive multipliers using supply and use sides of the

[2] The basic formula for the economic multiplier, in macroeconomics is $\frac{\triangle Y}{\triangle K} = \frac{\triangle Y}{I}$, where ΔY is change in equilibrium GDP and ΔK is change in capital stock (gross fixed capital formation – I). For example, consider a $100 million increase in business investment. This will set off a chain reaction of increases in expenditures. Those who produce the capital goods that are ultimately purchased will experience an increase in their incomes. If they in turn, collectively spend about 60% of that additional income, then $60m will be added to the incomes of others. At this point, total income has grown by ($100m + (0.6 x $100m)=$160m. The sum will continue to increase as the producers of the additional goods and services realise an increase in their incomes, of which they in turn spend 60% on even more goods and services. The increase in total income will then be ($100m + (0.6 x $100m) + (0.6 x $60m) =$196m. The process can continue indefinitely. The size of the multiplier effect depends on the Marginal Propensity to Consume (MPC). The higher the MPC, the larger the multiplier. For example, if MPC is equal to 0.6 (as in our example), then the multiplier can be calculated as: Multiplier = 1 / (1 – MPC) = 1 / (1 – 0.6) = 2.5. In other words, if the increase in spending (first round of stimulus) is $100m then the total increase in income given a multiplier coefficient of 2.5 is: 2.5x$100=$250m.

national accounts. Supply and use sides are measured using internationally accepted principles which are known as System of National Accounts - SNA93 (UN 1993). Therefore, multipliers derived using input-output analysis are consistent with SNA93.

Various attempts have been aimed to measure the economic impacts of the transport and tourism industries. Tourism Satellite Account (TSA) is an internationally accepted technique to measure economic impacts of tourism. The TSA for New Zealand is compiled by Statistics New Zealand and sponsored by the Ministry of Tourism. New Zealand's TSA presents total direct tourism output as the summation of the direct tourism value added and the intermediate consumption. The intermediate consumption is treated as the indirect tourism value added and intended to give an indication of indirect effects of tourism[3] (Statistics New Zealand 2008). Satellite accounts methodology can be applied to measure direct economic impacts of any sub-sector, but so far it has not been applied to the transport sector. Transport and tourism sectors are very much inter-linked. Tourism is also known as "travel and tourism" and has a significant transport component. In the national accounts, transport services are classified under eight main industries: (i) road passenger, (ii) road freight, (iii) rail passenger, (iv) rail freight, (v) water passenger, (vi) water freight, (vii) air passenger, and (viii) air freight. Travel and tourism is an activity that uses a combination of passenger transport services and other services such as accommodation, meal, recreation & shopping.

In aggregate terms, transport industries (including storage)[4] have been contributing on average 5 percent of GDP during the last three decades

[3] Using the national accounting terminology i.e. gross output=Intermediate consumption + value added, indirect tourism value added is derived as: Indirect tourism value added (=intermediate consumption)=gross output-direct tourism value added. Indirect tourism value added gives and indication of indirect effects. As this represents only the first round of the intermediate consumption, it fails to capture the full indirect effects of tourism expenditure.

[4] Storage is mainly included in "Services to transport" category. Please see Annex A for sub-divisions of Services to transport. As shown in the supply-use tables for 2003, share of Services to transport in all transport industries is approximately 30% (39% of Value added & 27% of Gross output).

	Value Added (NZ$ mil)	Gross output (NZ$ mil)	Value Added (%)	Gross output (%)

(Statistics NZ 2009a). The amount of value added measured in nominal terms was NZ $ 6.3 billions for the year ended March 2005. This was about a 45 percent increase during the ten year period between 1995 and 2005. Average annual growth of transport GDP has shown a noticeable 6 percent increase during the period 2001 to 2005. The increase during the period from 1996 to 2000 was 2 percent.

Similarly, contribution of tourism industries was 5.1 per cent of GDP in 2005 (Statistics NZ 2006). The amount of value added (in nominal terms) was $7.1 billion for the year ended March 2005. Published GDP data on transport and tourism take only the direct contribution and it would be much higher if indirect and induced effects are included. Our aim was to calculate total economic impacts of transport and tourism on the New Zealand economy using the input-output multiplier analysis. Our focus was to derive Type I multipliers and Type II multipliers for transport and tourism industries. Type I multipliers measure change in output due to change in final demand. This is the ratio between the change in gross output and the change in final demand. For example, if $ 1 additional demand for transport services generates $ 2 additional gross industrial output then the Type I multiplier relating to the transport sector is equal to 2. In other words, if the Type I transport multiplier is 2, then for each $ 1 additional demand for transport services would generate $ 2 worth of additional gross output within the economy. The important thing here is the addition to gross output is not only within the transport sector but among all other sectors that supply inputs to provide transport services. Type I multiplier takes into consideration all these direct and indirect effects generated due to first round of spending. Type II multiplier on the other hand takes into account, in addition to direct and indirect effects,

Road passenger transport	276	625	6%	5%
Rail transport	127	473	3%	4%
Water and air transport	1,064	4,465	21%	35%
Services to transport	1,954	3,441	39%	27%
Road freight transport	1,540	3,681	31%	29%
All transport	4,960	12,687	100%	100%

the extra activities generated within the economy through the expenditure made by employees in a particular sector. For example, income received by employees in the transport sector is being used to purchase goods and services that in turn generate extra economic activities because of the attempts by other industries to make those goods and services available in the market. Economic impacts generated due to employee income are called “induced effects”. Type II multipliers takes into consideration these induced impacts in addition to effects measured by Type I multipliers. If Type I multiplier is 2 and Type II multiplier is 5, then the value of induced effects is 3. Calculation of Type I and Type II multipliers within input-output analysis requires series of iterative procedures that utilise supply-use tables as the starting point.

The objective of the present paper is to describe the use of Type I and Type II multipliers to measure direct, indirect and induced effects of the transport and tourism industries in New Zealand. The paper also highlights the important steps involved in deriving Type I and Type II multipliers from supply- use tables. These include the calculation of inter-industry transaction table and the Leontief matrix. The most recently updated supply-use tables measured in basic price are available for the years 2003 in aggregated level with 85 industries and 61 products (Statistics New Zealand 2009b). The reference year has been 2003 means the multiplier coefficients need to be updated when more recent supply-use tables become available.

The paper is divided into six sections. The next section includes a brief survey of literature that is followed by section 3 which discusses the methodology. Section 4 presents the results and analysis. Limitations of the study are discussed in section 5, followed by summary and conclusions in section 6.

2. Literature survey

Input-output analysis has become a major tool to seek answers to a variety of questions such as: Which industries are more competitive? What are the multiplier effects of an investment program? How do environmental restrictions impact on prices? National accounting and how to resolve issues such as the choice of technique, the comparative advantage of a national economy, its efficiency and dynamic performance (Thijs 2006). However, application of input-output analysis to measure economic impacts for the transport and tourism industries has been limited.

There are a few versions of multipliers which are used to describe different economic impacts (Krumme 2009). Brief descriptions of three popular versions are given below.

(a) Output multipliers

Output multiplier for an industry is expressed as the ratio of output changes to a unit increase in final demand.

(b) Employment multipliers

The employment multiplier expresses an estimate of the total employment attributable to the stimulus per job or man-year of employment directly created.

(c) Income multipliers

These measure the change in income (wages, salaries, and profits etc.) which occurs throughout the economy as a result of a change in final demand.

The present paper is dealing only with output multipliers.

We have attempted below to highlight some of the studies that have used input-output analysis and multipliers to investigate economic impacts in transport and tourism.

Diekmann (2002) used input-output tables to analyse the use of energy for transport purposes in Germany. He calculated energy requirements of transport-related final demand by means of the Leontief-inverse linked to the energy data. He found that the energy requirements of transport-related final demand have actually grown faster than the energy consumption by transport as an industry. According to Diekmann, the cause for this lies in the disproportionate growth in transport-related exports. In choosing techniques to assess economic impacts of transportation projects Weisbrod and Weisbrod (1997) have suggested input-output multiplier analysis as one of the recommended techniques. They have shown output multiplier coefficients (Type I) for transport services of 2.4 and 1.8 for larger and smaller state respectively. Oosterhaven and Stelder (2000) on the other hand looked at the importance of the transport and distribution sector for the regional and the national economy. Their view was that to answer such a question the literature often takes refuge in (regional) input-output analysis in order to estimate the economic impacts of the sector at hand. Their paper produced such estimates for the Dutch transportation sector by using new bi-regional input-output data for the northern part of the Netherlands versus the whole of the Netherlands. They calculated the Type I regional multiplier coefficients of 1.48, 1.49, 1.41 and 2.00 and National multiplier coefficients of 1.76, 1.80, 1.74, and 2.52 for Public transport, Road freight transport, Air/sea/inland shipping and other transports respectively. Azzoni and Guilhoto (n.d) used a Leontief-Miyazawa model to measure the income distribution effects of changes in the modal composition of cargo transport in Brazil. The results showed that the relative impacts are small, considering the size of the Brazilian economy and the small importance of the transport sector. They found that an increases in the share of rail or water transport increases GDP and personal income, but reduces employment. Furthermore, they also found that an increases in the share of rail transport had more positive effects on personal income and income distribution than in increases in the share of water transport. A change to water transport has resulted in a larger GDP change and a smaller number of jobs lost in comparison to a change to rail transport in Brazil.

With regard to the tourism industry, there are more studies that applied input-output analysis to measure economic impacts. Studies by Lee and Taylor (2005); Chhabra et al (2003); Gelen (2003); Archer and Fletcher (1996); and Johnson (1993) are some of such examples. According to Fletcher (1989), the input-output analysis has been widely used in tourism economic impacts studies as it is more comprehensive in providing a holistic picture of economic structure. As stated in Archer (1977), the main goal of a majority of tourism research is to measure the economic impacts of tourism on a region or country, and the income/expenditure multiplier is one of the most commonly applied approaches. Early reviews of the literature on the tourism multiplier include those conducted by Archer (1977) and Bryden (1973). In both cases, output multipliers for tourism were derived to compare the hotel visitor expenditure multiplier with the general tourism multiplier.

Fletcher and Archer (1991) also analysed the concept of the multiplier and its use in tourism research. They also outlined the concept and historical background of the multiplier. Both the methodology of *ad hoc* models and input-output analysis were examined. Wen and Tisdell (2001) used input-output table for the year 1990 for Chinese province of Yunnan. Their study found that the tourism industry has high multipliers and high linkage effects in Yunnan. They also concluded that the industry has great potentials to improve economic growth.

TSA prepared for Fiji Islands also included multiplier analysis (Department of Tourism 2006). The analysis revealed the output multiplier coefficients of 1.7 and 2.97 for Type I and Type II effects respectively for total tourism sector. The highest multipliers were for the tourist goods industry with a Type I and Type II multiplier coefficients of 1.94 and 3.05 respectively. The reason behind having highest multiplier for tourist goods is its high percentage of local inputs and its high involvement of local population in production of tourist goods such as handicrafts.

In terms of methodology, West and Gamage (2001) used a modified, non-linear, input-output model to assess the economic impacts of tourism in the State of Victoria in Australia. This study demonstrated that in gross terms day-trippers contributed the greatest amount to gross state product and employment, followed by interstate, and least of all, international visitors. However, if substitution expenditure effects by residents are taken into account, their analysis showed interstate tourism contributed the greatest amount to gross state product and employment, followed by international visitors.

Frechtling and Horvath (1999) used the U.S. Department of Commerce Regional Input-Output Modelling System II (RIMS II) to model the economic impact of tourism on the Washington D.C. economy. The study identified that the use of direct-effect multipliers is more appropriate than final-demand multipliers. The study concluded that the tourism sector generated normal earnings levels, but employment multipliers higher than three-quarters of other local industries. Their magnitudes suggest that the tourism sector is more highly linked to local suppliers than the average industry or that it employees tend to spend more of their earnings locally, or a combination of both. The multipliers for Washington D.C. were relatively low compared to other U.S. cities. This makes sense given the small geographic size of Washington D.C., which is situated in a highly integrated metropolitan area where there are many earning and employment leakages.

3. Methodology

(i) The theoretical model

We start from income expenditure equality given by expression 1[5].

$E=C+I+G+X-M$ (1)

Where E= expenditure measure of Gross Domestic Product (GDP); C=consumption; I=Investment; G=Government expenditure; X=Exports & M=Imports.

Right-hand side of expression 1 shows the components of final demand as C=Household consumption expenditure; I=Gross Fixed Capital Formation (*GFKF*). The definitions of G, X, & M remain the same. Re-writing the expression 1 with above definitions, we get:

$E=GDP=C+I+G+X-M$ (2)

---

[5] The expression 1 is the expenditure measure of GDP. It focuses on finding the total output of a nation by finding the total amount of money spent on final goods and services (final demand).

From production method we can express the value of *GDP*, also known as the value Added (*VA*) as:

$GO-IC=VA=C+I+G+X-M$ (3)

Where: *GO*=Gross Output; *IC*=intermediate consumption and VA=GDP. Multiplying left-hand side of expression 3 by *GO* and simplifying we get[6]:

$GO(1-\frac{IC}{GO})=VA$ (4)

Consider $a=\frac{IC}{GO}$ and then we can re-write the expression 4 as:

$GO(1-a)=VA$ (5)

Re-writing expression 5 in terms of GO, we get

$GO=(1-a)^{-1}VA$ (6)

where $(1-a)^{-1}$ is the Leontief Inverse and 'a' or $\frac{IC}{GO}$ shows the proportion of intermediate consumption in the gross output. This term also knows as the technical coefficients matrix in the Input-output analysis.

Expression 6 is particularly important as it gives us the basis for our multiplier analysis. Multiplier coefficients are simply the column sum of the Leontief Inverse. The Leontief inverse is also known as the total requirement matrix as it shows the input requirements for a unit increase in the final demand for a given industry (Claus, 2002). These input requirements are known as "backward linkages" as they measure the impact on the supplier industries of a unit increase in final demand (Hirschman, 1958 cited in Claus 2002).

Note that $(1-a)$ in expression 6 needs to be inverted to get the Leontief matrix means it should be a symmetric matrix. Only a symmetric matrix could be inverted. Supply and use tables are asymmetric matrices and we require to transform them to obtain a symmetric matrix $(1-a)$. This calls for the requirement for re-organising the use and supply tables to form the input-

[6] Note that we multiply left hand side of expression 3 by $\frac{GO}{GO}$ to get:
$\frac{GO}{GO}(GO-IC)=VA$. Removing brackets: $\frac{GO^2}{GO}-\frac{(GO)(IC)}{GO}=VA$ and re-arranging:
$GO(1-\frac{IC}{GO})=VA$

output table. The steps involved in this process are presented in the next section.

(ii) The empirical model

Use and supply

Suppose an economy with ‘m’ number of products and ‘n’ number of industries. The relationship between the use of products by industries and final users are shown in Table 1.

Table 1 – Use of products by industries and final users

		Industry use				Final use					Products gross output
		Ind (1)	Ind (2)	..	Ind (n)	HCE	GOVT	GFKF	Exports	Imports	
Product	Com (1)	$u_{1,1}$	$u_{1,2}$	..	$u_{1,n}$	hce_1	$govt_1$	$gfkf_1$	ex_1	im_1	$go(com)_1$
	Com (2)	$u_{2,1}$	$u_{2,2}$	..	$u_{1,n}$	hce_2	$govt_2$	$gfkf_2$	ex_2	im_2	$go(com)_2$
	..	..	..	..	..	..	..	..	..	..	..
	Com (m)	$u_{m,1}$	$u_{m,2}$	..	$u_{m,n}$	hce_m	$govt_m$	$gfkf_m$	ex_m	im_m	$go(com)_m$
Value Added	Compensation of employees	w1	w_2	..	w_n						
	Operating surplus	os_1	os_2	..	os_n						
	Taxes on products	tax_1	tax_2	..	tax_n						
Industry Gross Output		$go(ind)_1$	$go(ind)_2$	..	$go(ind)_n$						

Products are denoted by Com(j) where j=1,2….m and organized row-wise. Industries are denoted by Ind(k) where k=1,2….n and organized column-wise. The industry use columns show the value of the intermediate consumption of each industry. Each column shows the uses of various products by a particular industry. The sum of the industry use column is the total intermediate consumption for the corresponding industry. The value added rows show the value added components of each industry. The sum of the total intermediate consumption and the value added makes the gross output of each industry and is presented in the last row.

The supply of products to various industries is presented in Table 2. Products and industries are organized in the same format as in the use table (i.e. products in rows and industries in columns).

Table 2 – Supply of products to industries

		Industry				Products gross output
		ind (1)	ind(2)	..	Ind(m)	
Product	Com (1)	$s_{1,1}$		..	$s_{1,n}$	$go(com)_1$
	Com (2)	$s_{2,1}$		..	$s_{2,n}$	go(com)2
	..	..	..	..	..	..
	Com (m)	$s_{m,1}$		..	$s_{m,n}$	go(com)m
Industry Gross Output		$go(ind)_1$	$go(ind)_2$	..	$go(ind)_n$	

Each row shows the value of the supply of products to each industry. The last column shows the total supply of each product whereas the last row shows the gross output of each industry.

It must me noted that the total gross output of products in the use table (last column in Table 1) should be equal to those in the supply table (last column of Table 2). Similarly the industry gross outputs in the use tables (last row of Table 1) should be equal to those in the supply table (last row of Table 2). This equality characteristic is a fundamental requirement in national income/expenditure accounting.

Input-output table

Once we organized the use and supply tables as given in Tables 1 and 2, then we are able to calculate the use and supply proportions, technical coefficients and the inter-industry or inter-product transaction tables. The inter-industry or inter-product transaction tables are important for compiling the input-output tables.

An example of a typical input-output table is given in Table 3. A typical input-output table consists of and inter-industry (or inter-poduct) transaction table (the shaded area of Table 3), the final demand matrix and the value added components (measured using production method).

Table 3 – Input-output table

		Industry				Final use					Industry gross output
		Ind (1)	Ind (2)	..	Ind (n)	HCE	GOVT	GFKF	Exports	Imports	
Industry	Ind(1)	$A_{1,1}$	$A_{1,2}$	..	$A_{1,n}$	hce_1	$govt_1$	$gfkf_1$	ex_1	im_1	$go(ind)_1$
	Ind (2)	$A_{2,1}$	$A_{2,2}$	..	$A_{1,n}$	hce_2	$govt_2$	$gfkf_2$	ex_2	im_2	$go(ind)_2$
	..	..	..	..	..	..	..	..	..	..	..
	Ind (n)	$A_{n,1}$	$A_{n,2}$	..	$A_{n,n}$	Hce_n	$Govt_n$	$Gfkf_n$	Ex_n	im_n	$go(ind)_n$
Value Added	Compensation of employees	w1	w_2	..	w_n						
	Operating surplus	os_1	os_2	..	os_n						
	Taxes on products	tax_1	tax_2	..	tax_n						
Industry Gross Output		$go(ind)_1$	$go(ind)_2$	..	$go(ind)_n$						

Table 3 is an example of industry-by-industry input-output table as both rows and columns display industries. If we constructed a product-by-product input-output table then both rows and columns should display products. The inter-industry transaction table is the matrix required to calculate the Leontief matrix and hence the Type I & Type II multipliers. The steps needed to carry out this exercise are discussed below.

Derivation of multipliers

We discuss the steps involving derivation of multipliers in five steps. These steps are developed following UN guidelines (UN 1999) and certain other international applications of input-output analysis (e.g. Eurostat 2008; Government of Ireland 2009; Kula 2007; Scotland Government 2009).

Step 1: Calculate use and supply proportions from use and supply tables
Step 2: Calculate inter-industry transaction table
Step 3: Calculate Leontief matrix
Step 4: Derive multipliers
Step 5: Validate the empirical model

These five steps are discussed in detail in the following sections.

Step 1: Calculate use and supply proportions

Use proportions:

We calculate industry-by-industry use proportions by dividing each cell entry in the use table by industry gross output in the final row of the use table. We denote intermediate consumption and the value added parts of the use matrix as *U(j+v,k)* where *v* is the number of rows in value added part of the use table. Industry gross output which is a row vector is denoted as *G(1,k)*. Then, the use proportions matrix that includes intermediate consumption and value added components is:

$$B(j+v,k) = \frac{U(j+v,k)}{G(1,k)} \qquad (7)$$

The use proportion matrix that includes only intermediate consumption is:

$$B(j,k) = \frac{U(j,k)}{G(1,k)} \qquad (8)$$

Each column of the use proportion matrix (expression 7) shows the proportion of use by each industry. This could be confirmed by noticing that the column sum of use proportions of any particular industry is equal to 1.

Supply proportions:

Industry-by-industry supply proportions are calculated in the same manner but by dividing each cell entry by row sum as given below. Suppose the supply matrix is denoted by *M(j,k)*. Gross output of products is a column vector and given by *Q(j,1)*.

Then the supply proportions matrix is:

$$D(j,k) = \frac{M(j,k)}{Q(j,1)} \qquad (9)$$

Notice that row sum is equal to 1, which means that each cell shows the proportion of supply of each product to a particular industry.

Step 2: Calculate inter-industry transaction table

There are two variants of transaction table:

(i) Industry-by-industry transaction table and

(ii) Product-by-product transaction table.

These are two symmetric tables. The industry-by-industry transaction table also known as inter-industry transaction table and has an equal number of industries both in rows and columns. The product-by-product transaction table has equal number of products in both rows and columns. The kind of transaction table to be required depends on the objective of the desired economic analysis. If the aim is to analyse the industry demand and the industry output, then an industry-by-industry transaction table is required. On the other hand if the aim is to analyse the product demand and the product output then a product-by-product transaction table is required. There are advantages and disadvantages of industry-wise and product-wise analysis. Industry-by-industry input-output tables are closer to the statistical sources and the actual market transactions. Product-by-product input-output tables are believed to be more homogenous in terms of cost structures and production activities (Eurostat, 2008).

Calculation of the transaction table could be done by using the use proportions matrix and the supply proportions matrix. Note that intermediate consumption part of the use and supply proportions matrices have m number of rows (products) and n number of columns (industries). Usually $m \neq n$ so they are rectangular matrices.

Use and supply proportions matrices are given by expressions 8 and 9 and are used to calculate the technical coefficient matrix. It is possible to calculate the industry-by-industry and the product-by-product transaction tables using expressions 8 and 9. We illustrate this by focussing on the industry-by-industry transaction (inter-industry transaction) table.

Inter-industry transaction table

First calculate the industry-by-industry technical coefficients matrix as follows.

$$a(k,k)=D'(k,j)B(j,k) \qquad (10)$$

Where $D'(k,j)$ is transpose of $D(j,k)$. Note that the number of columns in first matrix i.e $D'(k,j)$ is equal to number of rows in second matrix i.e. $B(j,k)$ so matrix multiplication is possible. The resulting matrix is k by k and denoted by $a(k,k)$. The matrix $a(k,k)$ is called the industry-by-industry technical coefficient matrix. Each cell in this matrix represents the proportion of transaction from one industry to another industry. For example, cell $a(2,1)$ shows what proportion of industry 1 has obtained from industry 2. The diagonal shows the transaction within one particular industry. We obtain the inter-industry transaction table by multiplying the technical coefficients matrix by a diagonal matrix representing industry gross output denoted by d*iag[Q(k,k)]*. The resulting inter-industry transaction table is denoted by *A(k,k).*

A(k,k) = a(k,k) diag[Q(k,k)] (11)

A(k,k) is a symmetric matrix of size *k by k*. Each cell in this matrix represents the value of transaction in dollars from one industry to another industry. Diagonal of A(k,k) shows the transaction within any particular industry.

Step 3 – Derive the Leontief inverse

Re-write the expression for the Leontief inverse presented in expression 6 in matrix form.

$L(k,k)=[(I(k,k)-a(k,k)]^{-1}$ (12)

Where *I(k,k)* is an identity matrix of size *k by k*. In order to derive the Leontief inverse we first subtract the technical coefficients matrix *a(k,k)* from an identity matrix *I(k,k)*. The resulting symmetric matrix is inverted to obtain the Leontief inverse and denoted by *L(k,k)*.

Step 4 – Derive multipliers

Type I multipliers

Once the Leontief matrix is derived derivation of Type I multipliers is straightforward. Multiplier coefficients are the column sum of the Leontief inverse. In other words:

$$\alpha(i) = \sum_{i=1}^{n} L(i,k) \qquad (13)$$

α(i) is the multiplier coefficient for any given industry.

Type II multipliers

The purpose of Type II multipliers is to incorporate the effect of employee income in to the input-output model. This requires the inter-industry transaction table to be re-organised to include the household sector as an additional industry. This is done by introducing *HCE* as the $(k+1)^{th}$ column and employee income (compensation of employees) as $(k+1)^{th}$ row of the inter-industry transaction table. This is not straightforward as final demand categories are presented in terms of products and inter-industry transaction table is given as an industry-by-industry matrix. For example *HCE* component in final demand is given as a column vector and it shows the amounts of each product demanded by the household sector. For this reason, an additional step is needed in deriving Type II multipliers to transform product-wise *HCE* in to industry-wise *HCE*. This is done as follows.

$$HCE(k,1) = D'(k,j)\, HCE(j,1) \qquad (14)$$

Where *HCE(j,1)* is the column vector of HCE expressed in terms of demand for products obtained from the use table (Table 1). *HCE(k,1)* is the HCE column vector given in terms of demand for industries. *HCE(k,1)* is added as the $(k+1)^{th}$ column of the inter-industry transaction table.

Adding employee income (compensation of employees) in to the inter-industry transaction table is straight forward as compensation of employees is already available by industry. This is shown as a row vector in value added part in the use table (Table 1). We denote compensation of employees expressed in terms of industries as the row vector *COE(1,k).* We add *COE(1,k)* as an additional row of the inter-industry transaction table. The new inter-industry transaction table now becomes *A(k+1, k+1)*.

The next step is to calculate the technical coefficients matrix from the new inter-industry transaction table. This is done by dividing each column by the row vector of industry gross outputs.

$$a(k+1,k+1) = \frac{A(k+1,k+1)}{Q(1,k+1)} \qquad (15)$$

a(k+1,k+1) is the technical coefficients matrix with an additional row for compensation of employees and an additional column for *HCE*. Once the new inter-industry transaction able is calculated we follow Steps 3 and 4 as discussed previously and the resulting row vector gives the Type II multipliers.

Note that we take only the industry-wise multipliers. The result obtained by summing *HCE* column of the Leontief matrix is dis-regarded.

Step 5 – Validate the empirical model

The aim of this step is to ascertain the validity of the empirical exercise. This is done by re-estimating three aggregates namely gross output, intermediate consumption and value added using the model applied in empirical exercise and then comparing them with the actual values. We used the estimated Leontief inverse and multiplied it by the actual values for final demand to obtain the estimated values. This was done by using both the industry-by-industry Leontief matrix and the product-by-product Leontief matrix. Estimation was done using the following relationships.

Re-write the expression 6 as:

$$\overline{GO} = (\overline{L})\ (FD) \qquad (16)$$

The terms in expression 16 are: $\overline{GO}$ =estimated gross output., $\overline{L}$ = estimated Leontief matrix and FD = actual total final demand.

Re-writing expression 3 we get:

$$\overline{VA} = \overline{GO} - \overline{IC} \qquad (17)$$

Estimated value added $\overline{VA}$ shown in expression 17 is derived by subtracting estimated intermediate consumption $\overline{IC}$ from estimated gross output $\overline{GO}$.

The table 4 shows the results of the model validation exercise.

Table 4 – Results of the model validation exercise

(all values are in NZ$ million)

		Actual total	Estimated total	Percentage deviation of estimated from

				actual
Industry by industry method	Gross output	267,535.5	267,536.4	0.0003%
	Intermediate consumption	145,963.7	145,963.7	0.0000%
	Value added	121,572.9	121,572.3	0.0000%
Product by product method	Gross output	267,535.4	267,536.4	0.0004%
	Intermediate consumption	145,963.7	145.963.7	0.0000%
	Value added	121,571.7	121,571.7	0.0000%

Note: Actual totals are sourced from the 2003 supply and use tables.

Results of the model validation exercise confirm a very high level of accuracy of the empirical model at four decimal points.

4. Results and analysis

Table 5 presents the components of the final demand i.e Household Consumption Expenditure (HCE), Government expenditure etc. classified by selected transport and tourism industries. Please note that due to the overlapping nature of industries relating to the transport and tourism sectors, Table 5 shows three sets of industries: (i) four Industries representing both transport and tourism (road passenger, rail, water and air, and service to transport); (ii) one industry representing only transport sector (road freight); and (iii) five industries representing only tourism sector (accommodation, cafes & bars, machinery and equipment hiring and leasing, cultural and recreational services and retail trade). The reason for water and air transport being treated as one industry is due to the policy adopted by Statistics New Zealand to maintain the confidentiality of published the data on these two industries. Please see Annex A for detailed ANZSIC industry classifications.

The components of the final demand give an indication of the significance of each component in the total final demand of each industry. For example, total final demand of road passenger transport in 2003 is consisted of 44 percent HCE, 12 percent government expenditure, 9 percent investment, 18 percent exports and 18 percent imports. Household consumption expenditure represents the largest proportion of the final demand of six out of ten industries. On the other hand exports is of particular importance in rail, water & air and services to transport.

Table 5 – Industry-wise final demand and gross output – 2003 (NZ$ million)

(Percentages are in parenthesis)

	Industry	HCE	GOVT	GFKF	Exports	Imports	Total final demand	Gross output
1	Road passenger transport	73 (44)	20 (12)	14 (9)	31 (18)	-29 (18)	108 (100)	625
2	Rail transport	111 (29)	1 (0.2)	1 (0.1)	179 (47)	-93 (24)	198 (100)	473
3	Water and air transport	1,111 (27)	8 (0.2)	186 (5)	1,671 (41)	-1,122 (27)	1,855 (100)	4,465
4	Services to transport	770 (30)	14 (0.6)	36 (1)	1,174 (45)	-612 (23)	1,383 (100)	3,441
5	Road freight transport	371 (47)	111 (14)	17 (2)	232 (29)	-59 (7)	673 (100)	3,681
6	Accommodation	1,041 (62)	4 (0.3)	23 (1)	595 (36)	-12 (0.7)	1,651 (100)	1,813
7	Restaurants, cafes and bars	2,024 (63)	14 (0.5)	41 (1)	1,119 (35)	-7 (0.2)	3,190 (100)	3,521
8	Machinery and equipment hiring and leasing	123 (16)	3 (0.4)	28 (4)	235 (31)	-377 (49)	12 (100)	1,953
9	Cultural and recreational services	1,850 (72)	140 (5)	33 (1)	417 (16)	-144 (6)	2,297 (100)	3,675
10	Retail trade	8,702 (62)	192 (1)	1,658 (12)	1,581 (11)	-2,013 (14)	10,120 (100)	14,690
	Total of all industries	68,781 (34)	22,059 (11)	28,397 (14)	41,758 (21)	-39,422 (20)	12,1572 (100)	267,535

Notes:

1. HCE includes NPISH(Non-Profit Institutions Serving Households); GOVT=Central & local government; GFKF=Gross Fixed Capital Formation including change in stocks.
2. Total of all industries (last row) represents all 85 industries.

Components of value added is shown in Table 6. It could be seen that contribution of transport industries to total value added (GDP) is approximately 4 percent in 2003. It is also observed that approximately 5 percent of total compensation of employees is paid to employees in the transport sector. The share of compensation of employees in services to transport is approximately 2 percent which is highest among all transport industries.

The table 6 also reveals the value added components of tourism industries. The contribution of tourism industries to GDP is approximately 10 percent[7].

[7] TSA 2005 (Statistics New Zealand 2006 p 54) indicates the contribution of tourism to GDP was 5.1% in 2003 which cannot be compared with the percentage derived from input-output table. The reason is TSA percentage is representing direct tourism value added which is derived by applying tourism industry ratios to total sales. Tourism industry ratio is the proportion of direct tourism sales out of total sales. The value added derived from input-output analysis represents the value added relating to all sales by tourism industries regardless of

The share of tourism compensation of employees in total compensation of employees is approximately 12 percent.

Table 6 – Components of value added – 2003 (NZ$ million)

(Percentages are in parenthesis)

	Industry	Total IC	Compensation of employees	Taxes on products	Operating surplus	Consumption of fixed capital	Other taxes on production	Subsidies	Travel debits	Value added	Gross output
1	Road passenger transport	335 (0.2)	220 (0.4)	13 (0.4)	81 (0.2)	84 (0.5)	3 (0.1)	-112 (27)	2 (0.3)	276 (0.2)	625 (0.2)
2	Rail transport	331 (0.2)	110 (0.2)	7 (0.2)	-40 (0.1)	82 (0.5)	0 (0)	-25 (6)	8 (1)	127 ((.1)	473 (0.1)
3	Water and air transport	3,169 (2)	714 (1)	163 (6)	159 (0.4)	169 (1)	21 (0.5)	0 (0)	69 (10)	1064 (0.9)	4,465 (2)
4	Services to transport	1,443 (1)	914 (2)	11 (0.4)	742 (2)	256 (1)	42 (1)	0 (0)	34 (5)	1,954 (2)	3,441 (1)
5	Road freight transport	1,984 (1)	846 (2)	155 (5)	359 (0.9)	323 (2)	11 (0.3)	0 (0)	3 (0.5)	1540 (1)	3,681 (1)
6	Accommodation	822 (0.6)	460 (0.8)	83 (3)	320 (0.8)	88 (0.5)	31 (0.8)	-1 (0.3)	10 (2)	898 (0.7)	1,813 (0.7)
7	Restaurants, cafes and bars	1,921 (1)	946 (2)	113 (4)	366 (0.9)	156 (0.9)	20 (0.5)	-3 (0.7)	3 (0.4)	1,485 (1)	3,521 (1)
8	Machinery and equipment hiring and leasing	721 (0.5)	229 (0.4)	6 (0.2)	343 (.8)	647 (4)	11 (0.2)	-1 (0.34)	-1 (0.2)	1,228 (1)	1,953 (0.7)
9	Cultural and recreational services	1,676 (1)	785 (1)	25 (0.9)	842 (2)	242 (1)	97 (3)	-11 (3)	18(3)	1,956 (2)	3,675 (1)
10	Retail trade	6,617 (5)	4,170 (8)	76 (3)	3,044 (7)	625 (3)	133 (3)	-26 (6)	51 (8)	7,946 (7)	14,690 5)
	Total of all industries	145,964	55,222	2,909	41,424	17,905	3,853	-413	673	12,1572	267,535

Notes:

1. Value added is calculated as the sum of Compensation of employees, Operating surplus, Consumption of fixed capital, Other taxes on products, and Subsidies.
2. Total of all industries (last row) represents all 85 industries.

Multiplier coefficients for 2003 are presented in Table 7.

Table 7 – Multiplier coefficients

	Industry	**Representing sector**	**Type I (direct & indirect effects)**	**Type II (direct, indirect & induced effects)**
1	Road passenger transport	Transport & Tourism	2.21	5.27
2	Rail transport	Transport & Tourism	2.62	5.43

who bought them. It is possible to obtain a valued added comparable to TSA results by applying tourism industry ratios to value added reported in Table 5.

3	Water and air transport	Transport & Tourism	2.64	5.00
4	Services to transport	Transport & Tourism	1.96	4.30
5	Road freight transport	Transport	2.19	4.61
6	Accommodation	Tourism	2.13	4.46
7	Restaurants, cafes and bars	Tourism	2.37	4.96
8	Machinery and equipment hiring and leasing	Tourism	1.80	3.25
9	Cultural and recreational services	Tourism	2.00	4.17
10	Retail trade	Tourism	2.05	4.53
	All transport industries		2.30	4.73
	All tourism industries		2.15	4.56

Our calculations reveal that every $1 additional demand for road passenger transport generates a total of $ 2.21 output throughout the economy in 2003. The additional $1.21 is due to the chain effects of additional rounds of demand for inputs generated from the first round of demand. For example, an addition of 100 daily commuters to use the train services would create an additional demand for inputs such as addition of extra coaches and track maintenance etc. Type II multiplier coefficient takes into consideration the demand created by payments to staff as they use this income to purchase goods and services for their use. This also has a chain effect as recipients which in turns increase the demand for goods and services and so on. Our study reveals that Type II multiplier effect of road passenger transport is 5.27. As noted earlier, Type I multiplier captures the economic activity generated by the first round of demand and Type II captures in addition to Type I multiplier effects, the induced effect - addition due to economic activities generated by employee income. This means the induced effect of road passenger transport in 2003 was 3.06 (or for every $ 1 additional demand for road passenger transport generates an extra $ 3.06 of induced output).

Different industry groups within the transport and tourism sectors have varying multiplier coefficients. This means their abilities to generate economic effects are different. For example water and air transport shows the highest Type I multiplier coefficient. Lowest Type I multiplier is for machinery and equipment hiring and leasing industry. It should also be noted that Type II multiplier can take different values regardless of the values of Type I multipliers. The extent of value of Type II multiplier depends on the extent of direct and indirect effect (Type I multiplier effects) and the ability of the employee income to generate more demands for other goods and services (induced effects). For example, rail transport has highest total effect which includes direct, indirect and induced effect with Type II multiplier coefficient of 5.43.

We have also been able to re-calculate Type I and Type II multipliers for all transport industries. Please note that this is not the average of individual transport multipliers. Calculation of multiplier coefficient for all transport industries is done by adding all transport industries in the supply and use tables first and carrying out all subsequent calculations required to derive multiplier coefficients. The purpose of obtaining combined Type I and Type II multipliers to represent all transport industries is to understand the ability of transport as a single sector to generate multiplier effects. Our study reveals that transport as a single sector has a Type I multiplier of 2.30 and a Type II multiplier of 4.73. Similarly, tourism as a single sector has a Type I multiplier of 2.15 and a Type II multiplier of 4.56. It seems that induced effects added by employee income are more than the total direct and indirect effects indicated by the Type I multipliers.

It is worth mentioning that we have treated multipliers of transport and tourism industries based on the activities of particular industries. For example, accommodation is treated as a tourism industry although this category is not serving only the tourists. As revealed by TSA 2005 (Statistics NZ 2006) share of direct sales to tourists out of the total sales (tourism industry ratio) by accommodation industry in year ending March 2003 was 67 percent. This is to say only 67 percent of accommodation services were purchased by tourists and the rest was purchased by non-tourists. We have not addressed this issue separately and used multiplier coefficient estimated for accommodation to measure the economic impact generating from tourist expenditure on accommodation services. The issue related to transport industries is less serious as we can easily deduce that demand for transport services is fully related to transport activities. It is unlikely that there is a non-transport activity exists within a transport industry. For example, it is reasonable to use multiplier coefficient estimated for road passenger transport industry to assess the economic impacts generating from demand for passenger transport.

5. Limitations

The use of multiplier coefficients in assessing economic impacts is constrained by a number of limitations inherent to the input-output analysis which are summarized below (Krumme 2009).

(i) Size of multipliers can be misleading

"Large multipliers" are not the same as "large multiplier impacts". The impacts or effects depend on both the size of the multiplier and the magnitude of the "exogenous" stimulus by which the multiplier is multiplied. Thus, any given multiplier effect can be alternatively the result of large multiplier associated with minimal change in initial spending or small multiplier and substantial change in initial spending.

(ii) Assumption of un-employed resources

Multiplier effects are based on assumptions about the availability of un-utilised or under utilised resources and people to accommodate the effects. Since many resources are already fully utilised, multiplier effects tend to ignore or mask (negative) displacement effects. Thus, positive multiplier effects will -- presumably in a highly differentiated way -- include hidden opportunity costs and substitution effects.

(iii) Validity of multipliers for other periods

Empirically derived multipliers represent the period for which the underlying relationships have been quantified. Input-output relationships and particularly technical coefficients could be changing over time due to economic reasons. Therefore, multiplier coefficients calculated using supply-use tables of a particular year may not be appropriate to analyse another year since technical relationships might have been changed between these two periods. Because of the detailed process and the limitations of resources available to derive multipliers for every year, it has become a common practice to use multipliers calculated for one year for use in subsequent years. The validity of such applications is an issue to be carefully addressed. It is normally accepted that one set of multipliers is valid for the five years following the analysed year under the assumption that there would not be a significant structural change among industries during that period.

(iv) Pre and post stimulus effects

Multiplier effects are not necessarily occurring after the specified exogenous stimulus. Thus, one may have to consider that multiplier-related behaviors can be based on expectations and may thus occur in advance of the actual stimulus. There could also be lag effects, which means the full effect are yet to be realised in the future.

6. Summary and conclusions

We attempted to apply the input-output multiplier approach to measure the economic impacts of transport and tourism related industries. Our focus was to derive Type I and Type II multipliers as measures of direct, indirect and induced effects emanating from a change in final demand. Transport as a single sector has a Type I multiplier of 2.30 and a Type II multiplier of 4.73. Similarly, the tourism sector has a Type I multiplier of 2.15 and a Type II multiplier of 4.56. Considering the individual industries within the transport and tourism sectors, different industries have varying multiplier coefficients. This means their abilities to generate economic activities are different. For example, water & air transport shows the highest Type I multiplier coefficient with 2.64. The lowest Type I multiplier is for machinery and equipment hiring and leasing with 1.8. Rail transport has the highest Type II multiplier effects with 5.43. The economic meaning of this is that salaries & wages received by employees in rail transport industry have gone through more rounds of subsequent purchases than any other industry. In general, induced effects added by employee income are more than the total direct and indirect effects indicated by the Type I multiplier.

The findings of our research are limited by the availability of data and therefore the present study has given more focus on the application of the methodology rather than the final results and policy implications. Further effort is needed using more detailed supply-use tables to calculate the multiplier coefficients for a more disaggregated level of industries. Also we need to recalculate the multipliers for a more recent year as the findings relating to the year 2003 may not be appropriate to assess the economic impacts in recent years. It is also useful to calculate the multiplier coefficients using 1995/96 inter-industry study and compare them with the multiplier coefficients calculated for recent years to understand any changes in the multiplier effects over time. Further research is also needed to address the aspects such as employment multipliers, income multipliers, import leakage and changing patterns of inter-industry dependence over time. The present study focussed on industry-wise economic impacts. Similar study can be done for analysing product-wise economic impacts.

Annex A – Detailed Industry Classifications

NZ National Accounts Working Industries (NZNAWI)		Australian and New Zealand standard industrial classification - NZ version 1996 (ANZSIC96)	
H011	Accommodation	H571010	Hotels (Accommodation)
		H571020	Motels and Motor Inns
		H571030	Hosted Accommodation
		H571040	Backpacker and Youth Hostels
		H571050	Caravan Parks and Camping Grounds
		H571090	Accommodation nec
H012	Restaurants, cafes and Bars	H572000	Pubs, Taverns and Bars
		H573000	Cafes and Restaurants
		H574000	Clubs (Hospitality)
I011	Road Freight Transport	I611000	Road Freight Transport
I012	Road Passenger Transport	I612100	Long Distance Bus Transport
		I612200	Short Distance Bus Transport (including Tramway)
		I612300	Taxi and Other Road Passenger Transport
I021	Rail Transport	I620000	Rail Transport
I031	Water Transport	I630100	International Sea Transport
		I630200	Coastal Water Transport
		I630300	Inland Water Transport
I041	Air Transport	I640100	Scheduled International Air Transport
		I640200	Scheduled Domestic Air Transport
		I640300	Non-Scheduled Air and Space Transport
I091	Services to Transport	I661100	Parking Services
		I661900	Services to Road Transport nec
		I662100	Stevedoring
		I662200	Water Transport Terminals
		I662300	Port Operators
		I662900	Services to Water Transport nec
		I663000	Services to Air Transport
		I664100	Travel Agency Services
		I664200	Road Freight Forwarding
		I664300	Freight Forwarding (except Road)
		I664400	Customs Agency Services
		I664900	Services to Transport nec
L032	Machinery and Equipment Hiring and Leasing	L774100	Motor Vehicle Hiring
		L774200	Other Transport Equipment Leasing
		L774300	Plant Hiring or Leasing
P012	Libraries, Museums and the Arts	P921000	Libraries
		P922000	Museums
		P923100	Zoological and Botanic Gardens
		P923900	Recreational Parks and Gardens
		P924100	Music and Theatre Productions
		P924200	Creative Arts
		P925100	Sound Recording Studios
		P925200	Performing Arts Venues

	P925900	Services to the Arts nec
P013 Sport and Recreation	P931110	Racing Clubs and Track Operation (excluding Training and Ownership)
	P931120	Horse and Dog Training (excluding Racing and Ownership)
	P931200	Sports Grounds and Facilities nec
	P931900	Sports and Services to Sports nec
	P932100	Lotteries
	P932200	Casinos
	P932900	Gambling Services nec
	P933000	Other Recreation Services
G011, G012, G013, G014, G015, G016 Retail Trade	G511	Supermarket and Grocery Stores
	G512	Specialised Food Retailing
	G521	Department Stores
	G522	Clothing and Soft Good Retailing
	G523	Furniture, Houseware and Appliance Retailing
	G524	Recreational Good Retailing
	G525	Other Personal and Household Good Retailing
	G526	Household Equipment Repair Services
	G531	Motor Vehicle Retailing
	G532	Motor Vehicle Services

Source: Statistics New Zealand (2009c)

Bibliography

Archer, B. (1977). *Tourism multiplier: The state of the art. Bangor Occasional papers in Economics 11*. University of Wales Press: Cardiff.

Archer, B., & Fletcher, E. (1996). The Economic Impact of Tourism in the Seychelles. *Annals of Tourism Research, 23*(1), 32-47.

Azzoni, R., & Guilhoto, M. *Modal Composition of Cargo Transportation and Income Inequality in Brazil.* Brazil*:* University of São Paulo.

Baumol, W. & Blinder, S. (2003). *Macroeconomics: Principles and Policy*. (9th ed., p. 153). Thomson South-Western.

Bryden, M. (1973). *Tourism and Development: A case study of the Commonwealth Caribbean*. Cambridge*:* Cambridge University Press.

Chhabra, D., Sills, E., & Cubbage, F. (2003). The Significance of Festivals to Rural Economies: Estimating the Economic Impacts of Scottish Highland Games in North Carolina. *Journal of Travel Research, 41*(May), 421-427.

Claus, I. (2002) Inter industry linkages in New Zealand, New Zealand Treasury working paper 02/09 [Brochure]. New Zealand Treasury

Department of Tourism. (2006). *Tourism Satellite Account Fiji Islands* [Brochure]. Suva, Fiji Islands: Ministry of Tourism and Transport.

Diekmann, A. (2002). *The Use of Energy in Transport - Past and Future Trends and Implications*. Paper presented at the 14th Input-Output Conference, Montreal, Canada.

Eurostat. (2008). *Manual of Supply, Use and Input-Output Tables*, (Tech. Rep. No. L-2920.). Luxembourg.

Fletcher, J. (1989). Input-Output analysis and tourism impacts studies. *Annals of Tourism Research, 16*(4), 514-529.

Fletcher, E., & Archer, H. (1991). The Development and Application of Multiplier Analysis. *Progress in Tourism, Recreation and Hospitality Management, 3*, 28-47.

Frechtling, C., & Horvath, E. (1999). Estimating the Multiplier Effects of Tourism Expenditures on a Local Economy through a Regional Input-Output Model. *Journal of Travel Research, 37*(May), 324-332.

Gelen, A. (2003). Local Economic Impacts: The British Open. *Annals of Tourism Research, 30*(2), 406-425.

Government of Ireland. (2009). *Supply and use and input-output tables for*

Ireland [Brochure]. Dublin: Central Statistics Office.

Johnson, L. (1993). Tourism Impact Estimation. *Annals of Tourism Research, 20*, 279-288.

Krumme, G. (2009) Retrieved April 2009 from http://faculty.washington.edu/krumme/systems/ioquations.html

Kula, M. (2007) Supply and Use Tables and Input-Output Tables for Turkey, Turkish Statistical Institute, National Accounts and Economic Indicators Department. The paper presented at The 16th International Input-Output Conference 02 – 06 July 2007, Istanbul, Turkey

Lee, K., & Taylor, T. (2005). Critical reflections on the Economic Impact Assessment of a Mega-Event: The Case of 2002 FIFA World Cup. *Tourism Management, 26*(4), 595-603.

Leontief, W. (1965). The economic impact -industrial and regional of the arms cut. *Review of Economics and Statistics*

Lütkepohl, H (2008) 'Impulse response function'. *The New Palgrave Dictionary of Economics*, (2nd. Ed)

Ministry of Tourism. (n.d). Retrieved April 30, 2009, from http://www.trcnz.govt.nz/

Oosterhaven, J. & Stelder, D. (2000) *On the Use of Gross versus Net Multipliers with a bi-regional application on Dutch transportation.* Paper presented at the 13th International Conference on Input-Output Techniques, Macerata, Italy.

Scotland Government. (2009) *Input-Output Tables and Multipliers for Scotland 1998.* Retrieved April 30, 2009, from http://www.scotland.gov.uk.

Statistics New Zealand. (2006) *Tourism Satellite Account: 2005* Wellington: Statistics New Zealand.

Statistics New Zealand. (2008) *Tourism Satellite Account 2007* Wellington: Statistics New Zealand.

Statistics New Zealand. (2009a) Retrieved April 30, 2009, from http://www.stats.govt.nz/NR/rdonlyres/B1C990D4-A112-4BA5-AEE1-869757D70E45/39633/namar08yrgdpbreakdown1.xls

Statistics New Zealand. *(2009b) [Supply and use tables 2003].* Retrieved April 30, 2009, from http://www.stats.govt.nz/tables/supply-and usetables.htm

Statistics New Zealand.(2009c) *[ANZSIC Industrial classification 1996]*. Retrieved April 30, 2009, from http://www.stats.govt.nz/statistical-methods/classifications-and-related-statistical-standards/industrial-classification/industrial+classification+1996.htm

Thijs, R. (2006). *The Economics of Input-Output Analysis*. Cambridge: Cambridge University Press.

United Nations (1993) *System of National Accounts 1993,* Statistics Division Department for Economic and Social Affairs Statistics Division. New York, US: Retrieved from http://unstats.un.org/unsd/sna1993/tocLev8.asp?L1=1&L2=1

United Nations. (1999). *Handbook of Input-output Table Compilation and Analysis* [Brochure]. Department for Economic and Social Affairs Statistics Division. New York, US

Wen, J., & Tisdell, C. (2001). *Tourism and China's Development: Policies, Regional Economic Growth and Ecotourism*. Singapore: World Scientific Publishing.

Weisbrod, G., & Weisbrod, B. (1997). *Assessing the Economic Impact of Transportation Projects How to Choose the Appropriate Technique for Your Project* [Brochure]. Washington, DC: *Economic Development Research Group* Transportation Research Board.

West, G., & Gamage, A. (2001). Macro Effects of Tourism in Victoria, Australia: A Nonlinear Input-Output Approach. *Journal of Travel Research, 40*(August 2001), 101-109.

****