The Economic Impact of the London 2012 Olympics

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ABSTRACT

On 6 July 2005 the International Olympic Committee awarded the right to stage the 2012 summer Olympic and Paralympic Games to London. The decision to bid for the Games is a politically contentious one, with many arguments that support the benefits that such "mega events" bring and many arguments that highlight the detrimental effects that they can incur. This political decision is further complicated by the existence of groups in society that benefit from the hosting of such events and other groups that lose out because of them; and because of pressure groups that exist on both sides of this argument. This paper examines the economic benefits and costs of hosting the Olympics, in parallel with other studies that have estimated other social and environmental costs and benefits. The objective is to use the most appropriate form of methodology to examine the net economic consequences of hosting the Games for both the UK as a whole and for London. The net benefits are found to be positive, and large relative to the investment in the bidding process, although smaller than previous studies that have tended to examine gross effects.

Keywords: Olympic Games, Economic Impact, CGE Modelling.

JEL Classification: C68, D58, L83,

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Introduction

The evaluation of the economic importance of the Olympics to a host city, its region and country has become an important aspect of the overall evaluation of the value or worth of hosting the Olympic Games. These evaluations are often known as economic impact assessments or reports, and are increasingly being used in the early stages of the Olympic bidding process[1]. It is vitally important that the host city and the organising committee in the host city are aware of the scale of the economic benefits that hosting the Games may bring. This allows the Games to be promoted in the local context as bringing significant benefits to the local economy as well as providing the organising committee with the scale of benefits so that it can have an improved understanding of how large the costs of bidding for and hosting the games should be.

As Brown and Massey (2001:26) note, hosting the Olympics has not always brought financial reward. The 1972 Munich Olympics and 1976 Montreal Olympics made losses of £178 million and £692 million. The 1984 Los Angeles Olympics and the 1992 Barcelona Olympics made surpluses of £215 million and £2 million. This increased economic performance of Games organisers, as well as the increased economic impact of the Games is due to a larger market, particularly for television rights to the Games, but also because the higher costs of the Games with larger competitor numbers and higher expectations of the quality of Olympic venues has meant that organising committees have had to justify these costs and therefore have been driven to increase revenues and economic impacts.

[1] For example, three of the original candidates for the 2012 Olympics that did not make the short-list had conducted Economic Impact Assessments (BASOC 1998; Airola and Craig 2000; Fuller and Clinch 2000).

Financial performance of the Games organisers is a very narrow definition of the economic benefits from hosting the Olympics. The wider economic impact of the Olympic Games includes the effects that the visitors to the Games have on the local economy through their expenditures in the host city, the developmental benefits of targeted infrastructural investments in deprived areas and the long-term 'legacy' benefits that the increased exposure to the international media brings through increased tourist arrivals and tourism receipts in the years after (and before) the Games. The combination of these effects is very complex, and cannot be determined purely from the financial performance of the Games organisers or of the additional revenues that the Olympics bring to the host city. It is these factors have on the economy of the host city and nation that are the subject of economic impact assessments.

1.1 Economic Impact Assessments

In order to conduct an economic impact assessment (EIA) of the Olympic Games the following stages must be undertaken. Firstly, the effect of the Games on spending, by organisations such as the organising committee as well as by individuals must be calculated. Spending by the organising committee includes infrastructural spending in the pre-Games period as well as spending in the Games period itself. Spending by individuals includes the transport, accommodation, food and entertainment expenditures of spectators as well as athletes, officials and media representatives; although some of these categories have accommodation, food and/or transport provided through the organising committee's budget. Care must be taken to differentiate spending by residents from spending from non-residents, and also to take account of spending that is diverted away from the host city. Secondly, this expenditure must be categorised by product (goods and services) and thirdly, a model must be used to calculate how this spending translates into income and employment.

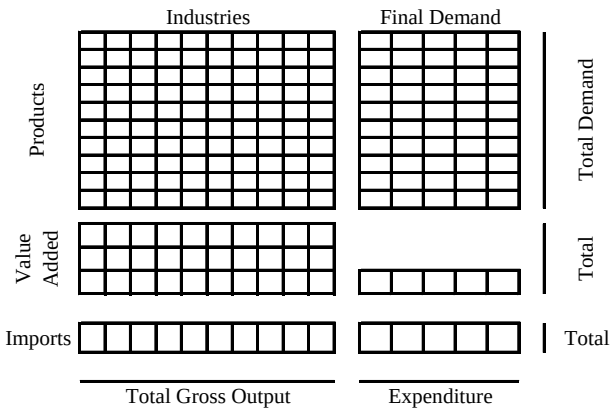
In the past, input-output models have been the primary means of translating spending effects into income and employment effects. A number of EIAs have been conducted of Olympic Games using these models. Input-output tables are at the core of input-output models.

Input-Output Tables

Input-output tables show a complete set of accounts for an economy, typically for a certain year. Figure 1 shows the basic structure of an input-output table. The main body of the table has industries listed in columns and products listed

in rows. The figures in the table show the value of each product used in each industry[2]. Products used in an industry are termed intermediate inputs, and include for example, agricultural products used in the food processing industry, rubber products (tyres) used in the car manufacturing industry, and business consultancy services used in the government services sector. The table of intermediate inputs usually contains some zero or blank entries as not every product is used by every industry. Different input-output tables contain different degrees of detail in the number of products and industries included; the latest UK input-output tables contain 123 products and industries (Office for National Statistics 2002a); the United States has published tables for 498 products and industries (Bureau of Economic Analysis 2002), while smaller tables of around 20 to 50 products and industries are more common.

Figure 1: The Basic Structure of Input-Output Tables



Below the intermediate input matrix is the value added matrix, which shows the use of labour inputs, the payments of production taxes, receipts of production subsidies and gross operating surplus (pre-tax profits before the replacement of depreciating capital). These items sum up to industry gross value added (GVA), which shows the value that is created in each industry. Below the value added matrix is a row of entries showing the values of imported goods used in production in each industry; note that the intermediate matrix shows the value of domestic products used in each industry. Input-output models only need to know the total value of imports used in each industry, not the value of imports of each product in each industry; so imports are often included as a single row in input-output tables[3].

[2] For simplicity certain technical details are not discussed here, such as whether or not the values in the input-output table include taxes, the definition of product by product or industry by industry tables and the inclusion of transport and marketing margins.

[3] There are exceptions where a separate intermediate matrix is produced for imports and domestic goods; the Spanish input-output tables (INE 2001) for example show a complete product by

On the right of the input-output table is a final demand matrix, showing the value of consumption of each product by various types of final demand. Typically, these types of final demand include private households, government, investment and exports although any of these items can be more detailed; for example separate columns could be included for local and central government, for tourism exports and other exports, or for domestic private tourism and private non-tourism demands. An import row is also included for final demand. For each of these types of final demand, the input-output table shows the value of domestic consumption of each product, the value of taxes paid on these products, and the value of imports purchased.

The row and column totals have special meanings in this framework. The industry column total shows industry gross output, or the value of products produced by that industry. The column totals for final demand components show total expenditure. The row totals for products show total demand for each product, which must also equal total supply. The value added row totals show, for labour: total labour earnings; for gross operating surplus, the total gross operating surplus; and for taxation, the total taxation of products and production.

It is worthwhile to summarise how gross domestic product (GDP) is measured in these tables, as this will be one of the main indicators used throughout the rest of this report. GDP can be measured in three different ways, each of which lead to identical values in the input-output framework although in practice there are different measurement errors in these approaches. Firstly, GDP can be measured through demand (the 'expenditure approach' in Office for National Statistics 2002b), where it is measured as total final demand expenditure (including exports) minus imports. This is a simple measure to compute from the input-output table, as it is the column totals for final demand minus the row total for imports. Secondly, GDP can be calculated through the income approach, where GDP is equal to total value added – the sum of the row totals for labour, gross operating surplus and taxation. Again, it should be stressed that this measurement leads to identical values to the demand-side measurement.

The usefulness of input-output tables is expanded when the calculation of GDP through income is split up into separate calculations for each industry, to show

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industry matrix for domestic goods, imports from other EU countries and imports from the rest of the world.

how each industry contributes to GDP. Gross value added (GVA) is defined as labour payments plus gross operating surplus plus taxation payments made by an industry. GDP is then the sum of GVA across industries plus the taxation payments made by final demand[4]. The third method of calculating GDP, the 'production approach' is undertaken by calculating GVA in each industry in this way.

Net value added (NVA) is defined as the labour payments and gross operating surplus of an industry. An obvious relationship exists between NVA and GVA – NVA is simply GVA net of tax payments.

It should be noted that GVA is sometimes also termed 'net output', which can lead to confusion in some of the studies discussed below regarding the true impact of an event, as studies sometimes give results for 'output' meaning gross output, which are then misinterpreted as being results for net output or GVA. Gross output is a measure of revenue, and is in most industries significantly larger than GVA; therefore impact calculations of gross output changes are usually much higher than earnings-based estimates through GVA. It should be stressed that gross output and measures of impact based on it can have no interpretation as 'benefit'. GVA and GDP based measures are a suitable way of approximating the benefit of events.

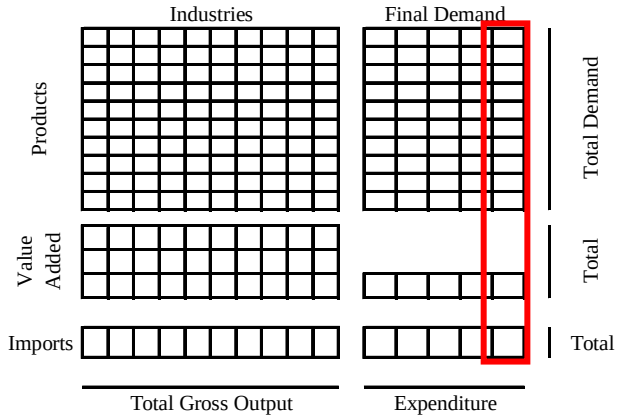
Input-Output Models

This structure of national accounts enables the value added of each industry to be examined, and in many cases the gross value added of a particular industry is all that a commentator may need to know. The use of an input-output model can however expand the usefulness of these tables to a significant extent. Indeed, input-output tables were first compiled by the Nobel Prize winning economist Vassily Leontief so that they could be used in input-output models, although they have since found wider uses.

[4] Note that here, and throughout this analysis that the final demand columns' tax payments in an input-output table are only taxes paid on products, such as value added tax and excise duties; they do not include direct taxes such as income tax and corporation tax.

Input-output models are used to derive the impact on industries' GVA, total GVA, GDP, imports and employment of changes in final demand expenditures. Typically, a type of final demand expenditure, for example tourism exports, is represented as a column (the red column in Figure 2) containing foreign tourists' demands for different goods and services, and also their direct spending on taxes (the value added taxes and excise duties levied on the goods and services they consume) and imports. For each product demanded by tourists, the GVA, import and employment impact is calculated by assuming that the industry that produces that product uses its inputs of value added and imports in a constant proportion to output; so that if the hotel industry has revenues of £100 million and has a gross value added of £50 million and uses imports of £20 million (the remaining £30 million being intermediate use of domestic products), then any additional £100 must be supported by an additional £50 of GVA and £20 of imports. The ratios derived in this manner are then multiplied onto tourism exports of each product to derive the GVA and import impact of foreign tourist spending on each product, and are summed to give the GVA and import impact of all tourism spending, where the import impact figure must also include tourists' direct purchases of imports. The GDP impact of tourism exports can then be derived by adding taxation on tourists' spending onto the total GVA impact.

Figure 2: Visitor Spending in an Input-Output Table



A second round of effects can be included by considering how the intermediate products used in say the hotel industry are produced. These will be products produced by domestic industries (because imports have been counted elsewhere), which have their own ratios of GVA and imports to output. These ratios can then be used to give the GVA and import impact of the hotel industry's intermediate purchases that are used to support the tourists' purchase of hotel services. Further rounds of intermediate spending, each leading to GVA and import purchases, can be considered. In fact there are potentially an infinite number of rounds of spending, although a small number

of steps would usually be an adequate approximation. All of these rounds of intermediate purchases are, when calculated together, termed the 'indirect effect', and there is no need to calculate the rounds one after the other as there is a quick solution to the problem involving matrix algebra[5].

Further rounds of effects are sometimes considered, as any additional income that is earned through labour or gross operating profits will (if owned by domestic private individuals) lead to further private consumption. A further set of effects termed 'induced effects' are therefore sometimes considered.

Three sets of effects (direct; direct and indirect; direct, indirect and induced) can therefore be calculated. For each of these sets, multipliers can be calculated that divide the GVA, GDP or import impact by the level of spending that drives that impact. At the direct and indirect level the GDP multiplier and the import multiplier will always sum to unity. This is because all intermediate purchases are traced through the economic system until they are eventually spent on either GVA or imports. Different types of spending (tourism exports and total exports, for example) can only have different GDP multipliers at the direct and indirect level because they have different import multipliers; a high GDP multiplier can always be explained at this level in terms of the type of spending leading to low levels of imports.

In contrast, the direct multipliers and the direct, indirect and induced multipliers have less clear meanings. Direct multipliers can be different simply because two sets of input-output tables have been compiled under different definitions, for example where one large firm owns two smaller firms that sell products to each other, if the firm is considered as a single entity in the table construction then these purchases will disappear and the direct GVA multiplier will be higher than if the two smaller firms are considered to be in different industries, in which case the industries will be purchasing inputs from each other. If firms contract out services to other companies that they previously performed in-house, the direct multipliers calculated from national accounts will fall while direct and indirect multipliers will be unaffected. Similarly, if large firms are broken up into

[5] This involves taking the matrix of intermediate inputs and dividing by column totals (industry output) to derive a matrix A of intermediate coefficients. Subtracting this matrix from the identity matrix and inverting the result obtains the Leontief inverse matrix $(I-A)^{-1}$, which neatly shows the quantity of each industry's output that is required to sell 1 unit of each other product. This is sometimes termed the total coefficients matrix. Then multiplying this matrix by, say, the tourism export vector (column) gives the total output of each industry that results from all foreign tourism spending. Multiplying this by each industry's value added gives the GVA impact of this spending.

smaller firms purchasing inputs from each other, as happened for example to the UK rail industry in the 1990s, direct multipliers will fall. It should be noted that such differences do not imply that there is any different impact from an expenditure change; the direct plus indirect measure has the advantage of being independent of the level of integration between firms.

The direct, indirect and induced multipliers can lead to some problems of interpretation as the sum of GDP and import multipliers must always be higher than one, and often GDP multipliers have been found that are higher than one. The methodological problem with these multipliers is that they assume all private consumption to be endogenous within the economic system; that is, without the other forms of final demand (government, investment and export demand) no private consumption, or for that matter any production, would take place. This has tended to cast a shadow of suspicion over the whole input-output technique, which is regrettable because the direct and indirect multipliers undoubtedly have significant meaning. The answer to this methodological problem is that while additional private income will lead to additional private consumption, there are other variables that will change in an economic system as well, such as wages, prices and the exchange rate. The inclusion of these variables leads to a form of modelling known as computable general equilibrium modelling, more of which will be said subsequently.

Using an Input-Output Model for Event Impact Assessment

As stated above, the first step of an economic impact assessment for an event such as the Olympic Games is to define the levels of spending brought about by the event. Once these are defined, the use of an input-output model requires two further steps: firstly, one or more columns of expenditures must be estimated that represent the additional spending generated by the event. This might include a column for visitors to the event and a separate column for construction activity prior to the event, or visitor spending might be considered under several different categories. Secondly, an input-output model must be used to calculate the GVA, GDP and import effects of these expenditure patterns. Several of the studies discussed below use this technique. A number of issues must be borne in mind with these studies. Firstly, to which year, and in which year's prices is a model calibrated? A model of an event in 1999 would be in different units if constructed prior to the event using 1993 data at 1993 prices to another model constructed after the event using 1999 data at 1999 prices. Secondly, are the impacts discussed in terms of GDP, GVA, or gross output? Many studies give impacts on all three of these indicators, and gross

output figures can often be misinterpreted as being the total economic impact. Thirdly, do the impacts relate to just direct effects, or direct and indirect, or direct, indirect and induced? The scale of effects will be different using the three types of effect. Finally, what is included in the initial sets of expenditure columns? Is there double-counting of any items; are domestic expenditures treated as if they are exports? Do the expenditure columns include displacement effects? All of these issues will greatly influence the value of results.

Computable General Equilibrium Modelling

Computable general equilibrium (CGE) models are used in a wide variety of economic areas such as international trade, free trade areas and customs unions, agricultural policy, economic development and environmental policy. Recently they have become used in the analysis of the economic impact of tourism where they are replacing input-output based techniques which are now seen as the "old" method (Dwyer *et al*. 2000, 2003). In the field of event impact assessment they have also begun to be used, with as shall be discussed below, the main analyses of the Sydney Olympics being conducted with CGE models.

The main difference between input-output and CGE models is that key relationships that input-output models ignore are included in CGE models. These are firstly that input-output models impose no constraint on the amount of extra income that can be earned by labour or capital. CGE models impose constraints on the availability of these factors of production, which may be that the supply of these factors is fixed or that supply is variable, but will respond to prices rather than simply being available at whatever quantities will satisfy demand. Secondly CGE models impose constraints on income and expenditure, that for private households, and separately for the government (and possibly for other agents that may be present in the model) the value of income must equal expenditure. These additional constraints require that a much higher level of complexity is used in the modelling process, because it is necessary to model prices and wages, and the way that quantity variables, such as the level of output in an industry and the level of demand for labour within that industry, respond to prices and wages.

The incorporation of these changes mean a CGE model is more complex than an input-output model but also that it measures impacts more accurately. In short, input-output models can measure all of the positive impacts of an event but are

incapable of modelling most of the negative impacts, so they consistently overestimate the impact of events. CGE models give more realistic results, and also give results for variables such as prices and real values, that input-output models cannot.

Two main differences emerge in the way that CGE models and input-output models predict the effects of an event. Firstly, the effects of changes in tourism demand have different effects in these two types of models. Input-output models capture the initial effects of tourism spending plus the indirect, and if included, the induced effects. The 'multiplier' of tourism spending on GDP is therefore fairly high, and if induced effects are included, can be greater than one – implying that £1 of tourism spending will increase GDP by more than £1. CGE models, by including (i) the effects of higher prices 'crowding-out' tourism demand, and more significantly (ii) the movement of resources into tourism-related industries from other industries, with consequent falls in output of other industries, particularly in other exporting industries, have much lower 'multiplier' effects (Adams and Parmenter 1995; Zhou *et al.* 1997; Blake 2000; Blake *et al*. 2001). In the theoretical literature it is well known that tourism only benefits an economy if it raises prices (Copeland 1991). In CGE models this is also true, as without price rises resources are simply shifting from other industries into tourism and earning exactly the same wages as they would in their original industry. If events are small in relation to the overall size of an economy (and to the value of tourism in that economy) then price rises are likely to be small, with small welfare and GDP impacts of tourism-related changes.

The second way in which CGE models differ in the impacts that they will predict for events is that construction expenditures are not necessarily positive. Many of the input-output based studies discussed in the following section treat construction expenditures as a positive effect on the economy; $1 billion of infrastructural construction will have a positive effect on GDP of $1 billion multiplied by a multiplier[6]. A CGE model requires income-expenditure conditions to be met, so that the construction spending must be paid for. Government spending on construction is usually paid for by taxation, and where this is the case the net effect of the construction projects may be negative if distortions are introduced into the economy. A dynamic CGE model that takes into account

[6] In fact, the $1 billion would be split into spending on different categories, and multipliers applied to each category of spending.

the time dimension should also include the effects of the constructed infrastructure being available after completion, i.e. capital stocks should increase in the industries in the relevant industries, with income from this infrastructure accruing to whoever owns the capital – usually this would be the government that paid for the construction, who might rent out the built infrastructure or receive income from its sale. If the value of constructed capital exactly pays for its construction costs, there may be an initial net zero effect on GDP. There are, however, distortions that are introduced into the economy as investors would not have chosen the same industry in which to put their investments; construction costs may be increased during the construction phase because of the increased demand for construction services; and the value of the capital may fall because of increased supply of capital in the relevant sector. The net effects of construction projects are therefore likely to be small, and will probably be negative.

1.2 Previous Studies of the Olympic Games

Kasimati (2003) provides a recent review of research into the impact of major sporting events such as the Olympic Games. This section draws heavily on this source, with additional information on some research not included in that paper, and with values converted into US dollars. In this and other papers, no studies of the impact of the Olympics prior to the Los Angeles Games of 1984 have been found.

Economic impact assessments are often funded by an organisation involved in the process of bidding to stage the Olympics, and because of this many of the details of the modelling are not in the public domain, even years or decades after the Games have been held.

Los Angeles 1984

The economic impact of the Los Angeles Olympics was analysed by Economic Research Associates (1984). This study used an input-output model based on a standard input-output model used in the US for local impact analysis, RIMS II. This study found the economic impact of the games on Southern California to be US$2.3 billion in 1984 dollars, and supported 73,375 jobs.

Seoul 1988

Kim *et al.* (1989) examined the economic impact of the Seoul Games and found an economic impact of around $1.6bn, with an increase in employment of 336,000 jobs.

Barcelona 1992

Brunet (1993, 1995) examined the economic impact of the Barcelona Games, finding a direct economic impact of $30 million, with 296,640 new jobs in Spain as a whole.

Atlanta 1996

Humphreys and Plummer (1995) examined the economic impact of the Atlanta Games. Using an input-output RIMS II model (an updated version of the same model used by Economic Research Associates (1984) for the Los Angeles Games), they found that the economic impact of the Games on Georgia was US$5.1 billion in 1994 dollars, and generated an additional 77,026 jobs.

Sydney 2000

Three studies have examined the economic impact of the Sydney Games. KPMG (1993) and Andersen (1999) used input-output models while the NSW Treasury (1997) used a computable general equilibrium model. The economic impact of the Games on Australia was estimated to be US$5.1bn (KPMG, 1992 values), US$4.5bn (Andersen, 1996 values) and US$4.5bn (NSW Treasury, 1996 values). While the latter two figures are almost identical, the Andersen and NSW Treasury results are less convergent in terms of NSW GDP and employment figures. Overall the three studies estimated employment gains to Australia of 156,198 jobs (KPMG), 90,000 jobs (Andersen) and 98,700 jobs (NSW Treasury).

As can be seen from the results from the NSW Treasury study (Table 1), the main impacts from the Sydney Olympics were estimated to take place in the Games year, although a sizable proportion of the gains accrue prior to the Games. This study used a regional model, where results for Australia as a whole and for the state in which the Games took place, New South Wales (NSW), are estimated separately with results from the national model feeding into the state level model. In the Games year it is noticeable that the gains to Australia as a whole ($1,128 million) are lower than the gains to NSW ($1,237 million) –

implying that the rest of Australia incurred a loss in GDP during the Games year (but not in other years).

Berman et al.. (2000) examine the reaction of stock market prices to the IOC decision in 1993 to award the 2000 Olympics to Sydney. They find that there was no overall impact of the decision on the stock market, but that share prices of certain sectors (building materials, developers and contracts, engineering and miscellaneous services) increased following the announcement. They further find that such increases in share prices were confined to the state where the Games were to take place (New South Wales).

Table 1: Sydney Economic Impact Results (NSW Treasury Model)

		Gross Domestic Product	Real Household Consumption	Employment
		($95/96 million)	($95/96 million)	('000 annual jobs)
Pre-Games, 94/95-99/00	NSW	546	255	10.1
	Aust	564	200	11.1
Games year, 2000/01	NSW	1,237	255	24
	Aust	1,128	382	29.4
Post-Games, 01/02-05/06	NSW	291	273	3
	Aust	309	473	0.4

Source: NSW Treasury, 1997, Table 1; converted into US$ by author.

Athens 2004

Two studies, Balfousia-Savva *et al.* (2001) and Papanikos (1999) have examined the economic impact of the Athens Games. Both of these studies used macroeconomic multipliers. These studies found the impact of the Games to be US$10.2 billion (2000 values) and US$15.9 million (1999 values) respectively, in medium-run scenarios between 2000-2010 (Balfousia-Savva *et al.* 2001) and 1998-2011 (Papanikos 1999). The employment impact was calculated as 300,400 and 445,000 jobs respectively. Both studies looked at the economic impact of the Games on Greece as a whole.

Both of these studies have notably high results for economic impact, particularly for employment. Although in a lower-wage economy a higher

employment impact per dollar GDP impact might be expected, the employment results appear to be out of line with the estimates for other Olympics. As Kasimati (2003:440) notes, “scepticism is raised regarding data estimates related to the level of induced tourism, total Olympic construction expenditures and Olympics operating profits”.

Candidates for 2012

Three published studies show the economic impact of the Olympics in candidates for 2012. All three of these candidates have now dropped out of the bidding process, but the impact estimates and the methods used are useful.

Airola and Craig (2000) use a version of the RIMS II input-output model to estimate the economic impact of a potential Washington-Baltimore bid on the District of Columbia. They find an economic impact of US$5.3 billion (2000 values) and an employment effect of 69,758 jobs.

Fuller and Clinch (2000) use an input-output model based on the IMPLAN model and data to analyse the impact of a potential Houston bid. The find an economic impact of US$4.3 billion (2000 values) and an employment effect of 64,216 jobs.

BASOC (1998), the Bay Area of San Francisco Olympic Committee commissioned a consultancy, Econ One Research to conduct an economic impact analysis of their bid. They estimated total economic impact at US$7.5 billion. The units of analysis for this research, and the type of model employed are not evident from BASOC (1998), and the original research from Econ One Research is not published. The model does appear to be an input-output model, however, and is probably a RIMS II or IMPLAN model. The units of analysis are probably 1998 dollars, although the higher values in this compared to the Washington-Baltimore and Houston bids might be due to BASOC using 2012 values.

Winter Olympics: Vancouver 2010

The above studies all examine the impact of the Summer Olympics. One notable study (InterVISTAS 2002) has examined the economic impact of the Winter Olympics as part of the Vancouver bid for the 2010 Winter Games. This study is notable, because as discussed below, this particular bid attracted a considerable degree of local opposition, which has in part seized upon certain weaknesses in the economic impact analysis to weaken the case for the bid overall.

Other Studies

Irons (2000) examined the effects of a country hosting the Olympic Games by comparing GDP growth rates for Olympic hosts from 1952-2000 with their long-term average growth rates. He finds that in the four years leading up to the Olympics growth rates are higher than average, by as much as 1.5% but that in the eight years after hosting the Games growth rates are on average below their long-term mean, albeit at smaller absolute sizes of growth differential. Irons (1998) also examined the impact of the Football World Cup on growth rates, and found that average GDP growth rates for World Cup hosts between 1954 and 1990 were 1% higher in the two years following the World Cup than in the two years prior to the event. He finds no effect on GDP growth for World Cup winners or runners up. In both cases, as Irons (2000) suggests, the comparison of average growth rates is only suggestive and contains no statistical tests of validity.

1.3 Visitor Spending Estimates in Previous Studies

Most of the studies listed above do not provide the visitor spending estimates that the results are based on. The exception to this is Airola and Craig (2000) who provide estimates for expenditure during Houston (Table 2). In their analysis, Airola and Craig account for the food and lodging of athletes and officials elsewhere, so this category has a low spend per day ($30).

Notably, expenditures by sponsor visitors and the Olympic family are relatively high in this analysis. Sponsor visitors “includes visitors affiliated with corporate sponsors and will primarily arrive by air and will spend at a somewhat higher rate than other visitors” (Airola and Craig 2000:4). The Olympic family includes “IOC staff, representatives of other national Olympic committees, media, out-of-state security forces, and vendors and contractors”.

Table 2: Houston 2012 Visitor Spending Estimates

Type of visitor	number	Days per visitor	$ per day	Total spending ($ million)
Domestic out-of-town	275,500	5	147.14	202.7
Sponsor visitors	67,894	6	291.13	118.6
Broadcast visitors	20,543	16	186.7	61.4
International	65,000	10	257.38	167.3
Olympic family	35,500	18	187.19	119.6
Athletes and officials	16,500	18	30.17	9.0
Pre and Post Games	340,435	10	107.56	366.2
Displaced	-30,000	18	186.73	-105.9
Total Expenditures				938.8

1.4 Critiques of Previous Studies

In recent years several Olympics bids have been criticised by local campaign groups, such as 'Bread not Circuses' (www.breadnotcircuses.org), 'Australia Anti-Olympic Alliance' (http://cat.org.au/aoa) 'People Ingeniously Subverting the Sydney Olympic Farce' (www.cat.org.au/pissoff) and 'Whistler Olympic Info' (http://www.whistlerolympicinfo.com/economic.htm). These groups are often formed during the bidding process in an attempt to dissuade their cities from bidding for the Games; the Whistler (the name of the resort outside Vancouver that will stage much of the 2010 winter Games) group campaigned unsuccessfully in a referendum to prevent the Games bid from proceeding. These campaigns use many of the criticisms found in the literature, as well as other political arguments against staging the Games. Of particular interest here is the ways in which anti-Olympics movements can use inadequacies in economic impact assessments to criticise the Games themselves. It is therefore important to take these potential criticisms into account while designing the economic impact study for the London 2012 bid so that any future movement will not be able to use weaknesses in the economic impact study to criticise the Games themselves, although as London 2012 (2004:3) point out, "there is no organised public opposition to hosting the Games in London." and the bid has strong public support in London and across the UK.

The way in which the Olympic Games are financed brings concern to economic impact assessments. In short, the IOC has legally absolved itself of any debt resulting from any Olympic Games. This means that while the IOC takes it's share of the revenues associated with the Games, the financing of any debt is the responsibility of the host city. Even the local organising committee shares none of the debt burden. Notably, debts are likely to be incurred even if the Games are an overall success as the structure of financing means that infrastructural investments are funded through borrowing. While debts are therefore balanced against the acquisition of infrastructure, there is no guarantee that the actual value of the infrastructure matches the level of debts incurred, if for example the infrastructure includes press facilities and miles of high-tech cables linking press centres with stadiums, much of which may not be used again. The British Olympic Committee has declared that it will have a policy of "no white Elephants", meaning that infrastructural projects must have long-term value. However, the popular conception of the Olympic Games since 1984 of being commercial successes is drawn into dispute when host cities' debts are taken into account. Additionally, since the entire costs of infrastructure projects are borne by the host city, there is an issue as to whether those infrastructure projects would have proceeded without the Olympic Games; if so, then they bring no additional benefits to the host city, and if not then the Games must be diverting public investment from other more worthwhile investment projects, such as health or education.

Another criticism is that economic impact studies calculate indirect and induced benefits but ignore the full costs of holding the Games, such as time costs of public servants, security and policing costs, and the costs of transporting, accommodating and entertaining IOC officials and members of the international press. While there is some confusion caused in the interpretation of these "indirect" and "induced" benefits, and the erroneous use of the same terms for costs, there is a real concern that the full costs of holding the Olympics should be assessed.

Assumptions that employment will increase without any wage or price effects is criticised as being unrealistic. In particular, the common assumptions of input-output models of the additional economic activity being able to take place using previously unemployed resources is seen as being unrealistic for a two-week event, which is often considered to be too short a time period to expect employers to hire and train new employees for. Computable general equilibrium models are capable of taking resource constraints and price effects into account.

The distributional impact of the Games is often ignored. Real estate developers, hotel owners, broadcasters and the IOC benefit from the staging of the Games, but little analysis is performed to see how widely the effects of hosting the Games are spread. Tax revenues are needed to pay for the Games, which means that those required to pay higher tax rates or new taxes to finance the Games may lose out. In the UK, lottery funding is likely to be displaced from other "Good causes".

Displacement effects are often ignored in economic impact assessments, particularly those relying on input-output techniques. Other activities are displaced as a consequence of the Games, as businesses that are positively affected by the Games are able to pay higher wages and take workers away from other economic activities. Tourists who would normally arrive during the Games period are discouraged from visiting because of the perception of high prices and congestion caused by the hosting of the Games, and for the same reasons, residents are encouraged to leave the host city for the duration of the Games.

In many cases, over optimistic pre-Games evaluations are criticised. This can be in terms of the numbers of tourists that are expected because of the Games, their average spend, an over optimistic assessment of the proportion of ticket sales purchased by non-residents, or because the construction impacts are overestimated.

Environmental costs of the Games are underreported, and are often seized upon by anti-Games movements who see them as one of the main reasons that the Olympics should be discouraged. The principal environmental costs are congestion, local pollution (due to increased emissions from cars and other transport in city areas where emissions are already high) and global pollution, where the Games may increase the emission levels of gases related to greenhouse warming because of the increased use of air transport and other emission-intensive transport activities.

1.5 Timescales and Types of Impact

A number of different types of impact have been identified in previous studies, and it is important that the London 2012 study should include the full impact (in terms of both benefits and costs) as possible. These impacts can be grouped into three categories: pre-Games, during-Games and post-Games. These categories are expanded on below. There is no real consensus on when the date

that these impacts occurs is; the impacts may overlap and are more readily defined by the types of impact. For example, the opening ceremony of the Games should not be used as a cut-off point, as the Paralympic Games would occur before this date, and many of the visitors to the Games would be in the host city before this date, and would therefore be causing an economic impact that is best classified in the “during-Games” period.

Pre-Games Impact

The pre-Games impact includes the impacts of the construction phase of the project, other pre-Games costs, as well as increases in visitor arrivals that occur because of the city’s increased profile in the run-up to staging the Games.

- The construction phase
- Other pre-Games costs
- Visitor impacts in the run-up to the Games

During-Games Impact

The during-Games impact relates to revenues from staging the Games, and the impact of visitors during the Games. As noted above, this should include events that occur prior to or after the Games, such as the Paralympic Games, that proceed because of the staging of the Olympics. The costs of running the Games should also be included.

- Revenues from staging the Games
- During-Games visitor impacts
- Costs of staging the Games

Post-Games Impact

The impact of the Olympics after the Games is often referred to as the “Legacy” effect. This includes a higher profile of the city and increased visitor arrivals to the city because of this profile. In addition, the stadia and transport infrastructure developed for the Games will provide value for many years after the Games, and the “legacy” effect of these infrastructural improvements should be included.

- Legacy visitor impacts
- Legacy infrastructural impacts

1.6 Learning from Other Studies

NSW Treasury (1997; appendix A.4.2) draws lessons from previous studies. This section draws heavily on that section as well as pointing to lessons from the NSW Treasury study and more recent studies reviewed above.

One lesson that NSW Treasury draws is that initial estimates of visitor expenditure during the games tends to be overestimated. *Ex post* analysis has shown *ex ante* visitor arrivals forecasts to have overestimated international visitor numbers by 100% (Tokyo Olympics 1964), 56% (Los Angeles Olympics 1984). Tickets often remain unsold for Olympic events – in the Los Angeles Olympics for example, 25% of tickets to events were not sold. Many of the studies listed above fail to take these effects in to consideration.

A second lesson is that international visitors to the Olympic Games have very different patterns of expenditure to normal international tourists, with less spending on non-Olympic recreation and entertainment, which has significant implications for government revenues as these activities include specific taxes on alcohol and gambling. Olympic visitors tend to watch Olympic events on television when they are not actually attending an event rather than engage in normal entertainment activities.

A third lesson is that significant degrees of expenditure switching by residents occurs during the Olympics, partly because of the congestion and higher prices because of Olympic visitors and partly because local residents tend to watch the Olympic events on television rather than engage in their normal evening entertainments such as eating meals in restaurants. In Los Angeles in 1984 and in Atlanta in 1996 restaurants were seen to have less business than normal. Expenditure switching has also been observed by non-residents who would have visited the host city but are deterred because of the perceived congestion and pricing.

2 London2012 Economic Impact Methodology

The methodology used in this study is based around a dynamic computable general equilibrium model of the UK and London economies. Before this model is employed, spending effects are estimated under a number of categories, and the level of uncertainty over these estimations is also estimated.

2.1 Types of Spending Effects

The calculation of the possible economic effects of London hosting the Olympic Games in 2012 has the obvious difficulty that any information on the levels of visitor spending, infrastructural costs, running costs and effects on tourism cannot be known at this point with certainty. The approach in this study has therefore been to make a 'central case' estimate of the effects of a London2012 Olympics and to undertake systematic sensitivity analysis around this central case. This allows the central case estimate to be taken to be the most likely outcome at this stage, but the sensitivity analysis acknowledges that there is a great deal of uncertainty about just what a London2012 Olympics would mean for the economy.

The modelling for this study has been undertaken at three levels – firstly, for the UK, secondly for London, and thirdly for five sub-regions within London. At the first two levels an economy-wide model of the relevant economies has been constructed and used in a dynamic modelling framework to estimate the effects of London2012. At the third level, central case results from the London model have been used with sub-regional data to generate how London2012 would affect earnings in the sub-regions of London.

The Games Organisation – LOCOG

The construction of sports facilities prior to 2012 and the operation of those facilities would be undertaken by the London Organising Committee of the Games (LOCOG). This body would also receive various revenues, both from ticket sales at Olympic events and from television rights and sponsorship deals. The current estimate of the revenues for LOCOG are given in Table 3, which shows estimates in a central case scenario, and both low and high estimates.

Table 3: LOCOG Revenues (£million, 2004 prices)

	LOW	CENTRAL	HIGH
Local sponsorship	240	411	590
Ticket sales	250	301	350
Transport	30	40	50
Asset sales	35	70	110
Catering	7	9	10
TV rights	410	455	500
TOP sponsorship	98	109	120
Total	1,164*	1,395	1,627*

*note that the low and high probability totals are not sums of the low and high values for each component, but are derived through systematic sensitivity analysis.

Table 4: LOCOG Operating Costs (£million, 2004 prices)

	LOW	CENTRAL	HIGH
Sports events - FF&E for new and existing venues	23	30	46
Sports events - other costs	162	171	184
Technology	240	260	300
Olympic village	42	100	144
Administration	210	250	300
Security	16	18	27
Transport	50	52	60
Ceremonies and culture	30	51	60
Advertising and promotion	70	78	90
Total	931*	1,010	1,089

*note that the low and high probability totals are not sums of the low and high values for each component, but are derived through systematic sensitivity analysis.

Table 5: LOCOG Infrastructural Costs (£million, 2004 prices)

	LOW	CENTRAL	HIGH
Olympic stadium	200	325	360
MPC&IBC	50	75	95
Olympic sports halls	42	55	84
Olympics aquatic centre	60	67	90
Greenwich sports hall	20	22	56
Olympic hockey stadium	15	16	21
Velodrome	22	26	30
Training venues	10	15	25
Broxbourne	8	9	10
University of East London	9	9.5	10
BMX track	6.5	7.5	8.5
Olympic tennis	3	6.5	7
Eton	3.3	5.3	7.3
Weymouth	2	3	4
Total	553*	642	731*

*note that the low and high probability totals are not sums of the low and high values for each component, but are derived through systematic sensitivity analysis.

Other Infrastructural Costs

A detailed breakdown of costs of infrastructural development at the Lower Lea Valley Olympics site was used (PriceWaterhouseCoopers 2004a) to provide both the costs of these developments and the variability associated with them. These developments include £1,452 million (at 2004 prices) of infrastructural development undertaken from the London Development Agency budget and £571 million undertaken as part of the Olympic transport strategy. The likelihood that each individual development project would be undertaken in the absence of the Olympics was also used to inform the 'NoGames' base scenario.

Table 6: Other Infrastructural Costs

	LOW*	CENTRAL	HIGH*
No games scenario			
Costs under the LDA budget	433	479	525
Olympic transport strategy costs	321	343	365
Total	767	822	877
Games Scenario (additional to above)			
Costs under the LDA budget	879	973	1,067
Olympic transport strategy costs	213	228	243
Total	1,103	1,201	1,299

*These values are derived through systematic sensitivity analysis from more detailed cost estimates. Low and high values do not therefore sum as this would represent a different confidence interval.

The increased infrastructure is modelled slightly differently for the Olympic venues and other infrastructure. In both cases though, additional capital is created in 2012 or 2013 that is either sold or is retained and rents from that capital are earned.

For Olympic venues, the new capital is constructed in 2013 and is completely made up of capital in the sports facilities sector. For other spending, the capital is constructed in 2012 and can be in business services (for LDA expenditure) – which includes real estate, for infrastructure converted to housing, or in railway transport (for TfL expenditure). The value of capital in sports facilities following from Olympic venue construction is 95% of the value that the same quantity of investment in private sports facilities would generate, allowing for some facilities that will not be used as well as for future-use slightly below the level that would prompt private sector investment even in the absence of the Olympics. LDA and TfL expenditure is assumed to create the same amount of capital that the same value of private investment would produce, but the sensitivity analysis allows for between 90%-100% “effectiveness” of investment.

Visitor Spending Estimates

Visitor spending during the Games year was estimated under a number of categories. The basis for this calculation is firstly, the London2012 ticket allocation model, which gives London2012’s latest assumptions regarding the numbers of tickets that would be sold, and likely proportions purchased by some of the visitor categories. Secondly, other assumptions were made based upon the past experience in other studies regarding the likely numbers of

visitors based on the ticket sales assumptions, thirdly on the number of days that each visitor category would spend in the UK (mainly based on London2012 estimates) and fourthly, estimates of spend per day based on latest data and assumptions regarding which type of visitor most closely resembles each category of Olympics visit category.

Table 7: Assumptions by Visit Category for the Olympics

	LOW	CENTRAL	HIGH
Tickets total	9,399,414	9,894,120*	10,388,826
Seat kills (%)	19.0	19.7*	20.4
Proportion sold (%)	70*	82*	95*
Average ticket price (£)	47.9	53*	58.6
Proportion sold to foreign visitors (%)	10.0*	15.0*	20.0*
Proportion of domestic to London residents (%)	60	80	90
Proportion of RUK sales to day visitors	20	40	60
Foreign, tickets per visitor	2	4	10
RUK day visitors, tickets per visitor	1	1	1
RUK tourists, tickets per visitor	1.0	1.25	2.0
Athletes, total	9,450	10,500*	11,550
Athletes, proportion from the UK (%)	4	5	6
Domestic athletes, proportion from London (%)	15	20	25
Number of Officials	7,200	8,000*	8,800
Officials, proportion from the UK	60	75	90
Domestic officials, proportion from London	20	25	30
Number of media visitors	18,000	20,000*	22,000
Media Visitors, proportion from the UK	4.0	5.0	6.0
Domestic media visitors, proportion from London	85	90	95
Volunteers, UK	42,300	47,000*	51,700
Volunteers, proportion from London	90	95	100
Number of sponsor visitors	6,300	7,000*	7,700
Sponsor Visitors, proportion from the UK	4	5	6
Domestic sponsor visitors, proportion from London	81	90	99
Olympic Family, foreign	4,500	5,000*	5,500
Olympic Family, UK	2,700	3,000*	3,300
Proportion of UK Olympic family from London	15.0	25.0	50.0

Source: *London2012 ticket allocation model; other figures, assumptions made.

Table 8: 'Central Case' Estimates of Visitor Numbers, Days and Spending outside events

	Visitor numbers	Days, total	Spending, total (£million)
London Residents	4,983,419	4,983,419	0.000
RUK day visitors	525,732	525,732	14.233
RUK tourists	576,098	2,794,077	206.297
foreign tourists	274,821	3,050,512	226.583
Athletes, foreign	13,775	442,178	14.348
Athletes, RUK	580	15,718	0.373
Athletes, London	145	3,205	0.057
Officials, foreign	2,625	84,263	2.037
Officials, RUK	5,906	160,059	3.797
Officials, London	1,969	43,509	0.771
Media visitors, foreign	19,000	609,900	67.703
Media visitors, RUK	100	2,710	0.299
Media visitors, London	900	19,890	2.276
Volunteers, RUK	2,350	51,935	3.259
Volunteers, London	44,650	986,765	12.985
Sponsor Visitors, foreign	6,650	213,465	35.544
Sponsor Visitors, RUK	35	949	0.157
Sponsor Visitors, London	315	6,962	1.195
Olympic Family, foreign	5,000	160,500	17.575
Olympic Family, RUK	1,500	40,650	4.421

Table 9: 'Central Case' Estimates of days and spend per day / visitor.

	Days per visitor	Spend per day (£)	Spend per visitor (£)
London Residents	1	0.00	0
RUK day visitors	1	27.07	27
RUK tourists	4.8	73.83	358
foreign tourists	11	74.28	824
Athletes, foreign	32	32.45	1042
Athletes, RUK	27	23.72	643
Athletes, London	22	17.73	392
Officials, foreign	32	24.17	776
Officials, RUK	27	23.72	643
Officials, London	22	17.73	392
Media visitors, foreign	32	111.01	3563
Media visitors, RUK	27	110.25	2988
Media visitors, London	22	114.43	2529
Volunteers, RUK	22	62.74	1387
Volunteers, London	22	13.16	291
Sponsor Visitors, foreign	32	166.51	5345
Sponsor Visitors, RUK	27	165.37	4482
Sponsor Visitors, London	22	171.64	3793
Olympic Family, foreign	32	109.50	3515
Olympic Family, RUK	27	108.75	2947

Table 10: Total Visitor Spending outside Olympic Events

	In London	Outside London	Total
London residents	19	0	19
Other UK residents	255	3	258
Domestic Total	274	3	277
Foreign visitors	296	67	364
Total	571	70	641

Table 11: Confidence Intervals for Visitor Spending

	LOW	Central	High
London residents	19	0	19
Other UK residents	255	3	258
Domestic Total	274	3	277
Foreign visitors	296	67	364
Total	571	70	641

The Legacy Effect

The extent to which the Olympic Games attract visitors to a country or city in the long-term is difficult to estimate with any accuracy. PriceWaterhouseCoopers (2004b) examined the trends in visitor arrivals before

and after recent Olympic Games, and based upon that analysis, the legacy effect that has been incorporated into this study involves modest increases in tourism arrivals in the central scenario with a wide range for the 'low' and 'high' scenarios. The percentage increases in tourism arrivals shown in Table 12 have been used in the UK model; in the London model the central estimate is doubled, with the same dispersion of spread between low and high values.

Table 12: Legacy Effects prior to and after the Games (% Change in Tourism Arrivals and Spending)

	LOW	CENTRAL	HIGH
UK Level			
2006-2011	0	1	2
2012-2016	-4	1.5	7
London Level			
2006-2011	1	2	3
2012-2016	-2.5	3	8.5

Diversion and Displacement Effects

Several levels of diversion and displacement effects take place in response to changes in prices and perceived congestion. Firstly foreign tourists may be displaced because they would have visited London or the UK but are deterred because of the Olympics. Secondly domestic tourists and day trip visitors who would otherwise have visited London are deterred. Thirdly, investment that would have taken place in London in industries not directly affected by the Games is deterred because of higher prices, particularly the prices of construction services during the construction phase of the Games. Fourthly, migration patterns may be disturbed because the Olympics and the activity during the construction phase makes London a more expensive place to live than would otherwise have been the case. The effects of these four types of displacement are included in the model without any need to specify them explicitly, because the relevant prices are included in the model and functions relating foreign tourism, domestic tourism and day visit demand all include prices, as do the migration and capital relationships in the London model.

One type of displacement, or expenditure diversion, effect that is likely to take place in any Olympic Games but is not driven by real or perceived prices is the expenditure switching that takes place because consumers change their activity patterns during the Olympics itself. This relates largely to expenditures on

restaurants and evening entertainment activities, which have been seen to fall during the period of the Games in previous Olympics. The expenditure diversion effect is modelled under the assumption that expenditures in these categories will fall by 10% in London and 2% nationally during the two-week period of the Olympics. It should be noted that while these figures might seem low, they are the additional expenditure switching that might occur because the Olympics are in London. Some expenditure switching might take place during the Olympics period regardless of the location of the Games, but an Olympics in London would involve more expenditure switching.

2.2 Inputs Summary

Table 13 shows the annual inputs for each type of effect, and the total value of these inputs. It is clear that the relatively small (in percentage terms) 1% and 1.5% increases in tourism expenditure due to the legacy effect have large effects on spending relative to the other items under consideration.

2.3 Modelling Approach

As discussed above, computable general equilibrium models have been used to analyse the economic impact of the Sydney Games, and are a more comprehensive means of measurement than more traditional input-output models. They overcome the failings of input-output models and therefore avoid some of the criticisms levelled at past studies.

The timescales of the economic impacts, as discussed above, generate a variety of very different effects in the pre-, during- and post- Games periods. Much of the literature has struggled to separately identify these effects. Static (one-period) models can only treat the three effects separately at best, although the literature studies almost all look at a single period of impact, with no coherent way of summing the effects. A dynamic model takes account of the time element and includes all three periods in a single modelling process, with effects calculated for individual years and summed (and discounted) values over all periods giving the “value” today of hosting the Games. A dynamic CGE modelling process is therefore be used in this study.

Table 13: Summary of London2012 Effects

	LOCOG Foreign Revenues	LOCOG Costs	LOCOG Domestic Revenues	Legacy Effect	Visitor Displace ment	Lda Infrast- ructure Spending	Transport Infrast- ructure Spending	Venue Constr- uction	Domestic Visitor Spending	Foreign Visitor Spending
2005								17		
2006				143		222		20		
2007				151		222		20		
2008				161		149	79	120		
2009				171		149	79	135		
2010				181		149	32	146		
2011				192		-73	32	182		
2012	615	1,010	780	306	-62	-42	206	3	309	447
2013				325		31	-48			
2014				345		21	-152			
2015				367		21				
2016				389		21				
2017						-10				
2018						-10				
Total	615	1,010	780	2,732	-62	848	228	642	309	447

Regionally the impact of the Games on London and on areas within London will differ from the impact at the national level. Given that the sponsors of the Games include local government and business groups, the impact on London and within London must be calculated. The economic effects of the London2012 Olympics are therefore examined at the UK level, the London level and at the level of five sub-regions within London.

Although economic impact studies tend to give precise-sounding figures as their results, the inputs into the process necessarily involve a great deal of uncertainty eight years before the event. It is possible to provide inputs on how certain or uncertain we can be about these inputs and to derive results showing how certain we can be about the figures given. Systematic sensitivity analysis is used to provide answers to how certain we can be about the economic impacts.

3 The CGE Model

The Database

The database used for the model relies predominantly on 2002 data. The UK Supply and Use Tables (ONS 2004) are the primary source of data. They provide all of the production and use data required at a fairly detailed level of 123 products and industries. For the purpose of this study, Annual Business Inquiry (ONS 2004b) data has been employed along with data on tax revenues (ONS 2004c) to derive a database with more detail in the accommodation, restaurant, transport and entertainment sectors. Data on industry concentration levels (ONS 2004d) also informs the level of competition within industries. The sole source of data that contains data for an earlier year is the UK Tourism Satellite Account (DCMS 2004), which contains data based on 2000 but which is updated to 2004 using totals from the international passenger survey (ONS 2004e), leisure day visits survey and UK tourism survey for domestic tourism. Additional data on employment in each industry is taken from the Labour Force Survey (ONS 2004f).

For the London-level model and the sub-regional model several additional sets of data were provided by the ONS on tourism spending, value of output and employment within London. Detailed breakdowns from the Family Expenditure Survey are also used in the model.

The UK economy is aggregated into twenty-six sectors for use in the model (see Table 14). The first ten of these sectors are specifically included because they

have special significance, either for tourism and legacy impacts (e.g. hotels, other accommodation, visitor attractions), sports impacts (sports facilities), or transport. The other sixteen sectors are the standard industrial classification (SIC) sections A to P, with the first ten sectors removed (most of the sectors that are removed fall under the classifications H, I and O). Sector H (hotels and restaurants nec[7]) therefore does not contain hotels, other accommodation, restaurants or bars – it contains the remainder of SIC section H, e.g. canteens and catering.

Table 14: Sectors and Products in the Model

Sector Name	Definition
A	agriculture
B	fishing
C	mining
D	manufacturing
E	energy
F	construction
G	distribution
H	hotels and restaurants n.e.c.
I	transport services n.e.c.
J	finance
K	business services
L	public administration and defence
M	education
N	health
O	other services n.e.c
P	domestic services
HOTEL	hotels
ACCOM	Other accommodation
REST	restaurants
BARS	Bars
RAIL	railway transport
LAND	passenger land transport
AIR	air transport
TATO	travel agents and tour operators
SPORT	sports facilities
ATTR	visitor attractions

The construction of a dataset for London is hampered by the lack of regional IO tables in the UK, and for London in particular. The approach used here has therefore been to construct an estimate of the IO table for London that matches with published data where data exists, and that uses the most reasonable assumptions available for the remainder of the table. Most of the control total data (such as industry GVA and household expenditure) were made available

[7] Not elsewhere classified.

for London which enabled most of the London IO table, which is in the same format as the supply and use tables, to be estimated based on the structure of industries at the UK level. Therefore for the following items in the London data, figures are directly sourced: industry gross value added (from ONS regional GVA data and the annual business inquiry; where the industries in the model are at more detailed classifications than these data, the same proportion of London to UK totals was assumed in each category for which data were available); household expenditure (ONS results from the family expenditure survey); tourism expenditures (travel trends, UK tourism survey and the UK tourism satellite accounts first steps projects for the UK and English regions) and day trip expenditures (leisure day visits survey).

Inter-regional trade flows were not available, so while under a few further assumptions it is possible to derive an estimate of the net inter-regional trade between London and the rest of the UK for each product, there is no data available to inform the absolute size of these trade flows. So for manufacturing (sector D) for example, a trade balance (with the rest of the UK and the rest of the world combined) of around £-2bn is derived from the rest of the IO table (the UK trade balance for this product is £-53bn). The absolute size of London's imports and exports cannot be estimated in this way; for example manufacturing exports could be £100bn and imports could be £102bn; or exports might be £1,000bn and imports £1,002bn.

Given the short time scale of the project, and the fact that most of the time in the project was taken up with modelling, it was necessary to construct a simple procedure that might give a realistic estimate of the absolute level of inter-regional trade flows. The procedure used is to firstly multiply the UK's imports and exports of each product by the ratio of London GVA to UK GVA (for 2002), and then to double these 'initial' estimates of imports and exports by product. Secondly, after the rest of the IO table has been estimated, the level of imports or exports is increased as a residual to balance the table by increasing either the value of imports or the value of exports.

The result is that the value of imports into London and exports from London are at least twice the value of UK imports and exports multiplied by London's share of UK GVA. Table 15 shows some of the results of this procedure. While the UK has a trade deficit of £18.4bn in all products (the last row), London has a deficit with the rest of the UK and the rest of the world of £2.7bn. Note that the difference in these trade deficits is larger than London's share of the UK's GVA,

which is due to spending (from the family expenditure survey) by households in London being relatively large.

For some individual products it is evident that the trade data in this derived London dataset are not perfect – there is no claim to the reliability or accuracy of these data other than that the procedure described above is a reasonable good way of estimating in the absence of any data. It is worthwhile noting that the assumption of doubling the initial estimates of imports and exports is the only assumption in the derivation of the London dataset that is not based on data in any way. Should a larger factor (x3 or x4, for example) have been used, the resulting dataset would have more trade between London and the Rest of the UK. Additional demand within London would then have a greater effect on imports from the rest of the UK into London, but this effect would be dampened by the choice made by producers in London to either sell products domestically, where prices would rise because of the additional demand, or export to the rest of the UK. An increase in demand which increases prices in London would therefore increase London's imports from the rest of the UK but would also reduce London's exports to the rest of the UK.

The UK labour market is characterised by (for each of nine labour types) a supply response elasticity of 0.33 – meaning that each 1% increase in real wages leads to an increase in labour supply of 0.33%. The same elasticity is used within London, so that a 1% increase in real wages will lead to an increase in Londoners' labour supply of 0.33%.

Given the labour supply response elasticity of 0.33, the model uses another elasticity that determines how households from outside London (migrants, temporary migrants and commuters) respond to changes in real wages in London. This elasticity is set at 0.10 – and relates the change in London's total labour supply to real wages; I am not aware of any empirical studies that estimate this elasticity; a value of 0.10 seems reasonable, given that any increase in London's labour supply would come mainly from London residents. Note, though, that the level of commuting in 2002 is accounted for through the use of residency-based and workplace-based employment estimates from the labour force survey and ONS estimates of regional GVA.

Table 15: Trade Ratios in the UK and London Datasets

	UK (SUT for 2002)			London (derived dataset for 2002)		
	Trade Balance (£bn)	Exports (% of total demand)	Imports (% of total supply)	Trade Balance (£bn)	Exports (% of total demand)	Imports (% of total supply)
Agriculture	-4.8	4.2	22.8	-2.0	5.5	93.2
Fishing	0.1	21.3	12.8	-0.2	4.1	93.8
Mining	5.3	35.7	23.3	-4.2	6.9	91.8
Manufacturing	-53.1	19.5	25.7	-2.3	33.6	35.5
Energy	-0.1	0.3	0.5	-1.2	0.6	18.7
Construction	0.1	0.1	0.1	-5.7	0.3	22.1
Distribution	0.3	0.4	0.3	13.1	33.5	0.6
Hotels and catering nec	0.2	4.3	2.5	1.1	56.4	4.8
Transport services nec	1.2	6.3	5.2	5.1	27.9	10.0
Finance	16.7	14.9	2.7	3.5	15.8	8.0
Business services	16.4	8.5	4.5	27.7	33.1	8.6
Public administration and defence	0.8	0.9	0.0	-20.1	0.9	63.6
Education	0.9	1.9	0.7	-20.1	1.5	63.6
Health	-0.2	0.0	0.2	-14.5	0.0	44.6
Other services nec	0.9	5.5	4.4	10.1	49.6	8.5
Domestic services	0.0	0.1	0.1	1.0	77.5	0.2
Hotels	-0.4	0.0	2.5	1.5	45.1	4.8
Other accommodation	-0.1	0.0	2.5	0.4	48.3	4.8
Restaurants	0.5	4.3	2.5	0.1	6.7	5.3
Bars	0.6	4.3	2.5	2.9	49.5	4.8
Railway Transport	-0.1	1.7	3.2	0.2	17.0	6.2
Passenger Land Transport	-0.1	1.2	1.8	0.7	30.0	3.6
Air Transport	-3.9	10.9	30.6	-0.7	36.7	46.9
Travel Agents And Tour Operators	0.2	4.1	3.4	0.7	17.9	6.6
Sports Facilities	0.2	9.0	6.9	0.3	22.9	12.9
Visitor Attractions	0.0	9.0	7.4	-0.1	9.4	19.3
TOTAL	-18.4	10.3	11	-2.7	24.1	26

The CGE model has various advantages over other techniques used for economy-wide modelling. The advantages over input-output modelling are discussed above. There are various advantages in using a dynamic CGE model for the current analysis when compared to error correction models (ECMs) which are used more extensively in applied macroeconomics and can also separately define industries in a similar manner, and using the same data, as CGE models. ECM and CGE models incorporate many similar features and to the uninitiated it might seem that they model the same macroeconomic variables, and (possibly with a different number or composition of industries) have a similar structure of industry-product relationships based on an input output table. ECM modellers tend to characterise CGE models as being based on too

little data and too much theory; they prefer less theory and to include more data, letting "the data do the talking", and may see CGE models as being "good in theory" but less practical and less soundly based on data.

The disadvantages of ECM models for impact analysis such as that conducted here can be grouped into two categories: firstly, they have short-term properties that give misleading short-term results at the industry-level and secondly, they do not incorporate forward-looking behaviour which would mean that even the most easily predicted effects of the Olympics in 2012 would not be foreseen by agents in the model.

The short-term properties of ECM models that can lead to misleading short-term results in impact modelling relate to their reliance on historical data series in preference to economic theory. ECM models introduce error terms, or residuals, that violate economic theory so that either the error terms need to be dropped (leading towards a CGE model) or the economic theory needs to be dropped (the ECM models). ECM modellers would characterise the economic theory that is dropped from a model as being unnecessary – letting the data do the talking leads to a sounder, more "real-world" model. This would be acceptable if it were not for the fact that the theory that ECM models ignore is not fanciful, unnecessary theorising, but basic economic relationships such as demand equalling supply, household expenditure plus savings equalling income and expenditure-based GDP equalling income-based GDP. Each of these relationships typically include error correction terms in an ECM model, so that demand does not equal supply but that over a long period of time prices will adjust to attempt to correct imbalances.

ECM modellers may assert that the long-run properties of their models are the same as CGE models, and this is essentially true but ECM models may require 20-40 year time periods to adjust to equilibrium – in the meantime demand can exceed supply by significant amounts, even in service industries where inventories (which are not typically modelled in ECM models anyway) could not be used as an excuse for the imbalance. Industries would receive incomes based on their supply – which means that they receive revenues greater than anyone is spending on their products and there is no consistency within the model as to where the extra money comes from. These short-term inconsistencies make such models unsuitable to impact modelling, although they may be preferable to CGE models for other purposes such as long-term macroeconomic forecasting.

ECM modellers would reply that their models demonstrate that these equilibrium relationships do not hold in the short-run, and hence the need for the error correction terms in their models. However, it is equally true that an ECM model necessarily imposes certain functional forms on consumer and producer behaviour and it is the specification of these functional forms that leads to violations of the equilibrium relationships; in other words, an ECM model will always lead to non-zero error terms because the functional forms can never be perfectly identified. The same may also be said of a CGE model, in which functional forms are also imposed upon the model. The point is that the non-existence of equilibrium in ECM models is not proof that equilibrium does not exist, and that this therefore does not justify dropping crucial, and basic, economic theory.

A further aspect of the short-term properties of ECM models is that the econometric component of these models relies on historical relationships, and there is no way of predicting that the economy would react to the effects being modelled in the same way as in the past, possibly because the same effects have never occurred in the past. CGE models are more 'structural' in that they rely on basic structural relationships while the error correction terms estimated by the ECM models rely purely on historical data, which cannot be relied upon as accurate predictors of future responses.

Forward-looking agents in models are necessary when modelling events that are pre-announced, so that consumers and producers know that the shocks or policy changes will happen at a definite point in the future. This is clearly the case for London2012. Models that do not include forward-looking behaviour would in the years 2005-2011 show responses only to events that occur in that period; businesses would, for example, continue to invest in London athletics venues because they would have no way of seeing that the construction activity taking place would lead to the building of athletics venues in 2012. Similarly, an ECM model would show a slow and gradual, build up of capital in hotels and other tourism-related sectors because of the pre-Games legacy effect, but the influx of visitors in 2012 would take businesses and investors by surprise, with increases in investment taking place *after* 2012 to 'correct' the errors made in 2012. ECM models are not accurate predictors of pre-announced shocks or policy changes that will take place only in one year.

4 Results

The results for this study are presented in five subsections. Section 4.1 presents and discusses the main results for the UK and London models, showing the positive effects that London2012 will have on welfare, GDP and employment levels. Section 4.2 examines the results by industry, showing the effects on gross value added, employment and numbers of firms in each of the twenty-six industries, for both the UK and London. Section 4.3 decomposes the main results, showing the main sources of welfare, GDP and employment gains. Section 4.4 presents the results from the sensitivity analysis, which show the probability, for both the UK and London, that results for welfare, GDP and employment will in fact be positive. Finally, section 4.5 shows the results of the London model split into the five sub-regions of London.

4.1 Main results – Welfare and GDP

The total net UK GDP Change resulting from the Olympics is £1.9 billion. This represents the difference in GDP between the without Games and the with Games scenarios. The majority of the GDP gain is realised in the year 2012 itself (£1,067 million), with smaller gains spread over the years prior to (£248 million) after (£622 million) the Games. In London, there will be a larger impact on GDP, with £925 million extra GDP in the Games year, £3,362 million in the years leading up to the Games and £1,613 million after the Games.

The value of all the future changes attributable to the hosting of the Games in 2012 is £736 million. This is the change in welfare, measured in terms of the equivalent amount of money that could be given to the UK in 2005 that would have the same benefit as hosting the Games. The change in welfare for London is significantly larger, at £4,003 million.

An important distinction between the two results is immediately apparent; the London figures are significantly larger than the UK figures. This is for several reasons: spending in London by UK residents from outside London visiting the Games; movement of workers, whether migrants, commuter or temporary migrants, into London because of higher wages in the capital; and the provision of Lottery funding, which in effect transfers money to the capital. The effects that work the other way, increasing UK GDP by more than London's GDP – the displacement of tourists, both international (who because prices rise more in

London may visit somewhere else in the UK[8]) and domestic – are less important.

It should be noted that the provision of lottery funding means that the London results should be interpreted with great care. They do show the total effects of the Olympics and funding package versus a no-Games scenario; they do not show the economic impact of the Olympics on London, as a large proportion of the GDP gains are attributable to increases in consumption that occur because London does not have to apply as high taxes as it would do without lottery funding.

In order to assess the impact on households a measure of consumer well being/utility is proxied - this is termed economic welfare[9]. Welfare is measured by a money metric utility function. This effectively puts a monetary measure on the consumer's welfare status. In this instance, welfare is a measure of the nominal income the consumer needs at one set of prices in order to be as well off at an alternative set of prices and nominal income. As such, it can be used to obtain monetary measures of the welfare effects of different policy scenarios. The most common of these measures in the equivalent variation (EV). The intuition behind this measure is that it calculates the amount of money that leaves a person as well off as they would be after a change in economic

Table 16: Main Macroeconomic Indicators

	UK £million or no. of jobs	%	**London** £million or no. of jobs	%
Change in welfare (equivalent variation)	736	0.004	4,003	0.193
Discounted value of all future GDP	1,559	0.006	5,647	0.135
GDP 2005-2011	248	0.002	3,362	0.147
GDP 2012	1,067	0.066	925	0.258
GDP 2013-2016	622	0.009	1,613	0.106
Total GDP change 2005-2016	1,936	0.010	5,900	0.143
FTE Jobs 2005-2011	2,955	0.002	25,824	0.104
FTE Jobs 2012	3,261	0.015	3,724	0.105
FTE Jobs 2013-2016	1,948	0.002	9,327	0.066
FTE Jobs Total	8,164	0.002	38,875	0.092

[8] Note that this is in addition to those tourists who do not visit the UK because of prices and perceived congestion.

[9] In the academic literature, policy impacts are generally measured in terms of economic welfare rather than GDP.

activity. Thus, it measures the amount of money required to maintain a person's satisfaction, or economic welfare, at the level it would be at after the change in economic activity.

In 2004 ONS estimates of GDP in the UK are approaching £1 trillion (£1,000 billion) and will, barring a major recession in the meantime, almost certainly surpass that figure by 2012 with or without the Olympics in London. Therefore it is understandable that any changes to the UK economy will be comparatively small given the scale of Olympics. Even in 2012 its self, where the largest economic impacts of the Olympics are observed then the total economy wide effect for the UK is only 0.066% of total UK GDP at 2004 prices. We infer that at the macro level that impacts of the Olympics are relatively limited. Nonetheless, this should not discount the wider impacts of the Olympics at various localised levels and the intangible impacts such as the raised profile that the Olympics will give to sectors of the UK economy.

Another key driver of results in the model are the UK's terms of trade. The terms-of-trade are the ratio of export prices to import prices. The consumption of foreign tourists can directly influence the UK's terms of trade. Foreign tourism is a valuable source of foreign exchange revenue for the UK (worth around £12billion in 2003), so consideration of the impacts of overseas revenues is vital for calculating the economic impact of taxation. In order to be

Table 17: GDP Changes Resulting from the Olympics – 2004 Prices

	UK		London	
	£million	%	£million	%
2005	0	0.000	271	0.090
2006	72	0.005	483	0.157
2007	69	0.005	501	0.159
2008	61	0.004	515	0.159
2009	46	0.003	535	0.161
2010	20	0.001	562	0.165
2011	-20	-0.001	495	0.142
2012	1,067	0.066	925	0.258
2013	136	0.008	433	0.118
2014	208	0.012	466	0.124
2015	136	0.008	361	0.093
2016	142	0.008	353	0.089

able to visit the UK, foreign tourists must obtain British currency to spend. The more foreign currency that tourists buy, the laws of supply and demand dictate that its price will rise. This appreciation in Sterling has a net positive impact on the UK's terms of trade. The UK is a net importer of goods and runs a large

trade deficit, so an increase in the price of sterling means that imported goods will become relatively cheaper in the economy. This benefit counters any adverse effects relating to a down turn in exports sales that would be associated with the appreciation in Sterling.

The results for repatriation of earnings from London are shown in Table 18. Of the change in the discounted value of all future GDP (£5,647 million), £1,098 million is earned by households outside London; either through changes in capital earnings that are repatriated (£822 million) or through labour earnings by commuters, migrants and temporary migrants (£276 million). The change in the discounted value of future GDP that is earned by London residents is therefore £4,549 million. GDP and welfare are never exactly equal, but the repatriation of earnings explains why the two are more divergent for London than for the UK; a large part of the difference is accounted for by repatriation of earnings.

Table 18: GDP, repatriation and welfare in London

	London £million
Discounted value of all future GDP	5,647
less	
Discounted value of all future earnings repatriated from London	1,098
of which	
Discounted additional earnings of capital repatriated outside London	822
Discounted additional earnings of labour by commuters, migrants and temporary migrants	276
Discounted value of future GDP earned by London residents	4,549
Change in welfare (equivalent variation)	4,003

4.2 Industry level results

Results are provided for the twenty-six sectors of the economy that have been modelled, both at the UK and London levels. All money values are in 2004 prices.

The impact of the Games will vary significantly across different sectors of the UK economy. In particular, sectors that are not directly related to the Games may contract in size indirectly as a result of hosting the Games. However, these results are relative to the 'No Games' scenario shown in **Error! Reference**

source not found., in which a substantial amount of growth takes place in all sectors of the economy; therefore no sector is predicted to contract in the time span modelled, but some will grow less because of the impact of hosting the Olympics. Therefore, these figures must be considered as relating to the Olympic effect alone.

UK Results

In the pre-Olympics phase (2005-2011), the largest changes relate to infrastructural construction, both of Olympic venues and of Olympic Park and transport infrastructure. A relatively small legacy effect also takes place, with a boost to international tourism arrivals and spending. Also in this period, agents make adjustments based upon the expected future, so for example investors make fewer investments in sectors that will contract in the future, or in which large capital investment projects are being undertaken that will increase the supply of capital at a future date.

In this phase the largest positive effect seen is in the construction sector, where gross value added increases by £506 million; this effect is directly related to the investment activities being undertaken. This sector sees a gain of 14,354 full-time equivalent annual jobs in this period as over 3,000 workers will be hired in the five year period 2006-2011 because of the Games.

Other sectors experience smaller increases in gross value added in the pre-Olympics phase, such as hotels (£54 million), Bars (£37 million), Restaurants (£37 million) and air transport (£37 million). These sectors gain through the legacy effect, and experience modest increases in employment in this period, for example 2,554 FTE jobs are created in hotels, 2,094 in Bars and 1,811 in restaurants. Note that job changes are not proportional to GVA changes, as some sectors are more labour-intensive than others, and the pattern of skills in each sector is different, so that some sectors hire more of the same types of labour as construction, for example.

Sectors that experience declines in the pre-Games period do so because they gain little or no direct benefit from the construction activities or the legacy effect and hire similar patterns of labour to the expanding sector. Workers therefore move to expanding sectors which can offer higher wages, leaving fewer workers in some other sectors. Manufacturing is the prime example of this (a £571 million contraction in gross value added, and a contraction of 18,923 full-time equivalent jobs. Note that this is a very large sector, and this comprises a small fraction of GVA and employment. Amongst the other

declining sectors in this phase, the sports industry is notable in that it declines by £33 million and loses 397 jobs because investment in sports facilities declines in the face of the looming introduction of the Olympic facilities onto the market after 2012.

Further to this, the model reports changes in employment via changes to the returns to employment component of GVA in the production block. It is debateable as to whether the relationship to returns to labour and employment are linear i.e. a 5% reduction in labour output may not necessarily lead to a 5% reduction in the number of jobs, workers could just reduce their hours. Nonetheless, despite this indirect relationship, the number of jobs figures are

Table 19: Sectoral Gross Value Added Changes Attributable to the Olympics – 2004 Prices. UK Level

	2005-2011		2012		2013-2016		Total 2005-2016
	£million	%	£million	%	£million	%	£million
Agriculture	-12	-0.02	-1	0.00	-15	-0.03	-28
Fishing	0	-0.01	0	0.04	0	-0.02	-1
Mining	-28	-0.01	-9	-0.03	-50	-0.04	-86
Manufacturing	-571	-0.04	71	0.04	-541	-0.06	-1041
Energy	-4	0.00	-4	-0.02	-7	-0.01	-16
Construction	506	0.11	-419	-0.55	244	0.08	330
Distribution	1	0.00	-103	-0.07	81	0.01	-22
Hotels and catering nec	17	0.05	8	0.16	22	0.11	48
Transport services nec	2	0.00	0	0.00	8	0.01	10
Finance	-18	0.00	-19	-0.02	-27	-0.01	-64
Business services	-34	0.00	100	0.03	179	0.01	244
Public administration and defence	-4	0.00	129	0.20	-1	0.00	124
Education	11	0.00	-11	-0.02	0	0.00	-1
Health	15	0.00	-15	-0.02	4	0.00	4
Other services nec	1	0.00	-58	-0.12	-4	0.00	-61
Domestic services	0	0.00	-6	-0.11	-1	-0.01	-7
Hotels	54	0.09	36	0.38	72	0.17	162
Other accommodation	10	0.09	7	0.35	14	0.17	30
Restaurants	37	0.04	-19	-0.15	46	0.08	64
Bars	37	0.05	16	0.13	46	0.09	99
Railway Transport	1	0.00	13	0.34	3	0.02	16
Passenger Land Transport	8	0.02	96	1.19	-23	-0.07	81
Air Transport	37	0.08	12	0.17	49	0.16	97
Travel Agents And Tour Operators	1	0.00	3	0.04	4	0.01	7
Sports Facilities	-27	-0.05	75	1.05	140	0.37	188
Visitor Attractions	1	0.00	20	0.95	0	0.00	21

judged to be a reasonable proxy for the reduction of FTE posts in the sector, i.e. if labour output did contract by 5% then employee hours are also quite likely to change accordingly.

In 2012, the largest impacts are due to the running of events and the spending of visitors to events. Public administration and defence expands by £129 million and 3,676 FTE jobs and sports facilities expand by £75 and 4,361 jobs because of the running of events; hotels (£36 million, 1,686 FTE jobs), bars (£16 million, 952 FTE jobs), railway transport (£13 million, -192 FTE jobs) passenger land transport (£96 million, 3,057 FTE jobs), air transport (£12 million, 191 FTE jobs) and visitor attractions (£20 million, 1,062 FTE jobs) all expand because of visitor demand for services in these sectors. Note that manufacturing (£71 million, 2,289 FTE jobs) also expands. This is a complex factor that is due in

Table 20: FTE Employment, UK

	2005-2011		2012		2013-2016		Total 2005-2016
	£million	%	£million	%	£million	%	£million
Agriculture	-313	-0.02	-11	-0.01	-325	-0.04	-649
Fishing	-3	-0.02	2	0.06	-3	-0.03	-5
Mining	-117	-0.02	-34	-0.03	-175	-0.04	-325
Manufacturing	-18,923	-0.05	2,289	0.05	-14,895	-0.07	-31,529
Energy	-86	-0.01	-18	-0.01	-31	0.00	-135
Construction	14,354	0.16	-11,143	-0.86	6,348	0.12	9,560
Distribution	-359	0.00	145	0.00	2,779	0.02	2,565
Hotels and catering nec	780	0.05	335	0.16	863	0.10	1,979
Transport services nec	-26	0.00	-136	-0.01	86	0.00	-75
Finance	-444	-0.01	-310	-0.03	-313	-0.01	-1,067
Business services	-33	0.00	826	0.02	87	0.00	879
Public administration and defence	-281	0.00	3,676	0.21	-134	0.00	3,261
Education	241	0.00	-360	-0.02	-55	0.00	-173
Health	411	0.00	-624	-0.03	106	0.00	-108
Other services nec	-52	0.00	-1,545	-0.16	18	0.00	-1,579
Domestic services	22	0.00	-331	-0.11	-70	-0.01	-378
Hotels	2,554	0.10	1,686	0.48	2,972	0.21	7,211
Other accommodation	396	0.11	259	0.50	467	0.23	1,122
Restaurants	1,811	0.05	-950	-0.19	2,009	0.10	2,870
Bars	2,094	0.05	952	0.17	2,359	0.10	5,405
Railway Transport	275	0.04	-192	-0.19	-926	-0.22	-844
Passenger Land Transport	292	0.02	3,057	1.18	-701	-0.07	2,648
Air Transport	661	0.08	191	0.16	745	0.16	1,598
Travel Agents And Tour Operators	12	0.00	74	0.04	68	0.01	155
Sports Facilities	-302	-0.02	4,361	1.51	708	0.06	4,767
Visitor Attractions	-11	0.00	1,062	1.24	-40	-0.01	1,012

part because of visitor spending, which includes spending on manufactured goods, and because capital investment has fallen in this sector in the pre-Games period, which means that a larger increase in employment is necessary in 2012 to meet demand.

Table 21: Change in the number of firms, UK

	2005-2011 average		2012		2013-2016 average		Average 2005-2016
	£million	%	£million	%	£million	%	£million
Agriculture	-2	-0.01	-2	-0.01	-5	-0.02	-3
Fishing	0	-0.01	-3	-0.05	-2	-0.03	-1
Mining	0	-0.01	0	-0.01	-1	-0.02	0
Manufacturing	-70	-0.04	112	0.05	-126	-0.06	-74
Energy	0	0.00	0	-0.01	0	0.00	0
Construction	119	0.05	-686	-0.27	100	0.04	45
Distribution	-2	0.00	5	0.00	31	0.01	9
Hotels and catering nec	6	0.03	20	0.08	13	0.05	9
Transport services nec	0	0.00	0	0.00	1	0.00	0
Finance*	-	-	-	-	-	-	-
Business services	-22	0.00	148	0.02	37	0.01	12
Public administration and defence*	-	-	-	-	-	-	-
Education	0	0.00	-2	-0.01	0	0.00	0
Health	1	0.00	-4	-0.01	0	0.00	0
Other services nec	-3	0.00	-120	-0.05	-6	0.00	-14
Domestic services*	-	-	-	-	-	-	-
Hotels	5	0.04	25	0.18	12	0.08	9
Other accommodation	2	0.04	9	0.17	5	0.08	4
Restaurants	13	0.02	-48	-0.07	28	0.04	13
Bars	12	0.02	39	0.06	25	0.04	19
Railway Transport	0	0.00	0	0.15	0	0.01	0
Passenger Land Transport	8	0.02	700	1.19	-41	-0.07	50
Air Transport	1	0.08	2	0.17	2	0.16	1
Travel Agents And Tour Operators	0	0.00	3	0.04	1	0.01	1
Sports Facilities	-7	-0.03	108	0.44	60	0.23	25
Visitor Attractions	0	0.00	195	0.42	-1	0.00	16
Total	56	0.00	526	0.02	127	0.01	119

* data limitations mean that effects on numbers of firms in finance and domestic services cannot be derived. Public administration and defence is a public service sector, so the number of firms does not change.

The post-Games period 2013-2016 is characterised by the legacy effect, with increased tourism demand from overseas. It is also a period in which, because there is less pressure on prices than prior to and during 2012, consumers choose to save less and consume more; prior to 2012 the Olympics raise returns to capital and increase prices, which induces a small shift towards savings and investment. A process of re-adjustment also takes place after 2012

as the economy returns to a more 'normal' situation; investment in construction and sports facilities declines, for example, because they have experienced large increases up to 2013.

The effects of the Olympics on visitor spending are outlined in Table 22 to Table 24. During 2012 there is some diversion of non-Olympic visitors, totalling £62 million for foreign visitors and £60 million for domestic visitors, but these figures are smaller than the additional spending from Olympic visitors (£364 million and £277 million).

In the years leading up to and after the Olympics there are substantial spending effects from foreign visitors from the legacy effect, which increases demand by 1% prior to the Games and 1.5% after the Games. This leads to real spending increases relative to the benchmark of between 1.0 to 1.1% prior to the Games and between 1.8 to 2.0% after the Games. The real spending effects are larger than the legacy effects alone because the combination of the legacy effect and the additional spending by Olympic visitors in 2012 leads to higher investment in industries supplying tourists, particularly from 2012 onwards. The higher level of investment leads to higher capital stocks, which further expand the UK's supply of tourism-related products, and leads to price increases in 2012 but (smaller) reductions in other years, which stimulates tourism demand except in the year of the Games.

Table 22: Changes in Spending by Foreign Visitors (£million)

	By purpose of visit				Total non-Olympic visitors	Olympic visitors	Total
	Holiday	Business	Visiting friends and relatives	Other			
2006	44	42	30	23	139		139
2007	47	45	32	24	148		148
2008	50	48	34	26	157		157
2009	53	51	36	27	167		167
2010	56	54	38	29	178		178
2011	60	58	41	31	190		190
2012	-20	-19	-13	-10	-62	364	302
2013	102	98	69	52	321		321
2014	107	103	73	55	337		337
2015	114	110	78	59	362		362
2016	121	117	83	63	384		384

Table 23: Changes in Spending by Domestic Visitors (£million)

	By purpose of visit			Leisure Day Visitors	Total non-Olympic visitors	Olympic visitors	Total
	Holiday	Visiting friends and relatives	Other				
2006	0.153	0.092	0.010	1.824	2.079		2
2007	0.193	0.100	0.011	1.832	2.136		2
2008	0.231	0.108	0.012	1.810	2.161		2
2009	0.282	0.121	0.013	1.838	2.254		2
2010	0.427	0.152	0.016	2.016	2.611		3
2011	0.964	0.247	0.026	2.672	3.909		4
2012	-23.252	-5.105	-0.544	-31.575	-60.476	277	217
2013	0.923	0.453	0.048	2.885	4.309		4
2014	1.180	0.799	0.085	0.549	2.613		3
2015	0.485	0.315	0.033	3.557	4.390		4
2016	0.410	0.302	0.032	3.727	4.471		4

Table 24: Percentage Change in Visitor Spending by Category

	Foreign Visitors				Domestic Visitors			
	Holiday	Business	Visiting friends and relatives	Other	Holiday	Visiting friends and relatives	Other	Leisure Day Visitors
2006	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.01
2007	1.03	1.03	1.03	1.03	0.00	0.00	0.00	0.00
2008	1.06	1.06	1.06	1.06	0.00	0.00	0.00	0.00
2009	1.09	1.08	1.09	1.09	0.00	0.00	0.00	0.00
2010	1.12	1.12	1.12	1.12	0.00	0.00	0.00	0.01
2011	1.15	1.15	1.16	1.16	0.00	0.01	0.01	0.01
2012	-0.37	-0.36	-0.36	-0.36	-0.10	-0.11	-0.11	-0.07
2013	1.82	1.82	1.82	1.82	0.00	0.01	0.01	0.01
2014	1.85	1.84	1.85	1.85	0.01	0.02	0.02	0.00
2015	1.91	1.91	1.91	1.91	0.00	0.01	0.01	0.01
2016	1.96	1.96	1.96	1.96	0.00	0.01	0.01	0.01

London Results

The sector results for London follow similar broad patterns to those for the UK – an increase in construction output and employment in the pre-Games period followed by a fall (relative to the 'no Games' scenario, when construction activity is still taking place) during 2012; increases in gross value added and employment in the main tourism-related industries such as hotels, other acoomodation, restaurants and bars and transport services throughout the 2005-2016 period.

The effects tend to be larger, however, because they are larger in percentage change terms – the £56 million increase in hotels gross value added during 2012 is for example, equal to 2.51% of the 'no Games' GVA for this sector whereas the £36 million increase for the UK is just 0.38% of the 'no Games' GVA for the UK hotel sector. Because the changes are larger in percentage terms, they entail larger changes in prices and wages for London than the average for the UK. This in turn increases the supply of labour in London by more than it does for the UK in total, because long-term labour supply is positively related to real wages. This leads to higher overall increases in output in expanding sectors (GVA in the hotel sector, for example, increases by £209 million in London over the twelve-year period, and by £162 million for the UK) and significantly lower reductions in output in sectors that contract – the manufacturing sector, for example, contracts by £445 million in London and by £1,041 in the whole UK despite the fact that the increased output of construction and tourism-related activities in London leads to greater demand for manufactured goods imported into London from the rest of the UK. Care must be taken when comparing the results of the two models in this way, however, for they are two unconnected, although similar, models rather than a single two-region model.

There are a number of cases where sectors do not follow the above general relationships in comparison to the UK results. These cases show that there are very complex mechanisms underlying the two models, as indeed there are in the real world economy. One of these mechanisms, for example, is labour markets, through which each of the twenty-six industries has a different pattern of demand for each of the nine labour types. An industry that happens to rely heavily on labour for which the demand is increasing in other sectors would face higher wages in competition with those other sectors, and contract. Another mechanism is through investment, by which products are demanded for the purpose of constructing capital for use in other industries. Private investment tends to decline in many years in both models, because investors see that in 2013 there is an influx of new capital – particularly in the sports industry (Olympic venues). Sectors that produce goods that are used in investment (principally construction, manufacturing and business services) can experience declines. Through such mechanisms, as well as the more obvious mechanisms of being part of the tourism supply chain, or being demanded by the construction sector, it is possible that results can be heavily dependent on the size of three or four separate sources of change, some of which may tend to increase output and others tend to reduce output, so that in the UK model

output falls and in the London model output increases. This is the case for example, with the business services sector, which experiences large positive increases in output throughout the twelve-year period in London, but declines in the pre-Games phase at the UK level.

Table 25: Sectoral Gross Value Added Changes Attributable to the Olympics – 2004 Prices. London Level

	2005-2011		2012		2013-2016		Total 2005-2016
	£million	%	£million	%	£million	%	£million
Agriculture	0	0.08	0	0.00	0	-0.07	0
Fishing	0	0.11	0	0.08	0	-0.02	0
Mining	3	0.11	0	0.03	0	-0.03	2
Manufacturing	-148	-0.10	-51	-0.22	-246	-0.24	-445
Energy	25	0.16	1	0.06	10	0.09	36
Construction	450	0.70	-160	-1.59	16	0.03	306
Distribution	278	0.16	-58	-0.21	88	0.07	308
Hotels and catering nec	18	0.25	19	1.65	25	0.51	63
Transport services nec	121	0.16	17	0.15	61	0.12	199
Finance	170	0.10	-2	-0.01	55	0.05	223
Business services	434	0.08	305	0.37	456	0.13	1196
Public administration and defence	-11	-0.02	36	0.45	-24	-0.07	0
Education	110	0.14	-13	-0.11	47	0.09	144
Health	18	0.02	-12	-0.09	-27	-0.05	-20
Other services nec	53	0.06	-25	-0.17	43	0.07	71
Domestic services	3	0.02	-6	-0.37	-13	-0.17	-17
Hotels	70	0.49	56	2.51	83	0.86	209
Other accommodation	13	0.49	10	2.31	15	0.83	38
Restaurants	83	0.44	5	0.18	80	0.62	168
Bars	49	0.26	28	0.96	48	0.38	124
Railway Transport	13	0.24	23	2.42	23	0.51	60
Passenger Land Transport	29	0.22	90	4.50	-8	-0.09	111
Air Transport	24	0.21	4	0.23	13	0.17	41
Travel Agents And Tour Operators	22	0.18	7	0.34	13	0.16	42
Sports Facilities	-26	-0.15	55	2.66	309	3.00	338
Visitor Attractions	9	0.22	16	2.63	0	-0.02	24

Table 26: FTE Employment, London

	2005-2011		2012		2013-2016		Total 2005-2016
	£million	%	£million	%	£million	%	£million
Agriculture	5	0.07	-1	-0.07	-5	-0.11	-1
Fishing	0	0.09	0	0.03	0	-0.06	0
Mining	6	0.10	0	-0.03	-2	-0.05	4
Manufacturing	-4,078	-0.14	-1,240	-0.31	-4,786	-0.30	-10,104
Energy	149	0.14	0	0.00	57	0.09	206
Construction	7,846	0.97	-3,008	-2.60	34	0.01	4,872
Distribution	4,896	0.15	-1,661	-0.35	1,207	0.06	4,442
Hotels and catering nec	530	0.23	546	1.67	642	0.49	1,719
Transport services nec	1,969	0.10	119	0.04	727	0.06	2,815
Finance	1,271	0.08	-207	-0.09	352	0.04	1,416
Business services	2,467	0.05	2,152	0.32	1,118	0.04	5,737
Public administration and defence	-418	-0.04	641	0.46	-560	-0.10	-337
Education	2,251	0.14	-287	-0.12	792	0.09	2,756
Health	130	0.01	-364	-0.14	-729	-0.07	-963
Other services nec	290	0.02	-606	-0.32	472	0.06	156
Domestic services	75	0.02	-244	-0.42	-472	-0.20	-642
Hotels	2,052	0.54	1,709	3.13	2,195	1.00	5,956
Other accommodation	315	0.57	253	3.15	333	1.03	902
Restaurants	2,600	0.49	80	0.10	2,202	0.71	4,881
Bars	1,625	0.26	1,004	1.12	1,464	0.41	4,092
Railway Transport	469	0.39	-11	-0.06	-395	-0.57	63
Passenger Land Transport	686	0.23	1,928	4.45	-182	-0.10	2,432
Air Transport	293	0.21	38	0.19	116	0.15	447
Travel Agents And Tour Operators	407	0.17	105	0.31	184	0.14	695
Sports Facilities	-268	-0.07	2,215	3.90	4,633	2.03	6,580
Visitor Attractions	256	0.22	565	3.36	-69	-0.10	751

Table 27: Change in the number of firms, London

	2005-2011 average		2012		2013-2016 average		Average 2005-2016
	£million	%	£million	%	£million	%	£million
Agriculture	0	-0.01	-1	-0.20	0	-0.03	0
Fishing	0	-0.05	0	0.00	0	0.30	0
Mining	0	0.03	0	-0.09	0	-0.02	0
Manufacturing	-29	-0.09	-61	-0.17	-62	-0.16	-43
Energy	0	0.07	0	0.03	0	0.03	0
Construction	118	0.26	-273	-0.55	3	0.00	47
Distribution	71	0.06	-148	-0.11	4	0.00	30
Hotels and catering nec	-1	-0.03	12	0.48	0	0.00	1
Transport services nec	6	0.05	5	0.04	5	0.03	5
Finance*	-	-	-	-	-	-	-
Business services	61	0.02	369	0.13	260	0.09	153
Public administration and defence*	-	-	-	-	-	-	-
Education	2	0.05	-4	-0.07	0	0.00	1
Health	1	0.01	-9	-0.08	-6	-0.05	-2
Other services nec	-2	0.00	-158	-0.24	-8	-0.01	-17
Domestic services*	-	-	-	-	-	-	-
Hotels	3	0.06	11	0.24	3	0.06	4
Other accommodation	1	0.05	-2	-0.11	0	-0.01	0
Restaurants	43	0.20	19	0.08	69	0.28	50
Bars	-1	-0.01	1	0.01	-16	-0.07	-6
Railway Transport	0	0.11	1	1.57	0	0.41	0
Passenger Land Transport	45	0.22	974	4.50	-19	-0.09	101
Air Transport	1	0.21	1	0.23	1	0.17	1
Travel Agents And Tour Operators	5	0.18	10	0.34	5	0.16	6
Sports Facilities	-22	-0.22	-12	-0.12	295	2.58	85
Visitor Attractions	16	0.09	165	0.82	1	0.00	23
Total	317	0.05	902	0.13	535	0.07	439

* data limitations mean that effects on numbers of firms in finance and domestic services cannot be derived. Public administration and defence is a public service sector, so the number of firms does not change.

Table 28: **Impact Of The Olympics On Employment As Measured In Percentage Change Of Total Sectoral Employment (UK Level)**

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Agriculture	-0.001	-0.025	-0.025	-0.026	-0.028	-0.027	-0.013	-0.005	-0.034	-0.057	-0.030	-0.030
Fishing	0.000	-0.022	-0.022	-0.022	-0.022	-0.020	-0.001	0.055	-0.019	-0.057	-0.015	-0.014
Mining	-0.002	-0.014	-0.016	-0.018	-0.021	-0.022	-0.019	-0.032	-0.045	-0.051	-0.037	-0.036
Manufacturing	-0.002	-0.071	-0.070	-0.069	-0.069	-0.065	-0.022	0.045	-0.050	-0.131	-0.054	-0.055
Energy	0.004	-0.013	-0.013	-0.011	-0.010	-0.008	0.006	-0.009	0.007	-0.022	0.000	-0.001
Construction	-0.014	0.250	0.241	0.226	0.222	0.203	-0.019	-0.861	0.040	0.396	0.029	0.028
Distribution	-0.002	-0.001	-0.001	0.001	0.000	-0.004	-0.003	0.004	0.010	0.037	0.011	0.011
Hotels and catering nec	0.009	0.055	0.056	0.058	0.061	0.064	0.070	0.160	0.101	0.094	0.106	0.109
Transport services nec	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.008	0.002	0.001	0.001	0.001
Finance	0.003	-0.011	-0.010	-0.010	-0.009	-0.007	0.003	-0.028	0.003	-0.026	-0.002	-0.003
Business services	0.001	0.001	0.002	-0.001	-0.001	-0.001	-0.002	0.023	-0.004	0.013	-0.003	-0.003
Public administration and defence	0.000	-0.003	-0.003	-0.003	-0.003	-0.003	-0.001	0.213	0.000	-0.003	-0.002	-0.002
Education	0.002	0.001	0.001	0.001	0.001	0.002	0.003	-0.017	0.000	-0.003	0.000	0.000
Health	0.001	0.003	0.003	0.003	0.003	0.003	0.002	-0.026	0.001	0.004	0.000	0.000
Other services nec	0.004	-0.003	-0.002	-0.003	-0.003	-0.002	0.004	-0.158	0.004	-0.005	0.001	0.001
Domestic services	0.006	-0.001	-0.001	-0.001	0.000	0.000	0.004	-0.110	-0.005	-0.006	-0.006	-0.006
Hotels	0.008	0.110	0.113	0.117	0.122	0.127	0.134	0.481	0.204	0.203	0.216	0.223
Other accommodation	0.008	0.117	0.120	0.124	0.129	0.134	0.141	0.502	0.218	0.218	0.230	0.238
Restaurants	0.009	0.054	0.055	0.057	0.060	0.063	0.070	-0.192	0.101	0.091	0.106	0.109
Bars	0.008	0.053	0.055	0.057	0.059	0.062	0.068	0.165	0.101	0.092	0.106	0.109
Railway Transport	0.009	0.020	0.027	0.036	0.045	0.056	0.071	-0.185	-0.424	-0.257	-0.109	-0.101
Passenger Land Transport	0.001	0.015	0.017	0.018	0.019	0.019	0.024	1.182	0.036	-0.381	0.038	0.039
Air Transport	0.006	0.073	0.080	0.087	0.093	0.100	0.115	0.160	0.156	0.131	0.166	0.167
Travel Agents And Tour Operators	0.000	0.000	0.000	0.001	0.000	0.000	0.005	0.037	0.016	-0.009	0.013	0.013
Sports Facilities	0.001	-0.011	-0.013	-0.018	-0.021	-0.023	-0.020	1.510	0.106	-0.045	0.095	0.089
Visitor Attractions	0.004	-0.005	-0.004	-0.005	-0.005	-0.002	0.005	1.244	-0.010	-0.018	-0.009	-0.009

Table 29 Changes in FTE Employment (UK Level)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Agriculture	-2	-54	-54	-57	-59	-57	-29	-11	-73	-123	-65	-64
Fishing	0	-1	-1	-1	-1	-1	0	2	-1	-2	0	0
Mining	-2	-15	-16	-19	-22	-23	-20	-34	-46	-53	-38	-38
Manufacturing	-89	-3,647	-3,616	-3,525	-3,562	-3,345	-1,139	2,289	-2,555	-6,710	-2,785	-2,846
Energy	8	-24	-24	-21	-19	-15	11	-18	13	-43	0	-2
Construction	-181	3,231	3,110	2,929	2,877	2,629	-240	-11,143	517	5,095	372	364
Distribution	-64	-36	-35	57	12	-177	-116	145	405	1,506	433	435
Hotels and catering nec	18	114	118	122	127	135	147	335	213	197	223	230
Transport services nec	-1	-2	-2	-4	-6	-7	-4	-136	29	25	17	15
Finance	36	-117	-113	-106	-101	-78	35	-310	27	-280	-27	-33
Business services	40	52	59	-26	-39	-52	-67	826	-154	471	-115	-115
Public administration and defence	4	-48	-48	-57	-57	-52	-23	3,676	-4	-60	-34	-36
Education	45	14	17	24	30	39	73	-360	11	-55	-5	-5
Health	23	62	62	64	70	76	53	-624	23	87	-2	-2
Other services nec	42	-26	-23	-33	-31	-18	37	-1,545	42	-49	14	12
Domestic services	18	-4	-4	-2	-1	1	13	-331	-15	-19	-17	-18
Hotels	28	382	395	409	425	445	470	1,686	716	713	759	785
Other accommodation	4	60	62	64	66	69	72	259	112	112	119	123
Restaurants	42	264	272	281	294	313	343	-950	499	449	522	539
Bars	48	307	316	327	340	360	395	952	586	530	611	631
Railway Transport	9	20	28	37	47	58	74	-192	-441	-267	-113	-105
Passenger Land Transport	2	40	43	46	48	50	62	3,057	93	-990	97	100
Air Transport	7	87	96	103	111	120	137	191	187	157	200	202
Travel Agents And Tour Operators	1	0	0	2	1	-1	10	74	32	-18	27	27
Sports Facilities	3	-31	-37	-51	-61	-67	-58	4,361	306	-129	273	258
Visitor Attractions	3	-4	-4	-5	-4	-2	5	1,062	-8	-16	-8	-8

Table 30: Annual Change in the number of Firms, UK Level

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Agriculture	0	-2	-2	-2	-3	-3	-2	-2	-5	-7	-4	-4
Fishing	0	0	0	0	0	-1	-1	-3	-2	-1	-2	-2
Mining	0	0	0	0	0	0	0	0	-1	-1	0	0
Manufacturing	-2	-90	-92	-92	-96	-89	-32	112	-83	-227	-94	-99
Energy	0	0	0	0	0	0	0	0	0	0	0	0
Construction	-8	177	177	170	170	157	-12	-686	26	324	24	25
Distribution	-4	0	0	5	0	-10	-5	5	10	68	22	22
Hotels and catering nec	1	6	6	6	7	7	8	20	13	12	14	15
Transport services nec	0	0	0	0	0	0	0	0	1	1	1	1
Finance*	-	-	-	-	-	-	-	-	-	-	-	-
Business services	0	-12	-12	-25	-33	-33	-34	148	65	22	30	31
Public administration and defence*	-	-	-	-	-	-	-	-	-	-	-	-
Education	0	0	0	0	0	0	0	-2	0	0	0	0
Health	0	1	1	1	1	1	0	-4	0	0	0	0
Other services nec	2	-4	-4	-6	-6	-6	0	-120	-2	-16	-2	-2
Domestic services*	-	-	-	-	-	-	-	-	-	-	-	-
Hotels	0	5	5	6	6	7	7	25	11	12	13	13
Other accommodation	0	2	2	2	2	3	3	9	4	4	5	5
Restaurants	2	13	13	14	15	16	18	-48	26	24	30	32
Bars	2	11	11	12	13	15	17	39	24	22	27	29
Railway Transport	0	0	0	0	0	0	0	0	0	0	0	0
Passenger Land Transport	0	7	8	8	9	10	14	700	23	-236	25	26
Air Transport	0	1	1	1	1	1	1	2	2	2	2	2
Travel Agents And Tour Operators	0	0	0	0	0	0	0	3	2	-1	1	1
Sports Facilities	-1	-4	-5	-7	-9	-12	-14	108	66	51	62	60
Visitor Attractions	1	-1	-1	-1	0	0	3	195	0	-3	0	1
Total	-7	111	109	92	77	63	-30	307	180	53	153	156

* data limitations mean that effects on numbers of firms in finance and domestic services cannot be derived. Public administration and defence is a public service sector, so the number of firms does not change.

Table 31: Impact Of The Olympics On Employment As Measured In Percentage Change Of Total Sectoral Employment (London Level)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Agriculture	0.039	0.061	0.066	0.064	0.065	0.073	0.087	-0.072	-0.111	-0.132	-0.102	-0.101
Fishing	0.047	0.077	0.087	0.088	0.093	0.105	0.126	0.025	-0.046	-0.093	-0.051	-0.049
Mining	0.041	0.095	0.103	0.105	0.110	0.117	0.125	-0.027	-0.078	-0.043	-0.039	-0.037
Manufacturing	0.069	-0.177	-0.180	-0.201	-0.220	-0.203	-0.092	-0.307	0.009	-0.527	-0.335	-0.333
Energy	0.186	0.129	0.128	0.123	0.118	0.123	0.158	-0.001	0.193	-0.001	0.089	0.091
Construction	-0.255	1.278	1.260	1.285	1.360	1.329	0.529	-2.601	-1.391	1.421	0.016	0.003
Distribution	0.014	0.149	0.153	0.180	0.186	0.162	0.174	-0.345	-0.153	0.272	0.065	0.067
Hotels and catering nec	0.159	0.223	0.229	0.221	0.216	0.247	0.343	1.669	0.819	0.171	0.469	0.488
Transport services nec	0.047	0.096	0.099	0.101	0.104	0.107	0.117	0.040	0.057	0.063	0.063	0.064
Finance	0.096	0.076	0.076	0.074	0.072	0.076	0.091	-0.092	0.101	-0.013	0.034	0.035
Business services	0.021	0.059	0.061	0.055	0.055	0.056	0.064	0.323	0.065	0.045	0.031	0.027
Public administration and defence	0.009	-0.053	-0.053	-0.057	-0.061	-0.056	-0.027	0.459	0.003	-0.190	-0.108	-0.107
Education	0.139	0.140	0.138	0.139	0.137	0.137	0.147	-0.124	0.120	0.050	0.086	0.088
Health	0.010	0.007	0.006	0.005	0.004	0.007	0.011	-0.143	-0.041	-0.094	-0.077	-0.075
Other services nec	0.054	0.018	0.018	0.009	0.003	0.010	0.039	-0.316	0.166	-0.020	0.052	0.047
Domestic services	0.072	0.024	0.016	0.010	0.001	-0.008	0.013	-0.416	-0.177	-0.183	-0.224	-0.220
Hotels	0.130	0.542	0.568	0.588	0.610	0.648	0.715	3.131	1.095	0.854	1.007	1.034
Other accommodation	0.125	0.562	0.593	0.616	0.641	0.683	0.752	3.154	1.124	0.891	1.037	1.063
Restaurants	0.330	0.507	0.508	0.507	0.509	0.516	0.527	0.104	0.749	0.655	0.712	0.727
Bars	0.157	0.248	0.259	0.260	0.265	0.289	0.348	1.119	0.575	0.228	0.405	0.417
Railway Transport	0.246	0.323	0.352	0.381	0.415	0.458	0.521	-0.064	-1.205	-0.879	-0.107	-0.073
Passenger Land Transport	0.062	0.188	0.211	0.234	0.261	0.292	0.340	4.447	0.270	-1.176	0.254	0.249
Air Transport	0.073	0.183	0.206	0.221	0.239	0.263	0.290	0.191	0.148	0.116	0.159	0.161
Travel Agents And Tour Operators	0.091	0.162	0.172	0.181	0.187	0.195	0.224	0.312	0.212	0.058	0.140	0.139
Sports Facilities	0.101	0.047	0.000	-0.061	-0.123	-0.188	-0.248	3.895	2.327	1.771	2.076	1.965
Visitor Attractions	0.196	0.194	0.204	0.208	0.218	0.234	0.262	3.355	-0.098	-0.146	-0.089	-0.077

Table 32 Changes in FTE Employment (London Level)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Agriculture	0	1	1	1	1	1	1	-1	-1	-2	-1	-1
Fishing	0	0	0	0	0	0	0	0	0	0	0	0
Mining	0	1	1	1	1	1	1	0	-1	0	0	0
Manufacturing	281	-722	-734	-817	-892	-823	-372	-1,240	36	-2,131	-1,351	-1,340
Energy	29	20	20	19	18	19	24	0	30	0	14	14
Construction	-294	1,475	1,454	1,487	1,573	1,538	612	-3,008	-1,604	1,617	18	4
Distribution	67	715	735	867	897	779	836	-1,661	-736	1,308	314	321
Hotels and catering nec	51	72	74	72	70	80	112	546	269	57	155	162
Transport services nec	137	280	292	298	306	314	342	119	167	186	186	189
Finance	217	172	173	168	163	173	205	-207	228	-30	76	78
Business services	137	393	405	369	367	372	424	2,152	436	299	204	180
Public administration and defence	12	-74	-74	-80	-86	-79	-38	641	4	-265	-150	-149
Education	321	322	319	320	315	315	339	-287	276	115	199	202
Health	26	17	16	13	11	18	28	-364	-104	-240	-195	-190
Other services nec	104	34	35	17	6	20	74	-606	319	-38	99	91
Domestic services	42	14	9	6	0	-5	7	-244	-104	-107	-132	-129
Hotels	69	290	305	317	330	352	389	1,709	599	470	555	571
Other accommodation	10	44	47	49	51	54	60	253	91	72	84	87
Restaurants	250	385	387	387	389	396	405	80	578	507	552	565
Bars	139	219	230	232	236	258	312	1,004	516	206	365	377
Railway Transport	43	56	61	66	72	80	91	-11	-211	-153	-19	-13
Passenger Land Transport	27	81	91	101	113	126	147	1,928	117	-518	110	108
Air Transport	14	36	41	44	47	52	58	38	29	23	32	32
Travel Agents And Tour Operators	31	54	58	61	63	65	75	105	71	19	47	47
Sports Facilities	58	27	0	-35	-70	-107	-141	2,215	1,324	1,011	1,181	1,118
Visitor Attractions	33	33	34	35	37	39	44	565	-17	-25	-15	-13

Table 33: Annual Change in the number of Firms, London Level

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Agriculture	0	0	0	0	0	0	0	-1	0	0	0	0
Fishing	0	0	0	0	0	0	0	0	0	0	0	0
Mining	0	0	0	0	0	0	0	0	0	0	0	0
Manufacturing	14	-34	-35	-41	-46	-42	-21	-61	22	-124	-71	-73
Energy	0	0	0	0	0	0	0	0	0	0	0	0
Construction	-16	140	144	151	162	162	81	-273	-150	154	4	3
Distribution	29	59	66	77	81	82	106	-148	-22	33	1	1
Hotels and catering nec	1	-1	-1	-2	-2	-1	1	12	8	-7	0	0
Transport services nec	3	5	6	6	6	7	8	5	5	4	5	5
Finance*												
Business services	53	55	61	58	51	58	90	369	538	73	221	210
Public administration and defence*												
Education	2	2	2	2	2	2	3	-4	2	-2	0	0
Health	1	1	1	1	1	1	2	-9	-3	-8	-6	-6
Other services nec	8	-6	-5	-7	-8	-4	10	-158	46	-58	-10	-11
Domestic services*												
Hotels	2	1	2	2	3	4	6	11	7	-2	3	3
Other accommodation	1	0	0	1	1	1	2	-2	1	-2	0	0
Restaurants	26	41	43	44	46	49	53	19	71	61	71	74
Bars	7	-7	-6	-5	-5	-1	8	1	13	-44	-17	-17
Railway Transport	0	0	0	0	0	0	0	1	1	0	0	0
Passenger Land Transport	12	34	39	45	51	59	72	974	66	-267	62	63
Air Transport	0	1	1	1	1	1	1	1	1	1	1	1
Travel Agents And Tour Operators	2	4	5	5	6	6	7	10	7	3	5	5
Sports Facilities	-1	-7	-13	-20	-28	-37	-47	-12	313	292	292	283
Visitor Attractions	11	12	13	15	17	19	24	165	5	-5	2	2
Total	155	299	324	333	339	366	405	902	932	102	564	543

* data limitations mean that effects on numbers of firms in finance and domestic services cannot be derived. Public administration and defence is a public service sector, so the number of firms does not change.

4.3 Decomposition of Results

This section examines the Olympics scenario (relative to the 'no Games' scenario) split into a number of separate scenarios, through which it is possible to see the causes for many of the model results.

Table 34 shows the results from the decomposition for the UK. The results from nine separate scenarios are shown in this table:

(i) LOCOG operations, being revenues for the organising committee that emanate from outside the UK (television revenues, TOP sponsorship and ticket sales to foreign visitors), LOCOG revenues from within the UK (local sponsorship, ticket sales and other revenues), infrastructural spending on venues and the completion of the venues for use after the Olympics. Note that domestic spending comes from domestic residents' budgets and therefore reduces spending on other goods and services. Local sponsorship also reduces spending on other items.

(ii) LDA-funded infrastructure and TfL-funded transport infrastructure;

(iii) domestic visitors' expenditure outside Olympic venues;

(iv) foreign visitors' expenditure outside Olympic venues;

(v) the legacy effect;

(vi) expenditure switching and displacement effects.

The decomposition results show that welfare is largely driven by LOCOG operations, infrastructure and the legacy effect, while GDP changes are largely driven by LOCOG operations, with smaller effects from the legacy effect and infrastructure. These effects are in part driven by the value of labour that enters the labour market because of real wage increases (column 3, labour effect). This additional supply of labour has a direct effect of increasing GDP although not welfare, because additional labour is supplied freely by people who would, at the original real wage, prefer to not work. Changes to foreign

Table 34: Result Decomposition: UK Level

	Welfare	Discounted GDP	Labour Effect	Foreign Capital Earnings
LOCOG operations	278	887	63	57
Infrastructure	274	196	53	31
Domestic Visitors	7	-2	-0	-3
Foreign Visitors	26	66	5	3
Legacy Effect	180	454	33	23
Expenditure Switching and Displacement	-16	-42	-3	0
Games Total	736	1,558	150	111

capital earnings (column 4) also add to the impact of changes to GDP but not to domestic welfare. Between them, these two effects account for some of the difference between welfare and discounted GDP; the remainder of the difference is due to relative prices changing in the economy.

The tourism-related effects (domestic visitors, foreign visitors and the legacy effect) have notably small effects both on welfare and GDP. As noted in earlier sections, when price and resource constraints are present in a model, tourism 'multipliers' tend to be much lower than in input-output based models. This is one major difference between this and input-output based studies, where the impact of visitor spending (£756 million) and the legacy effect (£2,732) would be a much larger fraction of the total £3,488 million spending that is generated.

Table 35 shows the decomposition of results for the London model, with the addition of an extra row for lottery funding and an extra column for 'foreign' labour earnings. Both this and the previous column 'foreign' capital earnings represent earnings for resources that come from outside London, although it would be assumed that some of the 'foreign' capital earnings would be payments to capital originating outside the UK. Here as above for the UK, LOCOG operations, infrastructure and the legacy effect are the three largest effects, except for the additional effect of lottery funding, which accounts for the largest increase on welfare and discounted GDP. The London effects are dominated more by the labour effect and 'foreign' capital earnings than the UK results, because these effects depend on real wages (for labour) and relative capital earnings. 'Foreign' labour earnings – the earnings of labour from outside London, have a smaller effect than the additional labour supply generated within London.

The size of the welfare and discounted GDP increases due to the lottery effect are disproportionate to the value of the lottery funding to London. This is because the increases in labour and capital supply to London are large, which increases London's GDP, although not directly it's welfare, and the additional output generated by these resources generates additional earnings for existing resources in London, with welfare consequences. The provision of lottery funding therefore not only gives a 'grant' to London that means that a substantial proportion of the cost of the Games does not need to be financed through local taxation (and therefore reducing the distortions in the local tax system) but also, through increased employment and consumption, increases prices and wages in London, which further increase welfare and GDP because they induce further supplies of labour and capital to be available.

The effect of foreign visitor spending is notably higher for London than for the UK, again because this spending increases prices more in London that for the UK as a whole. As noted in previous sections, when resources can move between sectors the existence of

and size of a positive impact of foreign tourism on welfare depends on price increases. This effect is more prevalent in the case of London than it is for the UK as a whole.

Note that the effects of expenditure switching and displacement and domestic visitor expenditures are small in both the UK and London models, and can be negative as is the case with expenditure switching and displacement on welfare in the London model, as switches of expenditure away from restaurants and entertainments during the Games can have little overall effect, and can be positive or negative depending on the labour, capital, and import intensities of the industries that contract because of the switching, and also because of different tax rates in different sectors of the economy.

Table 35: Result Decomposition: London Level

	Welfare	Discoun -ted GDP	Labour Effect	'Foreign' Capital Earnings	'Foreign' Labour Earnings
LOCOG operations	1,413	1,988	311	246	79
Infrastructure	473	623	64	64	15
Domestic Visitors	2	1	0	0	0
Foreign Visitors	97	81	20	15	5
Legacy Effect	404	161	80	63	19
Expenditure Switching and Displacement	-7	52	-1	-1	0
Lottery funding	2,720	3,228	630	435	158
Games Total	5,107	5,647	1,104	822	276

4.4 Sensitivity Analysis

The sensitivity analysis undertaken on both the UK and London models involves creating confidence intervals for any inputs into the model over which there is some uncertainty. Given the nature of estimating the impact of an event eight years in the future, and the lack of data and analysis on the impacts of previous events, the level of uncertainty over some of the inputs is necessarily large. We simply do not know, for example, what the legacy effect will be; therefore this effect has a small positive value in the central scenario, because the average experience of the past four Olympic hosts is that there is a small positive legacy effect, but with a large confidence interval – with a negative legacy effect at the lower limit of this interval because some recent Olympics have seen visitor numbers falling after the Games.

Given the confidence intervals on the inputs into the modelling process, and on parameters within the model itself, systematic sensitivity analysis involves repeatedly drawing a sample from these confidence intervals and solving the model. In each repeated model exercise a different value is drawn from the confidence intervals surrounding each unknown, so that some inputs might have low levels and others high levels in any single model exercise. One assumption of this process is that the random uncertainty of each model input is unrelated to the uncertainties over other inputs – for example, that the chance of a positive or negative legacy effect is unrelated to the chance of cost overruns on a particular project or of high or low daily spending by foreign visitors during the Games.

Both the UK and London models have been solved 100 times to generate 100 sets of results. The standard deviation for each individual result 'number' is then computed from these results, and confidence intervals derived. The results presented here rely on the presentation of 80% coefficients of variation. These coefficients of variation are a fraction that show the proportion of the central estimate that makes up the 80% confidence interval. If a result has a value of +200 with an 80% coefficient of variation at 0.35, there is an 80% chance that the true value of that result, if we could with absolute certainty predict the model inputs, would lie within the range +/- 35% either side of the central estimate of +200, i.e. between +130 and +270. There is also a 10% chance that the true value is below +130, and a 10% chance that the true value is above +270. If the coefficient of variation is greater than one, the chance that the true value is negative (or, if the central estimate is negative, positive) is greater than 10%. In these cases it is also possible to derive the chance that the true value is negative or positive.

UK Results

The macroeconomic results for the UK show a considerable degree of uncertainty (Table 36). The £736 million increase in welfare has an 80% coefficient of variation of 1.011, indicating that the true value of welfare increase lies between +/- 101.1% of £736 million, i.e. between £-8 million and £1,480 million. Based on this distribution, the probability that the welfare increase is positive is 89.7%. The welfare result is therefore strongly positive, and it should be noted for this and other results that while the lower bound is low, the upper bound of the confidence interval is also high. Just as there is a 10% probability that the welfare gain will be less than £-8 million, there is also a 10% probability that the welfare gain will exceed £1,480 million.

The reason for the level of uncertainty that exists in these results is largely due to the uncertainty associated with the legacy effect. The GDP gain in 2012 is strongly positive, with a coefficient of variation of 0.519 and a 99.3% probability of a positive outcome,

GDP gains prior to 2012 (a coefficient of variation of 1.823 and probability of a positive figure of 75.9%) and after 2012 (2.407 and 70.3%) have much larger degrees of uncertainty. The total change in GDP and discounted value of all future GDP have probabilities of being greater than zero of 89.7% and 85.8%. The London2012 Olympics would therefore be expected to increase GDP.

Employment results prior to and during 2012 have more uncertainty attached to them than the GDP results, with probabilities of being greater than zero of 64.9% and 92.3%, while employment results post-2012 have less uncertainty than the corresponding GDP figures, with a coefficient of variation of 1.400 compared with 2.407, and a probability of positive changes in employment of 82.0%. Nevertheless, the overall impact of the Olympic Games on jobs is less certain than the GDP effect, with a coefficient of variation of 3.186 and a 65.6% probability that the Games will have a net positive effect on jobs over the period 2005-2016. As noted above, high degrees of uncertainty also mean that the upper bound on the 80% confidence interval is high, with a 10% probability that the overall impact on employment will be over three times higher than the central estimate. There is therefore a 10% chance that the Olympics will create over 34,170 jobs in the UK.

Table 36: Main Macroeconomic Indicators: Sensitivity Analysis, UK level

	£million or no. of jobs	80% C.V.	10% less than	Prob. >0
Change in welfare (equivalent variation)	736	1.011	-8	0.897
Discounted value of all future GDP	1,559	1.196	-305	0.858
GDP 2005-2011	248	1.823	-204	0.759
GDP 2012	1,067	0.519	513	0.993
GDP 2013-2016	622	2.407	-875	0.703
Total GDP change 2005-2016	1,936	1.267	-517	0.844
FTE Jobs 2005-2011	2,955	3.339	-6,913	0.649
FTE Jobs 2012	3,261	0.897	337	0.923
FTE Jobs 2013-2016	1,948	1.400	-778	0.820
FTE Jobs Total	8,164	3.186	-17,842	0.656

London Results

The sensitivity analysis results for London are presented in Table 37. The change in welfare and discounted value of all future GDP have less uncertainty associated with them than the UK model results, with 80% coefficients of variation of 0.838 and 0.767. These results have a probability of being greater than zero of 93.7% and 95.3% respectively.

In both the GDP and employment results, there is considerably less uncertainty about the effects of the Olympics in 2012 itself for London than there is for the UK, with coefficients of variation of 0.282 and 0.251, indicating that the GDP and employment effects within London in 2012 are unambiguously positive. GDP and employment effects prior to and after the Games are less certain, however, as can be seen in the table. Total GDP over the 2005-2016 period has a coefficient of variation of 0.765 (95.3% probability of being positive), while the corresponding figure for employment is 1.310 (83.6% probability of being positive).

Table 37: Main Macroeconomic Indicators: Sensitivity Analysis, London level

	£million or no. of jobs	80% C.V.	10% less than	Prob. >0
Change in welfare (equivalent variation)	4,003	0.838	649	0.937
Discounted value of all future GDP	5,647	0.767	1,318	0.953
GDP 2005-2011	3,362	1.707	-2,377	0.773
GDP 2012	925	0.282	665	1.000
GDP 2013-2016	1,613	1.725	-1,169	0.771
Total GDP change 2005-2016	5,900	0.765	1,386	0.953
FTE Jobs 2005-2011	25,824	1.030	-782	0.893
FTE Jobs 2012	3,724	0.251	2,789	1.000
FTE Jobs 2013-2016	9,327	1.571	-5,322	0.792
FTE Jobs Total	38,875	1.310	-12,038	0.836

4.5 London Sub-Regions

The London sub-region model takes the gross value added changes for London presented in Table 25 to Table 31 and the employment changes presented in Table 26 and, using ONS data for labour earnings by London sub-region and industry, allocates the changes in GVA and employment to London sub-regions. Different coefficients are used for each industry that describe how the effects in each industry might be spread across London. In most industries the spread of GVA and employment impacts is assumed to be the same across East, North and Central London, with 30% lower impacts in West and South London because of their geographical distance from Lower Lea Valley. For the construction industry, however, the spread is assumed to be more concentrated in East London, with North and Central London less affected by construction output in East London (although still affected by 50% the level that they would be in East London) and even less in South and West London. The results depend therefore on these assumptions, and on the industrial composition of labour earnings in each of the five sub-

regions. The London Sub-Regions model makes the assumption that relative to East London, each sub-region is affected as follows:

	Construction	All other sectors
Central London	0.5	1
East London	1	1
West London	0.35	0.7
South London	0.35	0.7
North London	0.5	1

This means that if there are 10,000 jobs in a particular industry, and the CGE model predicts a net expansion of +1,000 jobs (+10%) then those extra jobs are allocated in proportion to the initial number of jobs in that industry in each sub-region multiplied by the factors in the table above.

Displacement therefore occurs where the CGE model predicts displacement as this way of allocating GVA and jobs will also allocate negative changes across the sub-regions. Other London regions will be positively affected by expansion due to the Olympics, particularly in non-construction sectors – hotels across London will benefit more for example, than construction for a given level of impact at the London level. 'Displacement' cannot occur, though, in terms of a positive effect on East London and negative effects elsewhere in London.

The results are presented in Table 38. Note that figures do not add up to the London totals because of the earnings and employment of commuters from outside London.

East London has the largest share (30%, £464 million) of gross value added increases in the pre-Games period, and also the largest share (33%, 7,344 jobs) of employment in the pre-Games period. This is due largely to this region's larger share of construction impacts, but is also due to the industrial composition of employment in East London, which is more heavily weighted towards employment in the construction industry than other London sub-Regions.

East London does not have such a high GVA or employment impact during 2012 or in the post-Games period, however, and receives only 10% of the increases in London's GVA and employment during these periods. This is largely due to the industrial composition of East London employment, which is less heavily weighted towards service industries in

Table 38: The Effects of the London2012 Olympics on London Sub-Regions

	2005-2011		2012		2013-2016		Total 2005-2016
	£million	% of London	£million	% of London	£million	% of London	£million
GVA Impact							
Central London	370	24	105	35	105	35	581
East London	464	30	31	10	31	10	525
West London	262	17	68	23	68	23	398
South London	265	17	61	20	61	20	386
North London	205	13	34	11	34	11	272
FTE Employment Impact							
Central London	4,948	22	1,470	46	1,470	46	7,887
East London	7,344	33	311	10	311	10	7,966
West London	4,461	20	1,248	39	1,248	39	6,957
South London	3,036	14	204	6	204	6	3,445
North London	2,541	11	-11	0	-11	0	2,518

general, and accommodation, restaurants and transport services in particular. Central London, with a higher proportion of employees in hotels and restaurants, and West London, with higher proportions in service industries in general and particularly in air transport services, perform the best in 2012 and in the post-Games period.

5 Conclusions

This study has undertaken a comprehensive measurement of the economic impacts of the London2012 Olympic Games. Two separate dynamic computable general equilibrium models have been used – one for the UK and another for London. Results have been analysed in terms of the overall impact of the Games (section 4.1), impacts on individual sectors of the UK and London economies (section 4.2), the overall impacts of different types of spending effect (section 4.3), sensitivity analysis (section 4.4) and the impacts on London sub-Regions (section 4.5).

Despite the fact that the UK-level and London-level results imply effects on the rest of the UK, care must be taken in interpreting such results. The UK model is built upon a much more detailed dataset from national accounts sources, and modelling at the national level means that many of the model parameters have been estimated in previous studies at that level, or at comparable levels. The London model is built upon an estimated dataset, which although the data that has been used to estimate the data are robust, is far less rich in detail than the UK data. Modelling at the regional level also contains more uncertainties because model parameters are rarely estimated at the

regional level. Therefore the UK model is a more robust model, both in terms of the dataset used and in terms of the modelling parameters.

This should not detract from the value of the London model and the results that it gives, but should rather be used to draw caveats on the use of any 'rest of the UK' results that are derived. The rest of the UK has not been modelled, and if it were modelled in a two-region model, results might be considerably different to those gained from deducting the London results from the UK total. This is not so much because there is anything 'wrong' with the London results, but merely because less confidence can be attached to the London database than to the UK database.

The main conclusions from this report are that the London2012 Olympics would have an overall positive effect on the UK and London economies, with an increase in GDP over the 2005-2016 period of £1,936 million and an additional 8,164 full-time equivalent jobs created for the UK. The impacts are concentrated in 2012 (£1,067 million GDP and 3,261 FTE jobs) and in the post-Games period 2013-2016 (£622 million GDP and 1,948 additional FTE jobs). Sensitivity analysis has shown that the overall impact of the Olympics is unlikely to be negative - the change in GDP is has a probability of 84.4% of being positive, but that larger risks exist in the pre- and post- Games periods, largely because of the high levels of uncertainty of the legacy effect.

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