

OXFORD ECONOMICS

Economic Benefits from Air Transport in Singapore

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A note on the data reported in the report

Unless otherwise stated, the numbers reported in this report relate to the calendar year 2009.

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v1.2

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Facts & figures

Singaporean aviation's economic benefits

Air transport to and from Singapore creates three distinct types of economic benefit. Typically, studies such as this focus on the 'economic footprint' of the industry, measured by its contribution to GDP, jobs and tax revenues generated by the sector and its supply chain. But the economic value created by the industry is more than that. The principal benefits are created for the customer, the passenger or shipper using the air transport service. In addition, the connections created between cities and markets represent an important infrastructure asset that generates benefits through enabling foreign direct investment, business clusters, specialization and other spill-over impacts on an economy's productive capacity.

1. Aviation's economic footprint

Contribution to Singaporean GDP

The aviation sector contributes S\$14.2 billion (5.4%) to Singaporean GDP. This total comprises:

- S\$8.7 billion directly contributed through the output of the aviation sector (airlines, airports and ground services, aerospace);
- S\$3.1 billion indirectly contributed through the aviation sector's supply chain; and
- S\$2.4 billion contributed through the spending by the employees of the aviation sector and its supply chain.
- In addition there are S\$9.3 billion in 'catalytic' benefits through tourism which raise the overall contribution to S\$23.5 billion or 8.9% of GDP.

Major employer

The aviation sector supports 119,000 jobs in Singapore. This total comprises:

- 58,000 jobs directly supported by the aviation sector;
- 35,000 jobs indirectly supported through the aviation sector's supply chain; and
- 27,000 jobs supported through the spending by the employees of the aviation sector and its supply chain.
- In addition there are a further 78,000 people employed through the catalytic (tourism) effects of aviation.

High productivity jobs

The average air transport services employee generates S\$243,290 in GVA annually, which is nearly three times more productive than the average in Singapore.

Contribution to public finances

The aviation sector pays S\$1.5 billion in tax. This solely consists of taxes paid by aviation firms and employee contributions. It is estimated that an additional S\$448 million of government revenue is raised via the aviation sector's supply chain and S\$343 million through taxation of the activities supported by the spending of employees of both the aviation sector and its supply chain.

Aerospace manufacturing benefits

Singapore is home to a significant aviation manufacturing sector, generating S\$2.6 billion direct, S\$799 million indirect and S\$825 million induced benefit to GDP.

Aerospace manufacturers directly employ 18,000 people. The supply chain supports another 9,000 jobs, with a further 9,000 of induced employment.

Taking all these channels into account, aerospace supports 36,000 jobs, and contributes nearly S\$4.2 billion to Singaporean GDP.

2. Consumer benefits for passengers and shippers

From visiting family and friends to shipping high value products, 37 million passengers and 1.6 million tonnes of freight travelled to and from Singapore. More than 132,000 scheduled international flights depart Singapore annually, destined for 126 airports in 43 countries.

Air passengers resident in Singapore comprise approximately 10 million of the passenger total. For the 37 million passenger flights in total, passengers pay S\$36.0 billion (inclusive of tax), with Singaporean residents paying around S\$9.7 billion. This expenditure is likely to significantly understate the value passengers actually attach to the flights they use (see Section 1). Calculations by Oxford Economics suggest the value of the benefit to travellers from flying, in excess of their expenditure, is worth S\$24.9 billion a year (S\$6.7 billion for Singaporean residents).

Air transport is crucial for the distribution of high value to weight products. Air freight may only account for 0.5% of the tonnage of global trade with the rest of the world, but in value terms it makes up around 34.6% of the total.

Shippers pay airlines S\$8.9 billion annually to carry 1.6 million tonnes of freight to and from Singapore. The benefit to shippers, in excess of this expenditure, is estimated as S\$3.7 billion. Based on the share of exports in total merchandise trade, Singaporean shippers receive just over half of this benefit (S\$2.0 billion).

3. Enabling long-term economic growth

In 2010 there were 92 routes connecting Singapore Changi International airport to urban agglomerations around the world. On average there were just over 3 outbound flights per day along these routes. A total of 20 of these routes were connecting Singapore to cities of more than 10 million inhabitants, with an average of 5 outbound flights per day available to passengers. Many of these city-pair connections are only possible because of the traffic density provided by hub airports. Singapore's integration into the global air transport network transforms the possibilities for the Singaporean economy by:

- Opening up foreign markets to Singaporean exports;
- Lowering transport costs, particularly over long distances, helping to increase competition because suppliers can service a wider area and potentially reduce average costs, through increased economies of scale;
- Increasing the flexibility of labour supply, which should enhance allocative efficiency and bring down the natural rate of unemployment;

- Encouraging Singaporean businesses to invest and specialise in areas that play to the economy's strengths;
- Speeding the adoption of new business practices, such as just-in-time-inventory management that relies on quick and reliable delivery of essential supplies;
- Raising productivity and hence the economy's long-run supply capacity. It is estimated that a 10% improvement in connectivity relative to GDP would see a S\$169 million per annum increase in long-run GDP for the Singaporean economy.

This report describes these channels in more detail.

Section 1 quantifies the benefits of air travel for air passengers and air freight shippers.

Section 2 examines the way in which the aviation sector supports long-run prosperity: by delivering supply-side benefits through a variety of different channels, which help to increase the economy's level of productivity, and hence its long-term sustainable rate of growth.

Section 3 analyses the economic footprint of the aviation sector - the airlines, the ground-based infrastructure, aerospace manufacturing and spillover effects on tourism and trade - to quantify the value of its output and the jobs it supports in Singapore.

1 Consumer benefits for passengers and shippers

The aviation sector – comprising the airlines together with the airports, air navigation and other essential grounds services that make up the air transport infrastructure - carries over 37 million passengers¹ and nearly 1.6 million tonnes of air freight to and from Singapore. More than 132,000 scheduled international flights depart Singapore annually, destined for 126 airports in 43 countries².

Among the many reasons that people and businesses use air transport, people rely on it for holidays and visiting friends and family; while businesses use air transport for meeting clients and for the speedy and reliable delivery of mail and goods often over great distances. For this reason, the air transport network has been called the Real World Wide Web³.

The most important economic benefit generated by air transport is the value generated for its consumers, passengers and shippers. Passengers spent S\$36.0 billion (inclusive of tax) on air travel in 2009 and shippers spent S\$8.9 billion on the transportation of air cargo⁴. With its speed, reliability and reach there is no close alternative to air transport for many of its customers. This means that many are likely to value air services higher than what might be suggested by their expenditure on these services. But this economic value will vary from flight to flight, and from consumer to consumer, making it difficult to measure.

1.1 Consumer benefits

The value of consumer benefit varies because as you fly more often, the value you attach to each additional flight will in general fall. As frequent flyers know, the more they fly, the less excited they get when they step on a plane. There comes a point when the fare exceeds the value we place on taking an additional flight, and we choose instead to spend our money on other things. For this reason the air fares that we are willing-to-pay do not reflect the value we place on air transport so much as the value we place on the last flight we have flown. Much the same applies to the market as a whole. Air fares reflect the value placed on the service by the marginal passengers - those who would forgo the flight were prices to rise - and not the value that passengers as a whole place on air transport services.

For this reason, valuing the consumer benefits for air passengers and air freight shippers can not be inferred simply from observed fares and shipping charges. In addition to the fares paid, we need an idea of how the passengers and shippers value air transport other than at the margin. Unfortunately there is no readily available data on this, and so we must rely instead on judgement, informed by economic theory, to guide us. Economics tells us that the estimated benefits hinge on the sensitivity of demand to changes in fares – the *price elasticity of demand*. Estimates of price elasticities are available from previous research. Economic theory also tells us that price elasticities will fall as we move away from the margin, but it offers less guidance on how much they may fall by. This matters, because lower the price elasticity – the less sensitive passengers are to a change in price – the higher the consumer benefit.

¹ This is a count of passengers on domestic flights as well as passengers arriving and departing on international flights. Each passenger connecting to another flight at a Singaporean airport is counted once on their arriving flight and again on their departing flight.

² Annual estimate of international and domestic operations for 2010 based on airline schedules published by SRSAnalyzer.

³ "Aviation – The Real World Wide Web", by Oxford Economics. Available at <http://www.oxfordeconomics.com/samples/airbus.pdf>

⁴ Passenger spending based on fares from IATA's PaxIS database plus estimates for taxes and surcharges paid. Cargo spending based on freight rates from IATA's CargoIS database.

It follows that taxation of air travel or cargo directly reduces the economic benefit of all passengers and shippers, as well as, at the margin, stopping a number of people travelling and stopping a number of shippers using air cargo services.

1.2 Estimated consumer benefits

Given its sensitivity to our assumption about how price elasticities vary, we have taken a very conservative assumption that probably understates the true benefits (see Annex). With this in mind, we calculate that air passengers and shippers valued the air transport services they used at S\$60.9 billion and S\$12.6 billion respectively. Contained within these amounts, the consumer benefits derived on top of that measured by expenditure on travel and shipments were about S\$24.9 billion for passengers and S\$3.7 billion for shippers.

The total benefits accruing to passengers using the Singaporean air transport system will include those related to residents and non-residents as well as passengers already being accounted for under the benefits associated with the economy at the other end of international routes. Some 10 million or 27% of the 108 million passengers using air transport services to and from Singapore were Singaporean residents. As for the share of freight shipped by firms based in Singapore, data is not readily available. To give a broad indication we have used instead the share of exports in total merchandise trade. This is estimated to be 52.8% of the total trade in goods in 2009⁵. From this we estimate that, out of the consumer benefits generated by Singaporean air transport and on top of that measured by expenditure, Singaporean citizens derived S\$6.7 billion in value and Singaporean shippers around S\$2.0 billion in value.

⁵ Oxford Economics Global Macroeconomic Model

2 Enabling long-term economic growth

2.1 Connectivity and the cost of air transport services

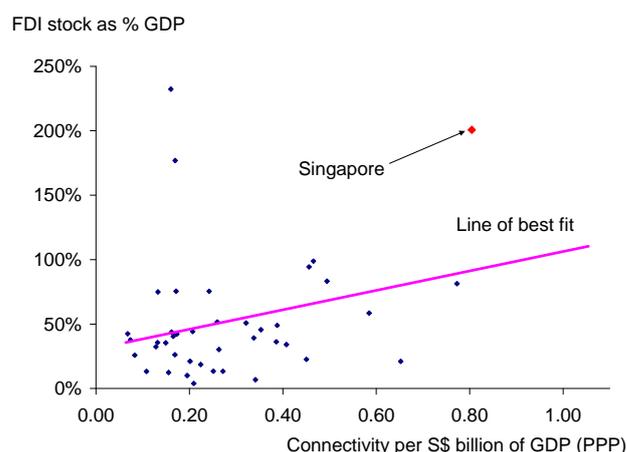
The air transport network has been called the Real World Wide Web⁶. Chart 2.1 gives an idea of how extensive the air transport network is for Singapore. Out of this network, in 2010 there were 92 routes connecting Singapore Changi International airport to urban agglomerations around the world. On average there were 3 outbound flights per day along these routes⁷. A total of 20 of these routes were connecting Singapore to cities of more than 10 million inhabitants, with an average of 5 outbound flights per day available to passengers. Frequencies are even higher to the most economically important destinations. For example, passengers benefited from up to 16 outbound flights per day between Singapore and Bangkok and 6 flights a day to Sydney Airport, providing high speed access for business and leisure purposes throughout the day.

Chart 2.1: Connectivity, 2010



Source : IATA

Chart 2.2: Foreign direct investment and connectivity



Source : Oxford Economics / IATA

These linkages represent the ‘connectivity’ of Singapore with major cities and markets around the world. Connectivity reflects the range, frequency or service, the economic importance of destinations and the number of onward connections available through each country’s aviation network. Improvements in connectivity achieved in recent decades has brought benefits to users of air transport services by: reducing time spent in transit, increasing the frequency of service, allowing for shorter waiting times and better targeting of departure and arrival times; and improving the quality of service, such as reliability, punctuality and quality of the travel experience.

A number of these city-pair connections have point-to-point services, where passenger flow density is sufficient to make the economics work. However, many of the city-pair connections that make up Singapore’s connectivity to overseas markets can only be served by airlines aggregating flows from a number of origins through a hub airport in order to generate a sufficiently dense flow of passengers.

⁶“Aviation – The Real World Wide Web”, by Oxford Economics. Available at <http://www.oxfordeconomics.com/samples/airbus.pdf>

⁷ Route and frequency figures from airlines schedules published by SRSAnalyzer. Urban agglomerations defined as contiguous built-up areas of at least 1 million population. See <http://www.citypopulation.de>.

Improvements in connectivity have been accompanied by a steady fall in the cost of air transport services. The cost of air transport services, in real terms, has fallen by around 1% a year over the past 40 years, contributing to the rapid expansion in the volume of trade seen over this period⁸. Air transport has also steadily become more competitive relative to other modes of transport. For example, it is estimated that its relative cost has been falling by around 2.5% a year since the 1990s⁹. As its relative cost has fallen, air shipments have become increasingly important for international trade.

Apart from the benefits to direct users of air transport services, the largest economic benefit of increased connectivity comes through its impact on the long term performance of the wider economy.

2.2 How aviation enhances economic performance

Improvements in connectivity contribute to the economic performance of the wider economy through enhancing its overall level of productivity. This improvement in productivity in firms outside the aviation sector comes through two main channels: through the effects on domestic firms of increased access to foreign markets, and increased foreign competition in the home market, and through the freer movement of investment capital and workers between countries.

Improved connectivity gives Singaporean-based businesses greater access to foreign markets, encouraging exports, and at the same time increases competition and choice in the home market from foreign-based producers. In this way, improved connectivity encourages firms to specialise in areas where they possess a comparative advantage. Where firms enjoy a comparative advantage, international trade provides the opportunity to better exploit economies of scale, driving down their costs and prices and thereby benefiting domestic consumers in the process. Opening domestic markets to foreign competitors can also be an important driver behind reducing unit production costs, either by forcing domestic firms to adopt best international practices in production and management methods or by encouraging innovation. Competition can also benefit domestic customers by reducing the mark-up over cost that firms charge their customers, especially where domestic firms have hitherto enjoyed some shelter from competition.

Improved connectivity can also enhance an economy's performance by making it easier for firms to invest outside their home country, which is known as foreign direct investment (FDI). Most obviously, the link between connectivity and FDI may come about because foreign investment necessarily entails some movement of staff: whether to transfer technical know-how or management oversight. But increased connectivity also allows firms to exploit the speed and reliability of air transport to ship components between plants in distant locations, without the need to hold expensive stocks of inventory as a buffer. Less tangibly, but possibly just as important, improved connectivity may favour inward investment as increased passenger traffic and trade that accompanies improved connectivity can lead to a more favourable environment for foreign firms to operate in. Chart 2.2 plots the total value of FDI built up in individual countries in relation to their GDP against an index of connectivity (produced by IATA), that measures the availability of flights, weighted by the importance of each of the destinations served. The chart shows that countries with higher connectivity (measured relative to their GDP), are in general more successful at attracting foreign direct investment. This is emphasised by the upward sloping line that confirms the statistical relationship between greater connectivity and greater FDI.

⁸ See Swan (2007), 'Misunderstandings about Airline Growth', *Journal of Air Transport Management*, 13, 3-8, and Baier and Bergstrand (2001), 'The growth of world trade: tariffs, transport costs and income similarity', *Journal of International Economics*, 53:1, 1-27.

⁹ See Hummels (2007), 'Transportation Costs and International Trade in the Second Era of Globalisation', *Journal of Economic Perspectives*, 21.3, Summer.

2.3 Connectivity and long-term growth

A thought experiment considering the impact on trade from eliminating the air transport network suggests the economic benefit of connectivity is substantial. Moreover, the experience of businesses in Europe during the volcanic ash-induced airspace closures of 2010, as just-in-time supply chains failed, provides a more concrete illustration of how dependent modern economies are on their air transport infrastructures.

A number of recent studies have attempted to quantify the long-term impact on a country's GDP that results from an improvement in connectivity. Measuring connectivity is not straightforward. Chart 2.3 shows one measure of Singaporean connectivity, compared to other economies (see Annex for details)¹⁰. Given that the supply-side benefits of connectivity come through promoting international trade and inward investment, any impact is likely to manifest itself gradually over time. This protracted adjustment makes it very challenging to disentangle the contribution that improved connectivity has had on long-term growth, from the many of other factors that affect an economy's performance. This issue is reflected in the wide range of estimates that studies have reached for connectivity's impact on long-run growth. Three studies undertaken in 2005 and 2006 provide estimates of the impact that connectivity can have on long-run level of productivity (and hence GDP). The mechanisms through which connectivity generates this economic benefit are those described in Section 2.2. These studies suggest that a 10% increase in connectivity (relative to GDP) will raise the level of productivity in the economy by a little under 0.5% in the long run, with there being a fair degree of uncertainty around this average estimate.¹¹ A much wider 2006 study, based on a cross-country statistical analysis of connectivity and productivity, derived a lower estimate of 0.07% for the elasticity between connectivity and long-run productivity.¹²

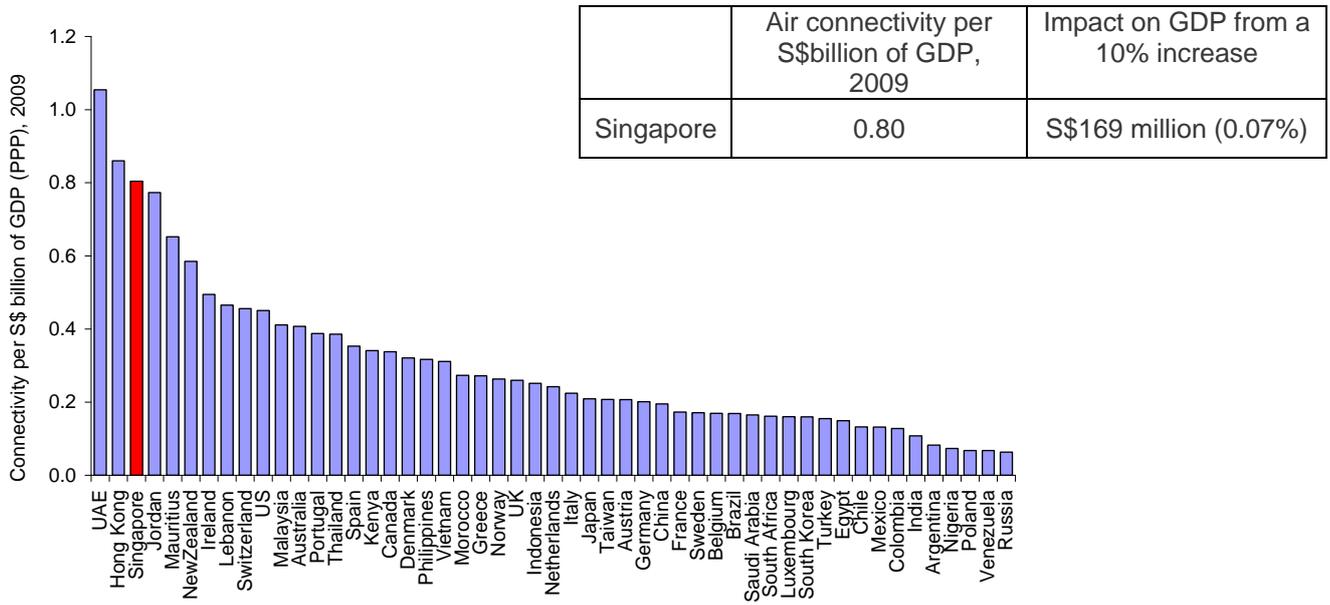
Given the uncertainty about the correct elasticity, here we adopt the elasticity of 0.07 derived from the 2006 study, as the lowest estimate among the available studies it provides a conservative estimate of the impact of connectivity on long-term GDP. Based on this estimate, a 10% improvement in Singapore's connectivity (relative to GDP) would see a S\$169 million per annum increase in long-run GDP.

¹⁰ This measure emphasises passenger connectivity and as such will reflect the freight connectivity associated with belly cargo capacity in passenger aircraft but may not fully capture that provided by all-cargo operations or integrator networks.

¹¹ 'The Economic Catalytic Effects of Air Transport in Europe', by Oxford Economic Forecasting (2005) on behalf of the EUROCONTROL Experimental Centre and 'The Economic Contribution of the Aviation Industry in the UK', by Oxford Economic Forecasting (2006). These studies also allow for connectivity to increase the long-run level of GDP through increasing investment. Allowing for this additional channel raises the total impact of a 10% increase in connectivity relative to GDP on long-run GDP to over 1%.

¹² "Measuring the Economic Rate of Return on Investment in Aviation" by InterVISTAS Consulting Inc. (2006)

Chart 2.3: Air connectivity by country, 2009



Source: IATA. IMF for GDP (PPP basis)

3 Economic footprint

Sections 1 and 2 have looked at the benefits of air transport services for its customers, and the longer-term benefits that come through increasing long-term growth in the economy as a whole. In this section we turn to the domestic resources that the aviation sector currently deploys to deliver its services, together with the domestic goods and services consumed by the workers who depend on the sector for their employment. We call the value added and jobs supported by this economic activity the aviation sector's 'economic footprint'.

The resources deployed by the aviation sector are measured by its Gross Value Added (GVA). GVA is calculated either as the output created by the sector less the cost of purchased inputs (net output measure), or by the sum of profits and wages (before tax) generated from the sector's economic activity (income measure). The two approaches are equivalent. Using either approach, by adding the GVA of all firms in the economy, one derives an estimate for the economy's overall output (GDP)¹³. We refer to this as the sector's direct contribution to GDP.

From this direct contribution, the sector's economic footprint is calculated by adding to it the output (and jobs) supported through two other channels, which we refer to as the indirect and the induced contributions. The indirect contribution measures the resources deployed by the aviation sector through using domestically produced goods and services produced by other firms – i.e. the resources used through its supply chain. The GVA generated through the indirect and direct channels supports jobs both in the aviation sector and in its supply chain. The workers whose employment depends on this activity in turn spend their wages on goods and services. The induced contribution is the value of the domestic goods and services purchased by this workforce. Taken together, these three channels give the aviation sector's economic footprint in terms of GVA and jobs.

The aviation sector contributes to the economy in two other ways. Through the taxes levied on GVA (recall that it is equal to the sum of profits and wages), the aviation sector supports the public finances, and the public services that depend on them. Second, through its investment and its use of advanced technology, the aviation sector generates more GVA per employee than the economy as a whole, raising the overall productivity of the economy. These issues are discussed at the end of this section.

3.1 The aviation sector and its economic footprint

The sector is comprised of three distinct types of activity:

- **Airlines** transporting people and freight.
- **Ground-based infrastructure** that includes the airport facilities, the services provided for passengers on-site at airports, such as baggage handling, ticketing and retail and catering services, together with essential services provided off-site, such as air navigation and air regulation.
- **Aerospace manufacturing** that builds and maintains aircraft systems, airframes and engines.

The aviation sector supports GDP and the employment in Singapore through four distinct channels. These channels are:

¹³ It is only true to an approximation that GVA is equal to the sum of profit and wages, or that the sum of GVA across firms equals GDP. The difference in each case, however, is small enough for us to proceed as if the equalities do in fact hold. The differences are explained in Annex A to this report.

- **Direct** – the output and employment of the firms in the aviation sector.
- **Indirect** – the output and employment supported through the aviation sector’s Singaporean based supply chain.
- **Induced** – employment and output supported by the spending of those directly or indirectly employed in the aviation sector.
- **Catalytic** – spillover benefits associated with the aviation sector. Some of these include the activity supported by the spending of foreign visitors travelling to Singapore via air, and the level of trade directly enabled by the transportation of merchandise.

Table 3.1: Aviation’s contribution of output and jobs to Singapore

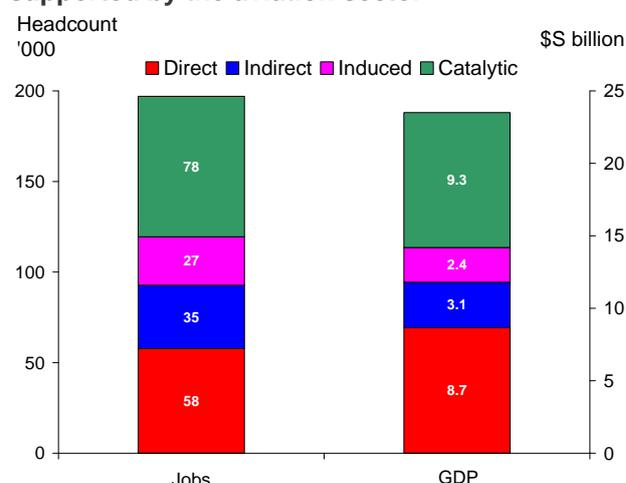
	Direct	Indirect	Induced	Total	% of whole economy
Contribution to GDP (\$\$ million)					
Airlines	3,756	982	715	5,453	2.1%
Airports and Ground Services	2,356	1,351	860	4,568	1.7%
Aerospace	2,557	799	825	4,182	1.6%
Total	8,670	3,133	2,400	14,203	5.4%
Catalytic (tourism)	4,949	3,330	1,015	9,294	3.5%
Total including catalytic	13,619	6,463	3,415	23,497	8.9%
Contribution to employment (000s)					
Airlines	15	11	8	34	1.2%
Airports and Ground Services	24	15	10	49	1.7%
Aerospace	18	9	9	36	1.2%
Total	58	35	27	119	4.0%
Catalytic (tourism)	40	27	11	78	2.6%
Total including catalytic	98	62	38	197	6.7%

Source: IATA, Individual Company Accounts, Oxford Economics

The table above reports the economic contribution of the airlines, airports and aerospace for each of the four channels. Contributions are reported both in terms of GDP and employment. In the following pages we look in turn at the airlines, the ground-based infrastructure, aerospace and catalytic spillover benefits in terms of trade and tourism, and describe their economic contribution in more detail.

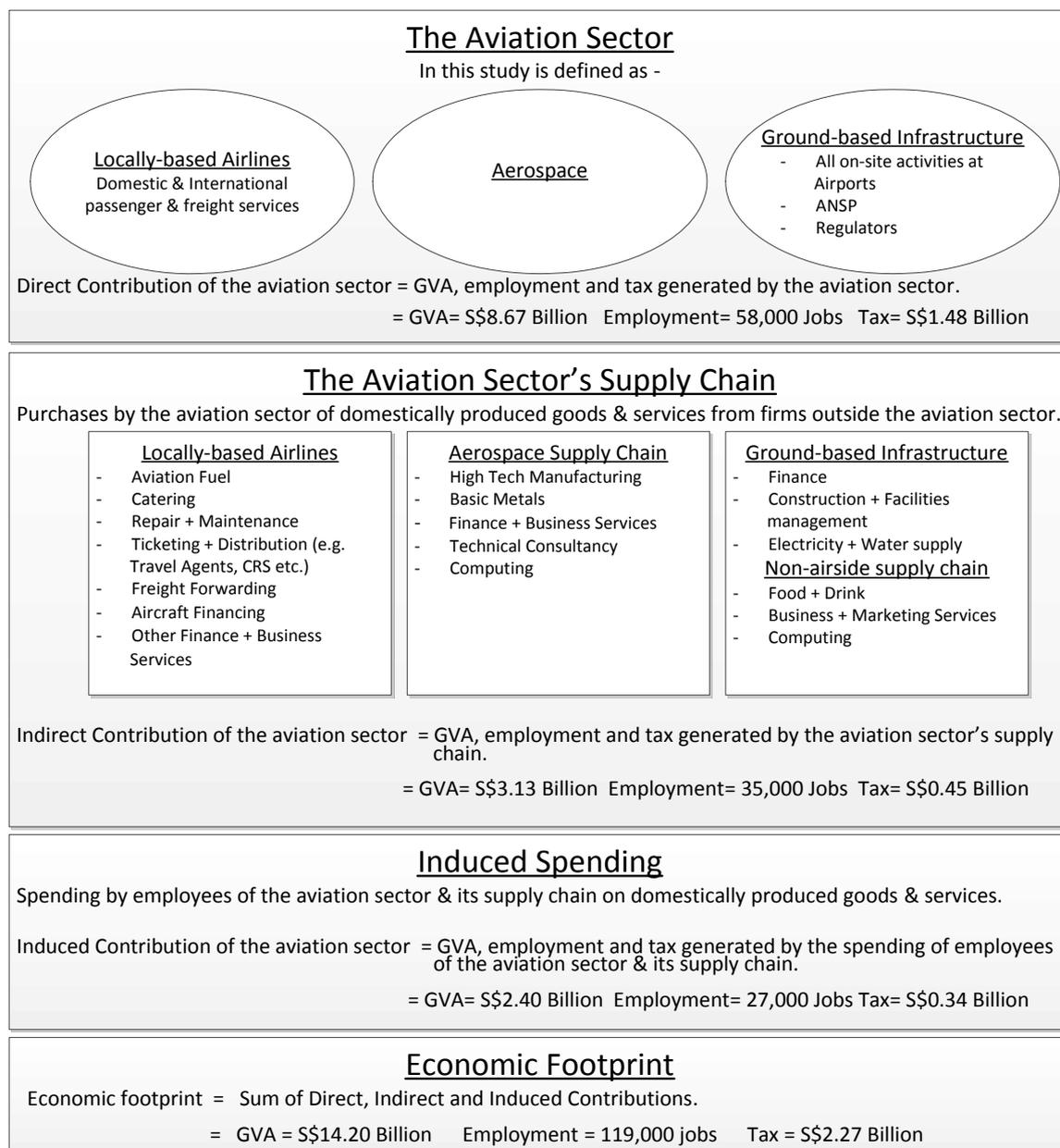
The way that we build up the aviation sector’s economic footprint is also illustrated in Figure 3.1. The top panel shows the three activities that comprise the aviation sector: aerospace, air transport services, and the airports and ground-based infrastructure. The panel below represents their supply chains with boxes that list the most important inputs purchased by each activity. The third panel from the top describes the induced contribution that comes through the spending by workers of both the aviation sector and its supply chain – represented by the arrows that link this panel with the panels above. The bottom panel, entitled ‘economic footprint’, reports the total GVA, jobs and tax contribution. These totals are the sum of the numbers reported in the panels above.

Chart 3.1: Singaporean Jobs and Output supported by the aviation sector



Source : IATA, Oxford Economics

Figure 3.1: Singaporean aviation sector¹⁴

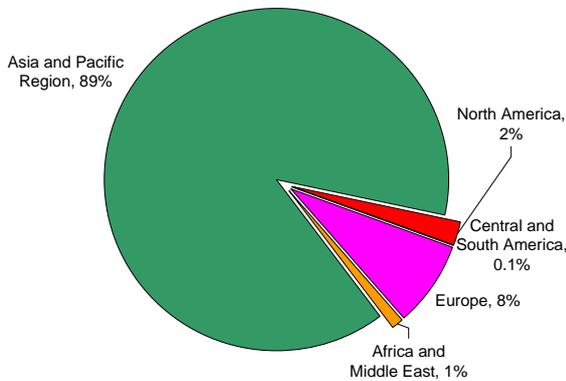


¹⁴ For a definition of GVA please refer to the Annex

3.2 The airlines

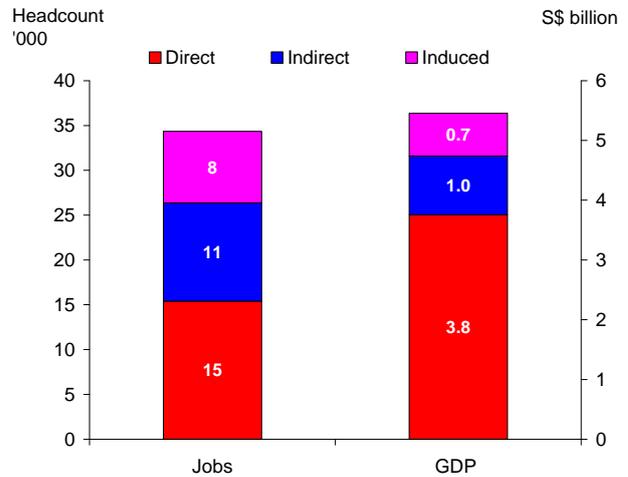
Airlines registered in Singapore carry 37 million passengers and 1.6 million tonnes of freight a year to and from Singapore¹⁵. Among the many reasons that people and businesses use air transport, people rely on it for holidays and visiting friends and family; while businesses use air transport for meeting clients and for the speedy and reliable delivery of mail and goods often over great distances. The air transport network, the “Real World Wide Web”, offers practical, fast and reliable transport across the globe. The regions which travellers fly to and from underline its global reach (see Chart 3.2).

Chart 3.2: Regional distribution of scheduled passenger trips originating in Singapore



Source : IATA

Chart 3.3: Singaporean jobs and output supported by airlines



Source : IATA, Oxford Economics

Airlines registered in Singapore directly employ over 15,000 people locally, and support through their supply chains a further 11,000 jobs. Examples of these supply-chain jobs include those in the distribution sector delivering aviation fuel; and jobs in the catering sector preparing the meals served on airlines. A further 8,000 jobs are supported through the household spending of those employed by airlines and their supply chain.

These airlines directly contribute around S\$3.8 billion to the Singaporean economy (GDP). The sector contributes indirectly another S\$982 million through the output it supports down its supply chain. A further S\$715 million comes from the spending of the employees of the airlines and their supply chains.

Overall, these airlines contribute over S\$5.5 billion to the economy and support 34,000 jobs in Singapore.

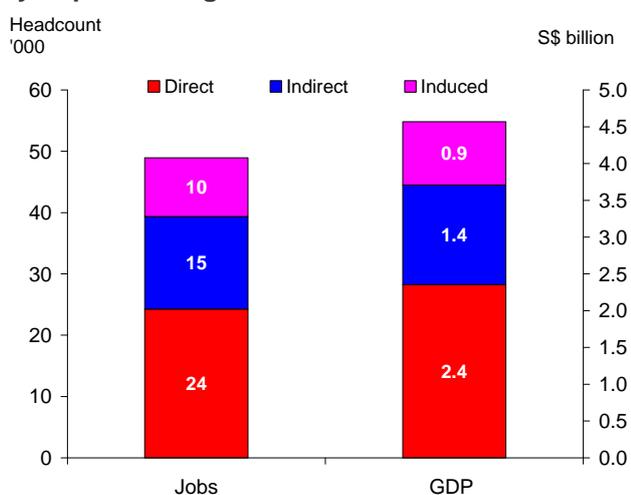
¹⁵ This figure relates to all passengers carried by Singaporean airlines. Some of this total would be passengers carried on trips that originate and end outside Singapore.

3.3 The airports and ground-based services

Airlines need ground-based infrastructure to operate. This infrastructure includes the facilities at Singaporean Changi International airport that directly serve passengers, such as baggage handling, ticketing, retail and catering outlets. Less visible are the essential services which are sometimes provided off-site, such as air navigation and air regulation, as well as the local activities of freight integrators.

In total over 37 million passengers arrive or depart from Singaporean Changi International airport each year. Over 1.6 million tonnes of freight is handled annually.

Chart 3.4: Singaporean jobs and output supported by airports and ground-based services



Source : IATA, Individual Company Accounts, Oxford Economics

Aviation's ground-based infrastructure employs 24,000 people and supports through its supply chain a further 15,000 jobs. These indirectly supported jobs include, for instance, construction workers building or maintaining facilities at the airport. A further 10,000 jobs are supported by the spending of those employed by the aviation industry's ground-based infrastructure and its supply chain.

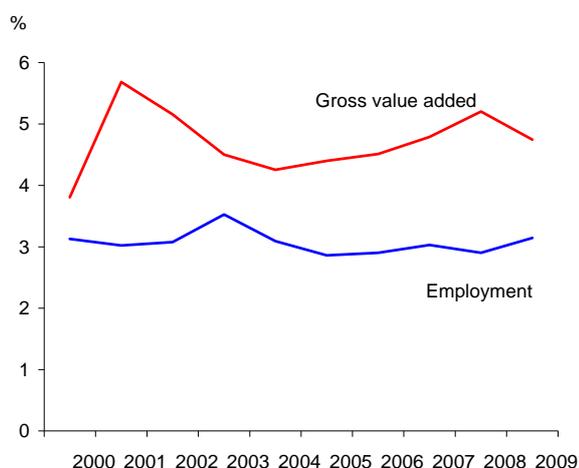
The ground-based infrastructure directly contributes S\$2.4 billion to the Singaporean economy (GDP). It contributes indirectly another S\$1.4 billion through the output it supports down its supply chain. A further S\$860 million comes through the spending of those who work in ground-based facilities and its supply chain.

Changi International Airport is Singapore's only international airport. As a hub airport for intercontinental passenger traffic, Changi can offer its Singaporean residents and businesses better access to more destinations, at a higher frequency and at lower priced fares. As discussed in Section 2 of this report, such network benefits enhance a country's connectivity, which in turn can feed through to the economy's overall levels of productivity and GDP.

3.4 Aerospace

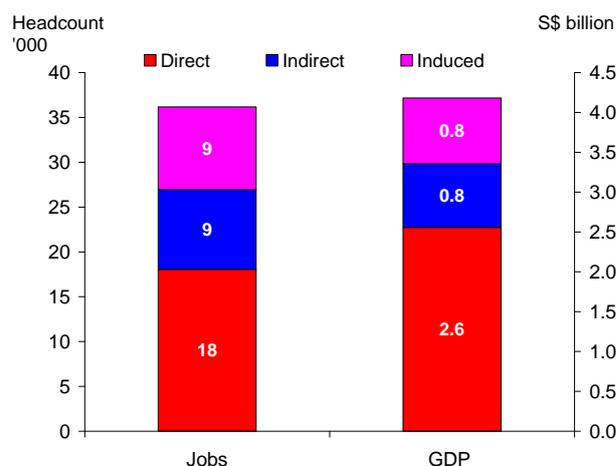
Aerospace manufacturing comprises firms that manufacture and maintain aircraft systems, airframes and engines. In Singapore, this accounts for around 3.1% of total manufacturing jobs, and 4.7% of total manufacturing GVA.

Chart 3.5: Aerospace as a share of total manufacturing



Source : Oxford Economics/Singapore Manpower Survey

Chart 3.6: Singaporean jobs and output supported by aerospace



Source : Oxford Economics/Department of Statistics

The aerospace industry directly employs 18,000 people, many in highly skilled engineering and related technical roles. Through its supply chain, it supports a further 9,000 jobs. Many of these indirectly supported jobs are in other manufacturing sectors, for instance, in firms that produce navigational and control equipment. A further 9,000 jobs are supported through the household spending of those working in aerospace and for the companies that supply the industry.

The aerospace industry directly contributes S\$2.6 billion to the Singaporean economy (GDP). It contributes indirectly another S\$799 million through the output it supports down its supply chain. A further S\$825 million comes through the spending of the employees of the aerospace companies and their supply chains.

Taking all these channels into account, aerospace supports 36,000 jobs, and contributes S\$4.2 billion to the Singaporean economy, around 1.6% of GDP.

3.5 Tax contribution

Aviation makes a substantial contribution to the public finances. In this section we estimate the corporation tax paid by aviation companies, the income tax paid by their employees, social security payments (both employer and employee contributions), and the revenue collected through aviation taxes. These estimates reflect the direct tax payments of the aviation sector. We also provide an indication of the taxes paid by the aviation sector's supply chain and taxes raised through induced spending channels. They do not include increases in the overall Singaporean tax base driven by aviation's contribution to investment and productivity growth in the wider economy.

Table 3.2: Aviation makes a substantial contribution to Singaporean tax¹⁶

	S\$ million	S\$ million
Taxes on Aviation Sector's GVA		1,481
	<i>Comprised of:</i>	
Corporation Tax	449	
Income Tax & Social Security payments	1,032	
Aviation sector's direct tax contribution		1,481
Tax generated through the aviation sector's indirect & induced impact		791
Total tax attributable to the aviation sector's economic footprint		2,272

Source: IATA, Individual Company Accounts, Oxford Economics

The aviation sector contributed almost S\$1.5 billion in taxes through corporation tax and the income and social security contributions (both employee and employer contributions). This contribution is likely to increase further, as the sector recovers following a number of difficult years where many firms suffered losses. Very indicatively, it is estimated that a further S\$791 million of government revenue is raised via taxation through the indirect (S\$448 million) and induced (S\$343 million) channels.

3.6 Investment and productivity

Apart from these transformative effects on the wider economy, air transport services – the airlines, airports and ancillary services, such as air traffic control – form a capital intensive sector that invests heavily in aircraft systems and other advanced technology.

¹⁶ Indirect and Induced Tax contribution is approximated by applying an economy wide average tax figure (as a proportion of GDP) to the Indirect and Induced GVA estimates, using data from the Oxford Economics Global Macroeconomic Model.

Table 3.3: Investment by the aviation sector

	Investment as % value of output
Air transport services	34.2
Singapore Economy	28.6

Source: Individual Company Accounts, IATA, Oxford Economics

Table 3.4: Labour productivity in the aviation sector

	Productivity (GVA per employee)
Air transport services	S\$243,290
Singapore Economy	S\$85,420
Aerospace	S\$141,677
Singapore Manufacturing	S\$98,114

Source: IATA, Individual Company Accounts, Singapore Department of Statistics, Oxford Economics

Table 3.3 reports the investment intensity of the aviation sector, as measured by its investment as a proportion of GVA. Investment in air transport services is equal to 34.2%, 5.5 percentage points higher the level of the economy average of 28.6%. Table 3.4 provides an indication of the productivity of the aviation sector versus the rest of the economy. Measured as GVA per employee, the productivity of air transport services (the airlines and the ground-based infrastructure excluding retail and catering services at airports) is estimated to be S\$243,290. This is well above that for the average productivity for the economy as a whole (S\$85,420). As one might expect, the aerospace industry segment of air transport services is also a high productivity sector. It is highly productive even when measured relative to manufacturing as a whole. Labour productivity in aerospace is estimated to be S\$141,677, nearly 45% higher than that for the manufacturing sector as a whole. This high level of productivity implies that were the resources currently employed in the aviation sector redeployed elsewhere in the economy, then this would be accompanied by a fall in overall output and income. For example, if productivity in the aviation sector was the same as the average productivity for the economy as a whole, then the level of Singaporean GDP would be around 1.3% lower than it is (about S\$3.5 billion in current prices)

3.7 Catalytic effects

3.7.1 Benefits to Singaporean tourism

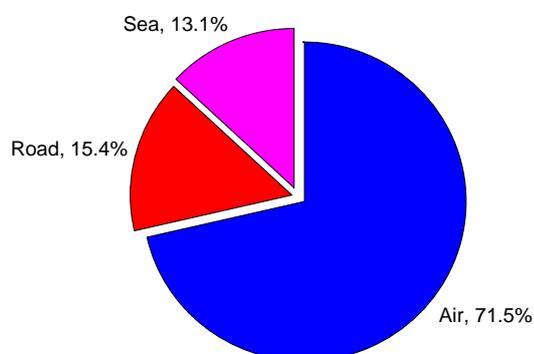
Air transport lies at the heart of global business and tourism. Through its speed, convenience and affordability, air transport has expanded the possibilities of world travel for tourists and business travellers alike, allowing an ever greater number of people to experience diversity of geography, climate, culture and markets.

Tourism, both for business and leisure purposes, makes a large contribution to the Singaporean economy, with foreign visitors spending just under S\$13.4 billion in the Singaporean economy each year¹⁷. Over almost three quarters of these visitors arrive by air (Chart 3.7), so that passengers who arrive by air probably spend around S\$9.6 billion in Singapore¹⁸.

¹⁷ Based on IMF statistics

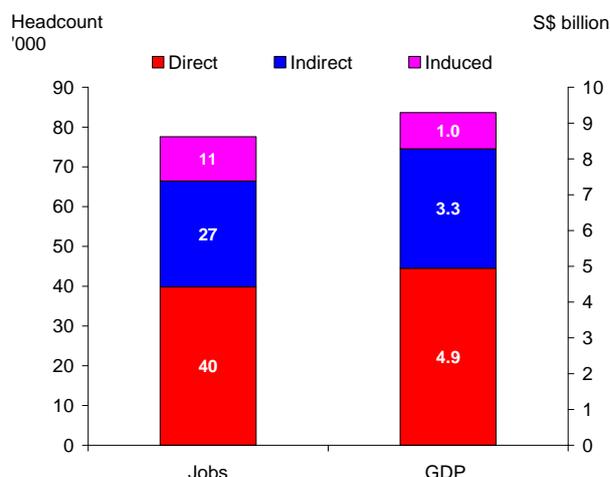
¹⁸ Includes foreign visitors arriving on both domestic and foreign carriers

Chart 3.7: Foreign visitor arrivals by mode of transport in 2009



Source : Oxford Economics, UNWTO

Chart 3.8: Travel and tourism's contribution to Singaporean GDP and Employment



Source : Oxford Economics

Oxford Economics estimates that in 2009 the travel and tourism industry directly employed 81,000 people and supported indirectly through its supply chain a further 78,000 jobs. A further 27,000 people were supported through the household spending of those people directly and indirectly employed by the travel and tourism sector. Of these jobs, we estimate that 40,000 (direct), 27,000 (indirect) and 11,000 (induced) were supported through the spending of foreign visitors who travelled by air.

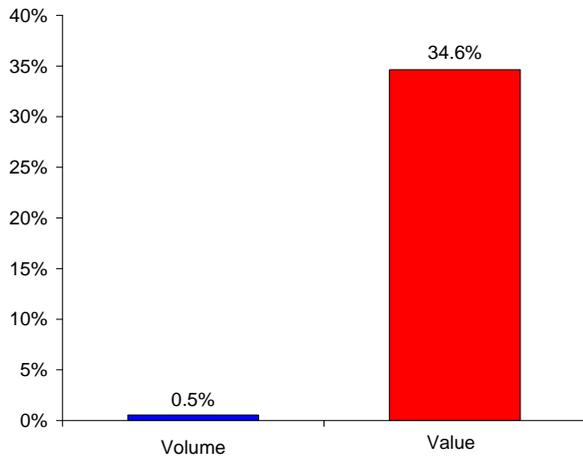
The travel and tourism industry directly contributed S\$10.0 billion to the Singaporean economy (GDP), S\$9.8 billion indirectly through the output it supports down its supply chain and a further S\$2.4 billion through the induced effects of consumer spending. When only considering the contribution linked to the spending of foreign visitors arriving by air on Singaporean produced goods and services, the sector contributes S\$4.9 billion directly to the Singaporean economy, S\$3.3 billion indirectly and a further S\$1.0 billion through induced effects.

3.7.2 Benefits to Singaporean trade

Compared to other modes of transport, air freight is fast and reliable over great distances. However, these benefits come with a cost attached. Consequently, it is mostly used to deliver goods that are light, compact, perishable and that have a high unit value.

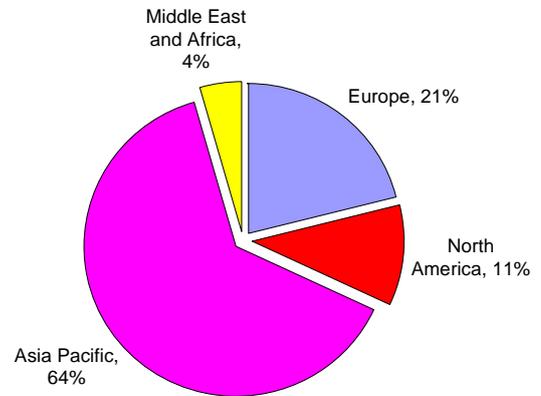
These key characteristics of air freight are most apparent in the data on the modes of transport used in world trade. While air accounts for just 0.5% of the tonnage of global trade (Chart 3.9), air freight makes up over 34.6% of the value of global trade.

Chart 3.9: Proportion of global trade transported by air



Source : The Colography Group¹⁹, Oxford Economics

Chart 3.10: Regional distribution of Singaporean air freight (tonnes)



Source : IATA, Oxford Economics

As with passenger services, air freight operations make up an essential part of the global transport network. Air freight’s global reach is clearly illustrated from Chart 3.10. Measured in terms of tonnage carried to and from Singapore, 64% of air freight travels to the rest of Asia Pacific with a further 21% linked to Europe, 11% to North America and 4% to the Middle East and Africa.

¹⁹ ‘Global Cargo Market Projections for 2006’, The Colography Group, Inc. (2005)

4 Conclusion

This study has described and quantified a number of channels through which aviation in Singapore generates important economic benefits for its customers and the wider Singaporean economy.

Studies of this kind usually focus on the 'economic footprint' of the industry, the GDP and jobs supported by the industry and its supply chain. We provide the latest estimates for these metrics. But the economic value created by the industry is more than that. It is not just jobs that are threatened if government policies are badly designed. The welfare of voting citizens and the effectiveness of infrastructure critical to the country's long-term success in global markets are also at risk.

The welfare of travelling citizens has been conservatively quantified in this study. Not all customers of airlines serving Singaporean Changi International airport are Singaporean residents, but over a quarter are. They currently get an economic benefit estimated to be worth S\$6.7 billion. Indicatively, more than half the shippers using air freight services are Singaporean companies. Taxing air transport directly reduces the welfare of these Singaporean residents and Singaporean businesses.

The study has also shown what a critical asset Singapore's air transport network is, to business and the wider economy. Connectivity between cities and markets boosts productivity and provides a key infrastructure on which modern globalized businesses depend. Many of these city-pair connections are dependent on hub airports through which to generate the traffic density necessary to sustain them. All airlines supplying services at Singaporean Changi International airport contribute to generating these wider economic benefits. These 'supply-side' benefits are hard to measure but are easily illustrated by the experience of the volcanic ash cloud, which closed much of European airspace for a week in early 2010. Travellers were stranded. Globalized supply chains and just-in-time manufacturing processes came to a halt.

More readily measured is the 'economic footprint' supported, mostly, by the activities of national airlines. Singaporean-based airlines were responsible for carrying 54% of both passengers and freight. The wages, profits and tax revenues created by these airlines flows through the Singaporean economy, generating multiplier effects on Singaporean national income or GDP. The economic benefits for Singapore created by non-Singaporean airlines are to be found in customer welfare and in the part these airlines play in providing the connectivity infrastructure between Singapore and overseas cities and markets.

Aviation has a significant footprint in Singapore's economy, supporting 5.4% of Singaporean GDP and 119,000 jobs or 4.0% of the Singaporean workforce. Including the sector's contribution to the tourism industry, these figures rise to 8.9% of Singaporean GDP and 197,000 jobs, or 6.7% of the workforce.

Also significant is the fact that these are high productivity jobs. The annual value added (or GVA) by each employee in air transport services in Singapore is S\$243,290, almost three times higher than the Singaporean average of S\$85,420.

Tax revenues from aviation are substantial. Singaporean-based aviation companies paid S\$1.5 billion annually in direct taxes and social security payment. It is estimated that an additional S\$448 million of government revenue is raised via the aviation sector's supply chain and S\$343 million through taxation of the activities supported by the spending of employees of both the aviation sector and its supply chain.

All together these points demonstrate that aviation provides significant economic benefits to the Singaporean economy and its citizens, some of which are unique and essential to the operation of modern economies.

Annex: Our methods

Benefits to passengers and shippers

In Section 1, we report estimates for the monetary benefits that air transport customers receive through the services provided by the aviation sector. These estimates are based on the economic concept of consumer surplus, the difference between the passengers' or shippers' willingness-to-pay and the actual airfare or freight rate they face. In order to calculate the overall consumer surplus for the various fare types and for freight, we need three pieces of information: (1) data on passenger numbers, freight tonnage and their respective average fares and freight charge; (2) an estimate of how sensitive passenger numbers and freight tonnage are to changes in fares and freight, known as the elasticity of demand; and (3) an assumption about customers' willingness to pay (airfare and freight charges), reflected through an assumption about the shape of the market demand curve.

The calculations are based on 2009 data on total passenger numbers and freight tonnage arriving and departing from domestic airports, together with the average fare and freight charge, broken down by the following market segments: first class, business class, economy, economy discount, and freight. The data are provided by IATA.

We apply an estimate for the elasticity of demand for each market segment. We draw on the findings of several recent studies that investigate elasticities of demand for air transport, to choose elasticities for each market segment that we believe are reasonable²⁰. The elasticities that we use are: first class -0.8, business class -0.9, economy -1.05, and freight -1. These indicate the percentage change in demand that would follow a one percent change in the average fare, or freight charge.

Based on these inputs, we calculate consumer surplus based on the approach proposed by Brons, Pels, Nijkamp, and Rietveld (2002) that assumes that the demand curve for each market segment has a constant elasticity of demand²¹.

Connectivity Index

The connectivity index is a measure of the quality of a country's air transport network that reflects both the volume of passenger traffic and the importance of the destinations served. For every destination country for which there are direct services, an estimate of total passenger seat capacity is derived from data on the frequencies of service and the available seats per flight. From this underlying data, an index is constructed by attaching a weight to each destination. This weight reflects the relative importance of the destination in the global air transport network, measured by the number of seats available for passengers from that airport relative to Atlanta, the largest airport. The connectivity index will therefore have a higher value, the more destinations are served, the higher the frequency of services, the larger the number of available seats per flight and the greater the relative importance of the destinations served.

Benefits to tourism

In quantifying the benefits from Travel & Tourism (T&T) we were seeking to capture the spending by tourists and businesses on accommodation, food etc outside of their airfare (which forms part of our estimate of the direct calculation). In doing this we relied heavily on the Oxford Economics Travel &

²⁰ 'Estimating Air Travel Demand Elasticities', by InterVISTAS Consulting Inc (2007). Available at http://www.iata.org/whatwedo/Documents/economics/Intervistas_Elasticity_Study_2007.pdf

²¹ See http://www.ecad-aviation.de/fileadmin/documents/Konferenzbeitraege/Braun_Klophaus_Lueg-Armdt_2010_WCTR.pdf

Tourism model prepared on behalf of the World Travel & Tourism Council (WTTC) which simulates Tourism Satellite Account (TSA) data across over 180 countries. From the model we obtained an estimate of the level of value-added created by foreign visitors, and assigned a share of this to the aviation industry based on the share of foreign visitor arrivals travelling by air. We then used coefficients within the model to divide this between T&T providers (direct) and their supply chain (indirect). Finally, we attributed a share of the total induced effect to the aviation industry by dividing our estimates of aviation-related direct and indirect GDP by total T&T direct and indirect GDP. It should be noted that this is a gross measure of the benefit from tourism and therefore does not account for the spending which is effectively “lost” when domestic residents travel abroad by air.

Economic footprint

In Section 3 we report the contribution that the aviation sector makes to the economy. The contribution is measured in terms of the value of the sector’s output and the number of people it employs. For each measure, the contribution is built up from three components: direct, indirect, and induced.

The direct output component is measured by Gross Value Added (GVA). GVA is measured either as the firm or industry sales revenue less purchases from other companies, or equivalently, as the sum of employee compensation and gross operating surplus, measured before the deduction of depreciation, interest charges and taxation. In this report we treat gross operating surplus as equivalent to gross operating profit, however, the two concepts differ slightly with the former including income from land and a technical adjustment for the change in stock valuation. GVA differs from Gross Domestic Product (GDP) in the price used to value goods and services. GVA is measured at producer prices that reflect the price at the ‘factory gate’ together with cost of distribution. GDP is measured at market prices that reflect the price paid by the consumer. The two prices differ by the taxes less subsidies levied on the goods or services.

The indirect output component is measured using an Input-Output table that reports how industries use the output of other industries in the process of production, and how their final output is used, e.g. in final domestic consumption, changes in stocks or exports. For many countries, Input-Output tables are available as part of the national accounts. As Input-Output tables describe how an industry uses the output of other industries as inputs in the production of its goods or service, they describe its full supply chain – its direct suppliers, those industries that supply its direct suppliers, and so on. This is reported as the indirect output component.

The Input-Output table reports how much of final output is sold in the domestic economy. Using similar methods as that used to derive the indirect output component, the Input-Output table can be used to estimate how much spending on completed goods (known as final domestic consumption) is supported through the employees of the industry and its full supply chain. This is reported as the induced output component.

We also calculate the contribution of freight integrator activity in countries where they have significant presence. Where reported, their contribution appears under airport and ground based infrastructure as a component of both the direct benefit (on-airport activity) and indirect benefit (off-airport activity), with the induced benefit adjusted accordingly. Our estimates are based on employment and market share information supplied by freight integrators (either directly or from company websites), and labour productivity estimates derived from Oxford Economics’ 2009 global express delivery industry study²².

²² See <http://www.oef.com/samples/oefglobalexpress.pdf>

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The three output components – direct, indirect, and induced – are converted to their respective employment components, using an estimate for the average labour productivity (GVA per employee) for the economy.

Passenger and freight volumes

Passenger and freight traffic is accounted for in different ways across the industry supply chain, depending on the focus of the operator and the purpose of analysis. For example, airlines generally count the number of passengers who board their aircraft, whereas airports often count the number of passengers arriving or departing their airport – which in some cases can lead to totals significantly larger than those reported by airlines, despite referring to the same inherent volume of passengers. The table below outlines the main passenger and freight volumes referred to in this report. In particular, it shows how the numbers used in the calculation of consumer benefit and the economic footprint were derived.

Passenger numbers 2009		Millions	Millions	
Number of passengers arriving or departing Singapore airport (A)		37		
Less domestic arrivals at Singapore airport (due double counting)		0		
Number of passengers on aircraft flying to and from Singapore (B)		37	20	Carried by Singaporean airlines (C)
			10	Singaporean residents (D)
Freight tonnes 2009		Thousands	Thousands	
Tonnes of freight carried on aircraft flying to and from Singapore (E)		1,634	882	Carried by Singaporean airlines (F)
			752	Carried by non-Singaporean airlines

Passenger measure	Millions	Use in report	Source
A Number of passengers arriving or departing Singaporean airports	37	Overall indicator of passenger arrivals and departures handled by airports in Singapore.	CAAS
B Number of passengers on aircraft flying to and from Singapore	37	Overall indicator of airline passenger traffic associated with the Singaporean market.	CAAS
C Passengers carried by Singaporean registered airlines	20	Overall indicator of passenger output 'performed' by airlines in the scope of the economic footprint analysis in Section 3 of this report	54% of Singaporean market scheduled capacity is operated by Singaporean airlines
D Number of Singaporean residents on flights flying to and from Singapore	10	Basis for calculation of passenger consumer surplus accruing to Singapore economy.	Immigration & Checkpoints Authority (ICA)
Freight measure	Thousands	Use in report	Source
E Tonnes of freight carried on aircraft flying to and from Singapore	1,634	Overall indicator of freight loaded and unloaded at airports in Singapore.	CAAS
F Tonnes of freight uplifted by Singaporean registered airlines	882	Overall indicator of freight output 'performed' by airlines in the scope of the economic footprint analysis in Section 3 of this report	54% of Singaporean market scheduled capacity is operated by Singaporean airlines

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