Modeling Competition Levels in the Chinese Economy: the Economic Impact of the Beijing 2008 Olympic Games

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ABSTRACT

The main characteristic of the Chinese economy is economic transition from a planned to a market economy. During this process, market competition has been introduced and the competition mechanism has undergone changes. The function of the government has been changed by limiting excess interference in the economy, while the dual price system remains in some industries and public ownership plays a dominant role. These features of the Chinese economy can be captured when an imperfect competition market structure is introduced in a Chinese Computable General Equilibrium (CGE) model. This paper builds a Chinese CGE model with imperfect competition and applies this model to an empirical case — the Beijing 2008 Olympic Games. This model is in value of incorporating some keys features of Chinese transition economy and has wide applications for Chinese issues, such as international trade and agriculture. By holding the Olympic Games, the increased international tourism expenditures are injected into the host country economy. This paper will employ the developed CGE model to predict the economic impact of the international tourism brought by holding the Beijing 2008 Olympic Games in China in the year 2008. The results show the whole economy impact and the industry level impact. Policy implications will be summarized from findings.

Key words: CGE modelling, Economic impact, Imperfect Competition, International tourism, the Beijing 2008 Olympic Games.

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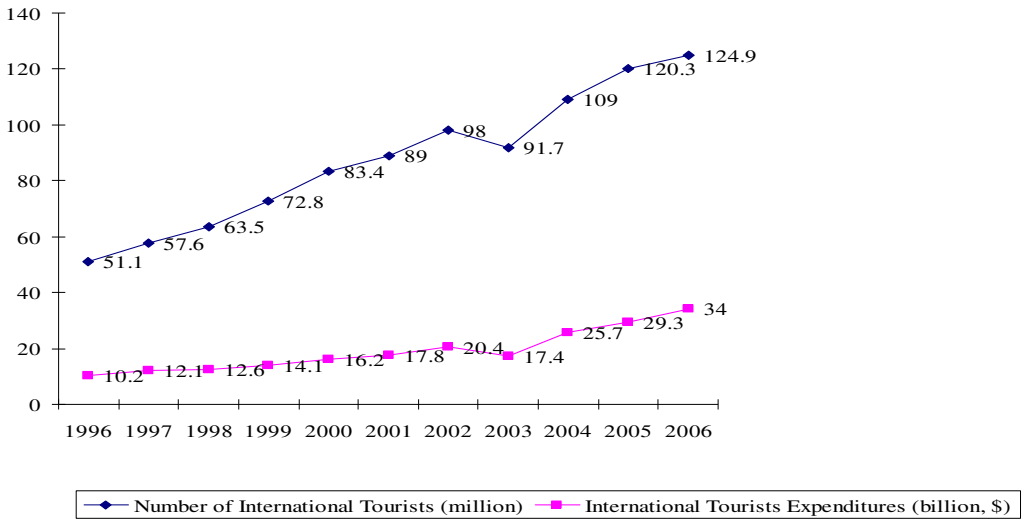
1. Introduction

International inbound tourism has developed in the context of China's economic transition. During 20 years of the development of international tourism, ranks of China's tourist arrivals and tourism receipts increased from 18 and 34 in 1980 to 5 and 7 in 2003. Figure 1 shows the development of international tourism in China from 1996 to 2006. Both the number of international tourists and their expenditures markedly increased [1] and the contribution of international tourism to foreign exchange reached $34billion in 2006. The UN World Tourism Organization forecasts that China will become the biggest tourism destination in 2015 with 100 million foreign tourists arriving in China. Given the significant role that international tourism plays in the Chinese economy, it is important to estimate the economic impact of international tourism on the Chinese economy and the impact of different tourism-related policies on tourism development, which would help the Government and tourism-related organizations formulate policies. Therefore, it is necessary to employ an appropriate method to assess the economic impact of international tourism in China.

[1] Except the year 2003 when tourism was negatively affected by the outbreak of Severe Acute Respiratory Syndrome.

Figure 1 The number of international tourists and their expenditures



Source: China National Tourism Administration website

Existing studies of the impact of international tourism on the Chinese economy have used input-output (I-O) modelling. In two recent studies Yan and Wall (2001) and Oosterhaven and Fan (2006) applied I-O modelling to examine the contribution of tourism to the Chinese economy for the years 1992 and 1997 respectively. As to the methodology used in the two studies, some crucial limitations lie in the assumptions of I-O models, which may lead to unreliable results (Dwyer et al., 2000). Instead, another applied economic modelling technique, Computable General Equilibrium (CGE) modelling has been applied to different tourism research, such as tourism impact, tourism demand, shocks and tourism crises, tourism taxation, tourism and the environment, tourism and globalization and special events. CGE modelling has been described as a paradigm shift from I-O modelling in tourism economic impact evaluation because CGE modelling has more realistic assumptions and then can generate more reliable results than I-O modelling (Dwyer et al., 2004a).

This paper will analyze the economic impact of international tourism on the Chinese economy during the Beijing Olympic Games in 2008 by using CGE modelling. A static CGE model with imperfect competition is built based on the 2002 China I-O table. The purpose of the paper is to explain how CGE modelling can be used in the impact of Chinese tourism on the economy. Four research questions are developed around this research purpose. First, how can we build a static CGE model for evaluating economic impact of international tourism in China? Second, how can we introduce imperfect competition into this model? Third, how can we predict the increased international tourism during the Beijing Olympic Games? Fourth, what do the findings of this CGE model mean?

2. Literature

The economic impact of international tourism during the Olympic Games' year is one of the most significant components of the effects of the Olympic Games on national economies (Blake, 2005). Other main components of the economic effects of the Olympic Games include operation expenditures by Organising Committee of the Olympic Games (OCOG), tourism legacies before and after the Olympic Games, investment in infrastructure and in Olympic venues and related facilities. The majority of the previous Olympic Games were financed by both public sectors, such as governments, International Olympic Committee (IOC) and OCOG, and private sectors, such as foreign and national industries (Preuss, 2004).

Holding the Olympics generates additional international tourists and tourism spending, which will then affect macroeconomic variables, such as GDP, employment and welfare. By using CGE modelling, Madden (2002) predicted the economic impact of the Sydney 2000 Olympic Games and Blake (2005) estimated the economic impact of the London 2012 Olympic Games. Given the

research objective of this paper, we only review the part of the economic impact of international tourism on the national economy during the Olympics in the two studies.

Madden (2002) used the MONASH Multiregional Forecasting model of the Australian economy to measure the wide economic impact of the Sydney 2000 Olympic Games. Key assumption in this model was related to capital constraints and labour supply constraints. The increased international tourism spending was modelled as one of the main types of Olympic-related direct expenditures during the Games and the other main type was the operation expenditures of the Games. During the Sydney Olympic Games year, the increased international tourism spending was predicted to be around AUS$400 million. As the aim of this study was to measure the economy-wide impact of the Sydney Olympic Games, the economic impact of the international tourism related to the Olympics was not analyzed in this study.

Blake (2005) constructed a dynamic and multi-regional CGE model, which based on 2002 I-O tables with twenty-six sectors. The increased international tourism expenditures directly related to the London Olympics in 2012 were predicted as an exogenous shock to the economy. Based on the London2012 ticket allocation model and previous studies, assumptions of visit category, visitor numbers, days and spending was made in three scenarios with low, central and high estimates. It is predicted that during the Olympic Games' year, it would be a growth of £364 million flowing into the economy contributed by international tourism expenditures, with £296 million going into the London economy and £67 million going into the outside London economy respectively. The objective of this London Olympic study was to analyze the economy-wide impact of the London Olympic Games which includes the increased tourism spending, the increased investment in the Olympic venues and other related infrastructure, so the findings showed the total impact rather than the impact of the international tourism spending. The

estimation of the increased international tourism spending is considered to be a difficult part in studies of the economic impact of the Olympic Games and the two studies shed some light on this issue. The two studies also showed ways of modelling tourism changes in the context of big events.

Studies on the economic impact of tourism employing CGE modelling have been conducted in different countries and areas, such as Spain (Blake, 2000), Hawaii (Zhou et al., 1997) and Australia (Adams and Parmenter, 1995). Figure 2 compares three studies on the economic impact of tourism in terms of six areas. Blake (2000) developed a single-country static model to analyze the economic impact of tourism in Spain and assumed a 10% increase in foreign tourism. Zhou et al. (1997) assumed a 10% decrease in tourism spending in Hawaii and found that tourism-related industries, such as hotels and eating and drinking places, would be negatively affected. Adams and Parmenter (1995) evaluated the economic effects of tourism Queensland, Australia and designed a scenario that there is an extra 10% growth in the number of tourist arrivals every year. Through discussing the three studies, it can be briefly summarized that the estimation of the economic impact of tourism using CGE modelling involves four procedures. The first procedure is data collection and data processing. CGE models are built on I-O tables or Social Accounting Matrices (SAMs). Data processing is required, such as data updating and data aggregating or disaggregating. Second, build a CGE model based on a series of assumptions and model closure rules. Third, simulations of tourism increases or decreases need to be assumed according to research objectives. For example, in the prediction of the economic impact of the increased international tourism during the Olympic Games, a stimulus of increased international tourism spending to the economy need to be calculated. Finally, the model findings are analyzed. These findings could help to understand the importance of international tourism to the economy and to formulate tourism policies.

Figure 2 Three studies on the economic impact of tourism using CGE modelling

Study	Blake (2000)	Zhou et al. (1997)	Adams and Parmenter (1995)
Country/area	Spain	Hawaii	Queensland
Data	49-sector Spanish tourism I-O table for 1992	The Hawaii SAM based on 1982 I-O table and the Hawaii GSP Account	1980-81 I-O data with up-to-date macro data in 1989 (base year)
Model form	A single country static CGE model	nonlinear CGE model with neoclassical production and expenditure functions	A static CGE model with some simple dynamic relationships
Main assumptions and model closure	Perfect competition, constant returns to scale, perfect mobility factors of production, constant government consumption, "small country" assumption, a constant current account surplus, Armington assumption	A competitive market, optimizing consumer and producer welfare, "small country" Armington assumption, fixed capital in the short-run, all factors are mobile in the long-run, closed external market	Public sector borrowing requirement is fixed. Average required rate of return on capital is fixed. 4% change of average real rate of interest on foreign debt. 1% of average annual rate of labour-saving technical change.
Simulations	10% increase in foreign tourism	10% decrease in visitor expenditure	10% growth in tourism per annum
Main findings	welfare increases by 27.7bn Pesetas or 0.05% of GDP	impact on tourism-related industries For example, the output in hotels industry decreases by 9.66% and eating and drinking places industry decreases by 9.4%	Real GDP increases by 0.37%. Real investment increases by 8.38%.

3. Measuring the Impact of International Tourism on the Chinese Economy and the Application to Other Chinese Issues

Most studies measuring the economic impact of international tourism impact on the Chinese economy used input and output models and no studies using CGE models have been found. Oosterhaven and Fan (2006) examined the impact of international tourism on Chinese economy using an I-O model. This I-O model was calibrated based on the 1997 China I-O tables of seventy industries. The findings showed direct, indirect and induced effects of total international tourist expenditures. Both the total impact and impact on each industry were analyzed. The contribution of international tourist spending to value added, household income and employment was estimated to be 1.64%, 1.40% and 1.01%. Yan and Wall (2001) employed an I-O model based on

the 1992 China I-O tables to examine the contribution of tourism to the Chinese economy and linkages between tourism and other industries. The results revealed that there was a weak linkage between tourism and other industries providing tourism-related products, such as agriculture, food manufacture and transportation equipment. The contribution of tourism to the national GDP was 1.6% in 1995.

Findings of the two studies indicate that the contribution of tourism or international tourism to the Chinese economy is small compared with the overall size of the Chinese economy. However, in the past ten year, international tourism spending has grown faster than GDP. The Beijing 2008 Olympic Games is an important stimulus to inbound tourism in China.

The research on CGE modelling in China started in the early 1990s. Development Research Center of the State Council (DRC), Chinese Academy of Sciences and Shanghai Academy of Social Sciences constructed a ten-sector China CGE model in 1997 and DRC continues to develop new editions and maintain this model (Wang et al., 1999). CGE modeling has been widely used in different areas, for example, the reform of indirect tax (Xiao and Zhou, 2005), China entering the World Trade Organization (Li, 2000), hi-tech policy (Cheng et al., 2003), Chinese monetary policy and capital stocks of the energy industry (Zhou and Deng, 1998), the income distribution of rural households in Yunnan Province (Zhao, 2004) and reform of endowment insurance policy (Li, 2005).

These studies show that CGE modelling is gaining in importance in Chinese economic studies as data sources and methodologies applicable to China improve. This demonstrates the feasibility of employing the CGE approach in Chinese tourism economic impact studies. It is important to use CGE modelling to measure the tourism economic impact on the Chinese economy. Previous

studies have used I-O models to evaluate the contribution of tourism to the Chinese economy. CGE modelling is considered as a new paradigm shift form I-O modelling in tourism economic impact evaluation as I-O modelling has many plausible assumptions while CGE modelling has more realistic assumptions. Tourism, especially inbound tourism has been developing fast in China and thus it is important to use a better methodology to measure the economic impact of tourism and analyze different tourism policies.

4. Assumptions and Simulations: a China CGE Model of the Beijing 2008 Olympic Games

Data

The model is calibrated to the China 2002 Input and Output (I-O) table formulated by China National Statistical Administration (2006), which is the most recent data source. This table of 2002 prices is updated to 2005 prices. It includes 122 industries, total export and two households, rural and urban households. Rural and urban households are aggregated into one representative household. Total exports are separated into tourism exports and non-tourism exports using data on tourism expenditures in 2005 (Figure 3).

For the purposes of presentation of results, the 122 industries are aggregated into thirteen industries, primary industry, secondary industry, ten tourism-related industries and other services, which include industries excluding the ten tourism-related industries in tertiary industry. The thirteen industries are summarized in terms of eight indicators from the China 2002 I-O table (Figure 4). The secondary industry accounts for the biggest proportion of GDP (60.8%), total value-added (45.2%), imports (90.4%), non-tourism exports (80.4%), total value of labour use (38.2%) and of capital use (49.1%), which indicates that secondary industry is in the dominant position in the Chinese economy.

Figure 3 Foreign exchange earnings of international tourism and its composition in 2005

Item	Value (USD million)	Percentage (%)
Total	29296	100
Long Distance Transportation	8294	28.3
Civil Aviation	5928	20.2
Railway	904	3.1
Highway	718	2.5
Waterway	744	2.5
Visiting	1227	4.2
Accommodation	3775	12.9
Food and Beverage	2748	9.4
Shopping	6378	21.8
Entertainment	1702	5.8
Post and Communication Services	844	2.9
Local Transportation	1030	3.5
Other Service	3299	11.3

Source: National Bureau of Statistics of China, 2006, Table 19-2.

Other services also use a large proportion of total value of labour (29.8%) and value of capital (29.3%) and contribute to 20.8% of GDP. Primary industry is an important part of the Chinese economy contributing to 9.1% of GDP by only six industries included. Among the ten tourism-related industries, catering, road transport and communication account for higher percentages of GDP, which are 1.8%, 1.7% and 1.5% compared with the other seven tourism-related industries. Tourism exports in air transport, accommodation and residential services together are up to 45% of the total, which shows that international tourists purchase a lot from the three industries.

Figure 4 Aggregation of industries in the China 2002 Input - Output Tables

	Number of industries included	GDP (%)	Total value-added (%)	Imports (%)	Non-tourism exports (%)	Tourism exports (%)	Total value of labour (%)	Total value of capital (%)
Primary industry	6	9.1	13.6	2.5	1.5	1.5	22.6	6.1
Secondary industry	82	60.8	45.2	90.4	80.4	18.6	38.2	49.1
Railway transport[1]	1	0.3	0.7	0.1	0	2.7	0.7	0.5
Road transport[2]	2	1.7	2.4	0.3	0.5	6	2.2	3.1
Water transport	1	1.4	1.4	0.2	1.9	2.5	1.2	2
Air transport	1	0.3	0.3	0.4	0.1	20.2	0.1	0.4
Communication[3]	2	1.5	2.4	0.1	0.2	2.9	1.1	4.6
Accommodation	1	0.5	0.6	0	0	13.4	0.4	0.8
Catering	1	1.8	1.8	0	0	8.8	1.3	2.2
Tourism[4]	1	0.2	0.3	0	0.2	4.6	0.2	0.5
Residential services	1	1.4	1.6	1.5	2.2	11.3	2	1.1
Recreation	1	0.2	0.2	0	0.3	5.8	0.2	0.2
Other services	22	20.8	29.4	4.3	12.6	1.6	29.8	29.3
Total	122	100	100	100	100	100	100	100

Model assumptions and model closure

This China CGE model is a single-country static model, which captures the short-run impact of the Beijing Olympic Games in 2008. There are different economic agents in the economy, 122 industries, representative household, and government, and two factors, labour and capital. On the demand side, utility maximization subject to the resource constraints leads to demand functions. On the supply side, profit maximization subject to resource constraints leads to supply functions. Prices, as one set of the most significant endogenous variables, are adjusted to make all excess demands equal to zero, which means that every market clears simultaneously.

[1] Railway transport, road transport, water transport and air transport all refer to passenger transport.

[2] Road transport includes highways transport and urban public transport.

[3] Communication includes postal and courier services and information transfer services.

[4] Tourism refers mainly to services offered by tour operators and travel agents.

The Leontief function, Cobb-Douglas function, the Constant Elasticity of Substitution (CES) function and the Constant Elasticity of Transformation (CET) function are applied to production and demand functions. A three level nesting structure of production is introduced in the model (Figure 5). Each level shows an elasticity of substitution. The first level reveals supply of each product is a CES function of domestic supply and imports using the elasticity of φ. Production of domestic outputs is a CET function of exports and supply using the elasticity of τ. Production of domestic products uses fixed coefficient of zero between value-added and intermediate inputs, and between different intermediate inputs in levels two and three. In anther group of the third level, the CES function with elasticity of σ is used between factors. The Armington elasticity of substitution between imports and domestic goods, the elasticity of transformation elasticity, and the elasticity of substitution between factors of production are taken from the Global Trade Analysis Project (Hertel 1997) database and are adapted to the industries used in this study (Figure 6).

Figure 5 Three-level nesting structure of production

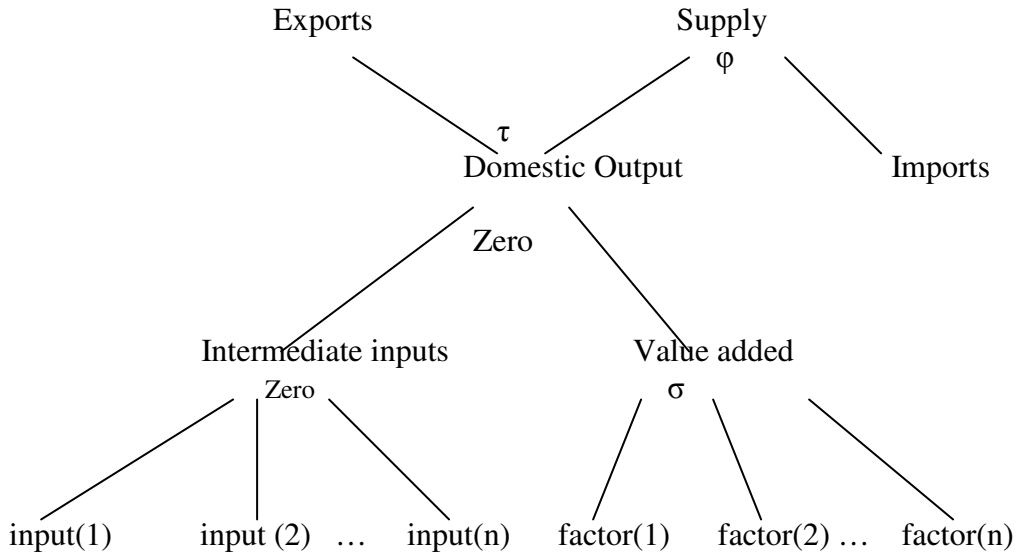


Figure 6 Elasticities used in the Model

	φ (Armington elasticity)	τ (output transformation elasticity)	σ (factor substitution elasticity)
Primary industry	0.5-1.1[1]	0.5-1.1	1.5-15
Secondary industry	0.6-1.5	0.6-1.5	1.5-15
Railway transport	0.5	0.5	10
Road transport	0.5	0.5	10
Water transport	0.5	0.5	10
Air transport	0.5	0.5	10
Communication	0.6	0.6	1.5
Accommodation	0.5	0.5	15
Catering	0.5	0.5	15
Tourism	0.5	0.5	10
Residential services	0.5	0.5	15
Recreation	0.5	0.5	15
Other services	0.5-0.6	0.5-0.6	1.5-15

Demand by international tourists is a Cobb-Douglas function of individual product demands (Figure 7 (a)), with demand for the Cobb-Douglas aggregate product being a downward slopping function of the aggregate tourism price (Figure 7 (b)). The price elasticity of international tourism demand is estimated as -1.37 according to recent research conducted by Song and Fei (2006).

Figure 7 Demand by international tourists

(a) (b)

Figure 7 (a) can also be formulated in the following function:

$$p^T = \lambda \prod_n p_i^{\alpha_i}$$

[1] Where more than one elasticities are used in different industries, a range is provided.

Where p^T is the aggregate international tourism price; λ is a shift parameter; p_i are individual product prices; $\sum_i \alpha_i = 1$.

Figure 7(b) can be expressed in the following function:

$$q^T = \overline{Q^T} \left(\frac{p^T}{e} \right)^{\mu}$$

Where q^T is the demand quantity by international tourists; $\overline{Q^T}$ is the benchmark demand quantity by international tourists; e is the exchange rate; μ is the price elasticity of international tourism demand, which is –1.37 in the model.

The government receives taxes on production and income, and consumes public goods. The remainder of government revenue after purchasing public goods is transferred to the representative household. Foreign investment is assumed to be fixed, which leads to a fixed current account balance.

The representative household receives revenues through offering factors, labour and capital, to produce domestic and export goods and it receives government transfers. The representative household purchases both domestic and import goods, pays taxes and saves additional revenues. International visitors are treated as a separate group of consumers, who purchase national goods and services.

The Armington assumption is used in the model, which specifies that domestic goods and import goods cannot be perfectly substituted by each other. China is a big country in terms of territory and population, but its prices still could not affect world prices. Thus, a "small" country assumption is employed, which indicates that domestic prices are determined by world prices.

Firms compete in a Dixit-Stiglitz type of imperfectly competitive setting (as in Harris, 1984; Harrison, Rutherford and Tarr, 1995). Each firm produces one variety of product, which is different from other varieties supplied by other firms in the same industry. Free entry and exit are allowed by assuming that the number of firms in an industry will change as industry output changes. While analyses of the Chinese economy have often concentrated on the nature of a dual economy, where both planned and market systems coexist, those characteristics are becoming less pronounced as the planned elements of the Chinese economy become more aligned to a market system with prices determined by the market to equate supply and demand (Naughton, 2005).

Prediction of international tourism during the Beijing 2008 Olympic Games

Some assumptions and simulations in CGE models may affect the results dramatically because of uncertainties (Blake, 2005). In this model, the increased international tourism expenditures brought by the staging of the Beijing Olympic Games are uncertain because it has not happened when the research is conducted. We try to address this uncertainty by introducing three scenarios (low, central and high) by assuming different international visitor expenditures per visitor per day. According to China National Tourism Administration, foreign visitor spending per visitor per day was $136.85, $138.76 and $140.09 in years of 2000, 2001 and 2002. Based on the trend of the increase in foreign visitor spending per visitor per day, the figure in 2008 is estimated to be $150.30, which is included in the low scenario. Foreign visitor spending per day per visitor in the high scenario is taken from an analysis by Beijing K&D Consulting Company, who predicted that a foreign visitor would spend $300 per day during the Beijing Olympics. The central scenario assumes an average of the low and high scenario, which is $225 per foreign visitor per day (Figure 8). The expenditures per visitor per day of other types of international visitors are a certain proportion of that of foreign tourists calculated according to the estimation in previous

studies (Airola and Craig, 2000; Blake, 2005). The increased foreign tourist number attributable to the staging the Olympics is forecasted to be 250,000 by the Beijing Tourism Administration. The estimation of other types of international visitor number and days per visitor are adapted from the estimates of Houston bidding of the 2012 Olympics (Airola and Craig, 2000) and the London2012 estimates (Blake, 2005). The increased international visitor spending due to holding the Beijing Olympics is projected to be $600.8 million in the low scenario, $899.4 million in the central scenario and $1199.2 million in the high scenario.

Figure 8 Estimation of international visitor spending during the Beijing 2008 Olympic Games (central scenario)

Type of international visitors	Visitor numbers	Days per visitor	Spend per day per visitor ($)	Spend per visitor ($)	Spending, total (million, $)
Foreign tourists	250,000	10	225	2250	562.5
Athletes, foreign	13,000	28	98.29	2752.22	35.78
Officials, foreign	2,500	28	73.21	2049.96	5.12
Media visitors, foreign	18,000	28	336.26	9415.23	169.47
Sponsor Visitors, foreign	6,000	28	504.37	14122.42	84.73
Olympic Family, foreign	4,500	28	331.68	9287.16	41.79
Total	294,000				**899.39**

Sensitivity Analysis

Sensitivity analysis is used to test the reliability and confidence of CGE models. The prediction of the Olympic economic impact is carried out before the Olympic Games are held, which may put constraints on the availability of data. Main assumptions and parameters in the model, such as elasticities, may also introduce uncertainties into the model. A key elasticity in the model is the price elasticity of international tourism demand. In order to test the degree of effects that this elasticity might bring to the results, the base elasticity (-1.37) is halved to be –0.685 and doubled to be –2.74 in two sensitivity tests. Sensitivity analysis will also be applied to three groups of

main elasticities, armington elasticity, output transformation elasticity, factor substitution elasticity, used in the model by doubling one elasticity and maintain the other two unchanged. For example, Armington elasticity is doubled while output transformation elasticity and factor substitution elasticity are kept the same as the base case.

6. Findings: the International Tourism Impact of the Beijing 2008 Olympic Games on the Chinese Economy

The whole economy impact

Figure 9 shows main results of the impact of the international tourism on the Chinese economy due to holding the Beijing Olympics in the low, central and high scenarios. Economic welfare, which shows the impact on households, is measured by the equivalent variation (EV). Blake (2000) points out that a welfare increase is equivalent to a real GDP increase. The increase in welfare, which is $177million in the central scenario (row A), would be brought to the households by holding the Beijing 2008 Olympic Games. The change in real tourism consumption ($862 million in the central scenario in row C) is less than the change in international tourism demand ($899 million in row B), which is the demand shock put in the model. This occurs because there is a 0.09 increase in price of foreign tourism consumption (row D), which offsets real tourism spending. The change in tourism expenditure ($899 million in the central scenario in row E) is the combination of the changes in real tourism consumption and the price of international tourism consumption. Every unit change in international tourism demand (row A/B) leads to a change in welfare by 0.197. Every unit change in real tourism consumption will change welfare by 0.205 (row A/C). Each unit of tourism expenditure generates 0.199 of the welfare value. In the low and high scenarios, it is projected that households will gain welfare equivalent to $118 million and $236 million, which is stimulated by an increase of $576million and $1151million in real tourism consumption respectively.

Figure 9 The economic impact in three scenarios

	Calculation	Low	Central	High
Change in EV (USD, million)	A	118.2	177.1	236.4
Change in international tourism demand (USD, million)	B	600.0	899.0	1199.0
Change in real tourism consumption (USD, million)	C	576.3	863.2	1150.8
Percentage change in price of foreign tourism consumption (%)	D	0.06	0.09	0.12
Change in tourism expenditure (USD, million)	E	593.6	889.3	1186.0
Change in EV per Change in international tourism demand	A/B	0.197	0.197	0.197
Change in EV per Change in real tourism consumption	A/C	0.205	0.205	0.205
Change in EV per Change in tourism expenditure	A/E	0.199	0.199	0.199

The results under the base and the sensitivity test 1 and 2 are compared in Figure 10. In the sensitivity test 1, although the price elasticity of international tourism demand is half of the elasticity in the base case, the change in the EV is only $3.5million more than the base case with $17.5 million difference in the change in real tourism consumption compared to the base case. In the sensitivity test 2, where the price elasticity of international tourism demand is twice as that in the base case, the change in the EV is about $7million and the change in real tourism consumption is around $33 million less than the base case. Therefore, the change in price elasticity of international tourism demand does not affect the results significantly in the whole economy level impact. The three ratios (A/B, A/C and A/E) do not show much difference between the base case and the two sensitivity tests. Particularly, the ratio (A/C) reveals that the value of welfare in each unit of real tourism consumption remains the same when the price elasticity of international tourism demand changes.

Figure 10 Sensitivity analysis of the whole economy impact in the central scenario (1)

(The Central Scenario)	Calculation	Base	Sensitivity test 1	Sensitivity test 2
Price elasticity of international tourism demand		-1.37	-0.685	-2.74
Change in EV (USD, million)	A	177.1	180.7	170.3
Change in international tourism demand (USD, million)	B	899.0	899.0	899.0
Change in real tourism consumption (USD, million)	C	863.2	880.7	830.2
Percentage change in price of foreign tourism consumption (%)	D	0.09	0.09	0.08
Change in tourism expenditure (USD, million)	E	889.3	907.4	855.3
Change in EV per Change in international tourism demand	A/B	0.197	0.201	0.189
Change in EV per Change in real tourism consumption	A/C	0.205	0.205	0.205
Change in EV per Change in tourism expenditure	A/E	0.199	0.199	0.199

Doubling Armington elasticity lowers the change in household welfare compared to the base case in the central scenario from $177million to $126million (Figure 11). A higher Armington elasticity appreciates real foreign exchange, which leads to a smaller increase in domestic prices. When other factors (for example, taxes) are not considered, the growth of tourism expenditures increases household welfare through bidding up prices of non-tradable goods (Brian and Copeland, 1991). Therefore, a smaller increase in household welfare results from a smaller increase in domestic prices. In sensitivity test 4, the elasticity of substitution between exported goods and domestic goods is twice as much as the base case. The change in household welfare slightly decreases compared to the base from $177million to 163million. The reason for this is similar to doubling the Armington elasticity. When output elasticity is doubled, larger demand for exports appreciates the real exchange rate, which causes a smaller scale of increase in domestic prices. Sensitivity test 5 shows that doubling factor substitution elasticity will not affect the results compared to the base case because the changes in the labour wage and rate of return to capital are the same.

Figure 11 Sensitivity analysis of the whole economy impact in the central scenario (2)

(The Central Scenario)	Calculation	Base	Sensitivity test 3	Sensitivity test 4	Sensitivity test 5
Three main elasticities		**Central scenario**	**Doubling Armington elasticity**	**Doubling output elasticity**	**Doubling factor substitution elasticity**
Change in EV (USD, million)	**A**	177.1	126.4	163.3	177.1
Change in international tourism demand (USD, million)	**B**	899.0	899.0	899.0	899.0
Change in real tourism consumption (USD, million)	**C**	863.2	872.1	870.3	863.2
Percentage change in price of foreign tourism consumption	**D**	0.09	0.07	0.07	0.09
Change in tourism expenditure (USD, million)	**E**	889.3	891.7	891.3	889.3
Change in EV per Change in international tourism demand	**A/B**	0.197	0.141	0.182	0.197
Change in EV per Change in real tourism consumption	**A/C**	0.205	0.145	0.188	0.205
Change in EV per Change in tourism expenditure	**A/E**	0.199	0.142	0.183	0.199

The industry level impact

In general, tourism-related industries experience increases in the total value of labour and of capital use, imports, tourism exports and output (Figure 12). The holding of the Beijing Olympics provides a stimulus to tourism-related industries through the increase in international tourism demand. As a result of the expansion of international tourism, outputs of tourism-related industries increases. For example, outputs of air transport, recreation and accommodation are predicted to increase by 0.98%, 0.60% and 0.43% respectively. Air passenger transport is the largest tourism exporter with an increase of $118.4 million, while the greatest leakage through imports can also be seen in air passenger transport ($180million).

However, the growth of international tourism during the Beijing Olympics brings crowing out effects on secondary industries. This allocation consequence captured by CGE models has also been observed in previous studies. The secondary industry experiences a big decline in non-

tourism exports, which is $691million, while it gains by exporting more tourism goods ($165million). This situation occurs because some secondary industries supply intermediate inputs to tourism-related industries, such as construction, manufacturing and food processing. A small decrease in output can been seen in secondary industries, of 0.046%. The outputs in primary industries increase by only 0.003%. The increased international tourism demand bid up prices in all industries and the percentage change of prices is between 0.044% and 0.108%.

Figure 12 The industry level impact in the central scenario

(Central scenario)	Change in non-tourism exports (million, USD)	Change in tourism exports (million, USD)	Change in price (%)	Change in output (%)
Primary industry	-4.2	13.8	0.098	0.003
Secondary industry	-690.6	165.2	0.086	-0.046
Railway transport	N/A	24.2	0.088	0.154
Road transport	0.1	53.1	0.094	0.060
Water transport	-4.1	22.6	0.108	0.009
Air transport	5.3	179.9	0.044	0.976
Communication	-0.1	25.6	0.090	0.032
Accommodation	0.2	119.5	0.080	0.434
Catering	N/A	78.5	0.097	0.079
Tourism	2.8	40.5	0.085	0.354
Residential services	10.2	100.1	0.083	0.126
Recreation	8.9	51.7	0.091	0.600
Other services	-45.1	14.6	0.101	-0.004

The results of sensitivity tests 1 and 2 by halving and doubling price elasticity of international tourism demand are presented in Figure 13 and Figure 14. In the first test, international visitors are less sensitive to changes in prices. Tourism-related industries benefit slightly more while secondary industries are slightly more negatively affected than the base case. For example, the percentage growth of output in air passenger transport increases from the base case (0.976%) to the first test (0.996%); output in secondary industries suffers a slightly higer decrease in the first test (0.046%) compared to the base case (0.047%). In the second test, the changes of prices have

a bigger impact on international visitors than the base case, which reduce the benefits to tourism-related industries. However, results in both sensitivity tests do not differ significantly from those in the base case, which means that the change of price elasticity of international tourism demand does not affect the model results qualitatively.

Figure 13 Sensitivity analysis of the industry level impact in the central scenario (1)

(Central scenario, Price elasticity of international tourism demand = -0.685)	Change in non-tourism exports (million, USD)	Change in tourism exports (million, USD)	Percentage change of price index (%)	Percentage change of output (%)
Primary industry	-4.3	14.1	0.100	0.003
Secondary industry	-704.6	168.6	0.088	-0.047
Railway transport	N/A	24.7	0.090	0.157
Road transport	0.1	54.1	0.096	0.061
Water transport	-4.2	23.0	0.110	0.009
Air transport	5.4	183.6	0.045	0.996
Communication	-0.1	26.1	0.092	0.032
Accommodation	0.2	121.9	0.081	0.442
Catering	N/A	80.1	0.099	0.081
Tourism	2.8	41.3	0.087	0.361
Residential services	10.4	102.2	0.085	0.128
Recreation	9.0	52.7	0.093	0.612
Other services	-46.1	14.9	0.103	-0.004

Figure 14 Sensitivity analysis of the industry level impact in the central scenario (2)

(Central scenario, Price elasticity of international tourism demand = -2.74)	Change in non-tourism exports (million, USD)	Change in tourism exports (million, USD)	Percentage change of price index (%)	Percentage change of output (%)
Primary industry	-4.0	13.2	0.094	0.003
Secondary industry	-664.1	158.9	0.083	-0.045
Railway transport	N/A	23.3	0.085	0.148
Road transport	0.1	51.0	0.090	0.058
Water transport	-3.9	21.7	0.104	0.008
Air transport	5.1	173.1	0.043	0.939
Communication	-0.1	24.6	0.087	0.030
Accommodation	0.2	114.9	0.077	0.417
Catering	N/A	75.5	0.094	0.076
Tourism	2.6	38.9	0.082	0.340
Residential services	9.8	96.3	0.080	0.121
Recreation	8.5	49.7	0.087	0.577
Other services	-43.4	14.0	0.097	-0.004

7. Conclusions

Although I-O models have been used to examine the economic impact of tourism in China, CGE models have not yet been employed in tourism studies in China. This paper attempts to take a first step in applying CGE modelling with imperfect competition to Chinese tourism research, especially, the economic impact of tourism in China. The results generated in this paper may be more realistic than the two previous studies conducted by Oosterhaven and Fan (2006) and Yan and Wall (2001). Since the two studies applied I-O modelling to examining the impact of international tourism on Chinese economy, they did not include constraints on factors and assumed that wages and prices are changeless in their models. This paper overcomes these limitations by using CGE modelling which have more plausible assumptions.

This paper has shown the importance and feasibility of applying CGE modelling to estimating the impact of international tourism on the Chinese economy by building a static CGE model. Imperfect competition is introduced into this model. The model predicts the economic impact of an increase in international tourism due to staging the Beijing 2008 Olympic Games. The findings are analysed in two parts, the macroeconomic impact and the industry level impact. It is estimated that an additional international tourism consumption of $863million has welfare benefits of $177million in the central scenario during the Beijing Olympics, which means that the change in one unit of international tourism consumption changes the welfare value by 0.205. This result stays almost the same in the low, central and high scenarios, and in two sensitivity tests. Also, the Change in EV, that is change in welfare is considered as a better economic indicator than Gross Domestic Product in terms of showing the net benefits that households can receive (Blake, 2000). Tourism-related industries are positively affected while industries not related to tourism expenditures decline during the Beijing Olympics. The low and high scenarios, where different assumptions of the increased international visitor spending are made, are also discussed. Sensitivity analysis is conducted with two tests of different price elasticity of international tourism demand and with three tests of three groups of elasticity. The results of the two tests show that the change of the price elasticity of international tourism demand does not affect the model results qualitatively.

Staging sustainable Olympics is one of the major objectives for a host city. In terms of an economy, sustainability can mean the Olympic legacy. Efforts need to be put in enhancing the Olympic legacy through promoting the city as a tourism destination, upgrading tourism facilities and improving services in tourism industries. To attract more international tourists, it is important to enhance the good side of the image of Beijing and change the bad side of its image. For example, pollution in Beijing is a main concern for many foreign tourists. On the one hand, the

government needs to publicize what it has done to curb pollution through media to build tourists' confidence of traveling. For instance, Beijing has spent over $12 billion pollution control, switched 1,100 coal-burning power plants to gas, and upgraded or replaced 2,000 old buses with cleaner models (Watts, 2007). On the other hand, the government should continue to reduce the pollution, such as to control the number of new cars. Hosting sustainable Olympics requests the government to provide a lasting tourism legacy by holding other events, further upgrading tourism facilities and improving tourism services after the Olympic Games. In 2009, another big event, the 60th Anniversary of China's National Day will be celebrated in China, which could be another important stimulus to tourism (Hu and Song, 2005).

This paper used an advanced method, CGE modelling, to predict the impact of one of the most important components of the economic impact of the Olympics, international tourism expenditure, on the host country in great detail. It also should be noticed that the economic impact of the international tourism is not the only economic impact brought by the Beijing Olympics and other economic effects also generated through the investment in the construction of the Olympic stadia and the Olympic-related infrastructure, the Olympic legacy after the Games and expenditures of the Beijing Olympic committee.

The Olympic Games bring about not only the economic effects, but also other types of effects, such as social, cultural and environmental effects. The Olympic Games also generate intangible benefits which are difficult to quantify. Preuss (2002) discussed some intangible effects including Olympic atmosphere, volunteer movement, national pride and living conditions. The IOC has launched the Olympic Games Global Impact project to evaluate a wide range of impact of the Olympics in terms of economic, social and environmental spheres.

The prospect of applying CGE modelling to China's tourism studies is promising. Further research can extend attempts to build dynamic or multi-regional models (for Beijing, the rest of China or different regions of China), estimate the long-run impact (before, during and after the Olympics), run simulations using different tourism policy scenarios and include other elasticities in the sensitivity analysis.

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