Economic Development RESEARCH GROUP

Technical Appendix 2: Consumer Surplus Calculations and Data

ACRP 03-28: The Role of U.S. Airports in the National Economy

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January 2015

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1 INTRODUCTION

As described in the final report, the analysis of consumer surplus was designed to estimate the change in consumer surplus of air travelers making personal air trips, as well as the associated overall economic impact on spending, output, employment, and value-added, from a given change in airfares. The analysis was restricted to air travelers making personal trips to avoid double-counting the economic impacts calculated from the analysis of the impact of changes in air service on multi-factor productivity for air travelers making business trips.

1.1 General Approach

Since average airfares and passenger travel vary by market, the general approach followed in the analysis was to select a representative sample of airport-pair markets and calculate the change in consumer surplus and spending for a given change in airfares in each market. The resulting change in consumer surplus and spending was then factored up to a national level using the ratio of the total volume of passenger trips at a national level to the number of air passenger trips in the sample markets.

Separate analyses of domestic air trips and international air trips were performed for several reasons. First, it was felt likely that air travelers making international trips may have a different response to a given change in airfares than air travelers making domestic air trips due to such factors as the greater distances involved in many international trips and differences in airfares between domestic and international trips. Second, it was felt that users of the results of the analysis may be interested in the difference in consumer surplus and economic impacts for domestic air travel and international air travel. Third, international air travel involves trips by both U.S. residents and foreign visitors to the U.S, but it was decided that the analysis should only address the change in consumer surplus of U.S. residents, since the economic impacts of a change in consumer surplus experienced by foreign visitors would most likely occur in their home countries rather than the U.S. Therefore the analysis of consumer surplus for international air trips needed to take this into account. Finally, there are significant differences in the data available for international air trips from domestic air trips, discussed in more detail below, which required a different approach to the calculations.

Separate calculations were performed for each of the selected sample of airport-pair markets and the resulting estimates of the change in consumer surplus and spending for each market were then weighted to account for the airport-pair markets not included in the analysis. The weighted estimates were then summed to give the total estimate at a national level.

Since average airfares in each airport-pair market are generally not proportional to distance, the given change in airfares assumed in each market to calculate the resulting change in consumer surplus and spending were based on three different approaches: a given dollar change in airfares in each market, a given percentage change in airfares in each market, and a given change in the average airfare per mile flown in each market. In the final report, based on guidance received from the Project Panel, the economic impact calculations from the consumer surplus analysis are based on a percentage change in airfares.

1.2 Time Frame for Analysis

The consumer surplus analysis was performed for 2010. This year is consistent with the most recent year of the 15-year period (1995 – 2010) used in the analysis of the contribution of changes in air service to changes in multi-factor productivity. Unlike the productivity analysis, which used a panel approach that combined cross-sectional and time series data, the consumer surplus analysis was essentially a cross-sectional analysis.

2 AIRPORT-PAIR MARKETS

A sample of 100 domestic airport-pair markets was selected, comprising the top 50 domestic markets plus a further 50 markets selected from the smaller markets. Because international trips tend to be concentrated in fewer markets, a sample of 30 international airport-pair markets was selected, comprising the top 15 markets plus a further 15 markets selected from the smaller markets.

2.1 Selecting Domestic Airport-pair Markets.

The number of origin-destination (O&D) domestic passengers in each directional airport-pair market in 2010 was obtained from the DB1B database maintained by the U.S. Department of Transportation (DOT) Bureau of Transportation Statistics (BTS).[1]

The number of O&D passengers in each direction in a given market was combined to give the total number of passengers in the market. Since the consumer surplus analysis was based on air passenger trips, in the case of round trips or open-jaw trips (a trip where the passenger returns from a different airport than their outbound destination) the outbound legs of trips in one direction in a market were combined with the outbound legs of trips in the opposite direction.

A significant number of one-way trips are seen in the data. In reality, many of these were undoubtedly part of round trips. However, if a traveler buys a ticket in one direction on one airline and a second ticket for the return leg on a different airline, these two tickets would appear in the data as separate trips.[2]

Since current airline pricing practice frequently results in one-way tickets being only about half the cost of a round-trip ticket, while the airline yield management procedures often result in the lowest fare in each direction of a round trip being on different airlines, passengers making round trips on two one-way tickets is believed to be quite common. However, one-way trips in the data were treated as outbound trips for this analysis. This does not affect the analysis of consumer surplus and spending, since two one-way trips at a given fare in a market would be treated as identical to a round trip at twice the fare.

Since each airport-pair market included outbound trips in both directions, markets were classified on the basis of the three-letter airport codes for the two airports, with the codes

[1]. This represents an approximately 10% sample of all air passenger trips on scheduled flights (it is supposed to be a 10% sample, but when compared to the number of enplanements reported by the airlines is typically found to differ slightly from a true 10% sample).

[2]. Due to the sampling procedure there is only a 10% chance that the return ticket would get reported anyway.

given in alphabetic order. Thus the market between New York Kennedy International Airport (JFK) and Los Angeles International Airport (LAX) was defined as JFK-LAX, irrespective of the actual direction of the outbound trips between the two airports.

Since the DB1B data is organized on a quarterly basis, the O&D passenger counts in each market for each quarter were summed to give the annual total number of O&D passengers in each market. Because the number of records for each quarter is so large, it was not possible to assemble a single data table for 2010 with separate records for each quarter. Instead, the O&D passenger counts for each market for each quarter were exported to a Microsoft Excel file, and summed there. Since some smaller markets did not have O&D passenger counts in every quarter, the process of creating a table of quarterly passenger counts for each market used Excel lookup functions. The resulting table of annual passenger counts was then sorted in descending size and the market rank assigned to each market.

In total, 47,653 unique airport-pair markets with reported O&D passengers occur in the DB1B database for 2010. Of these, 3,094 airport-pair markets had only one reported O&D passenger itinerary and an additional 14,967 airport-pair markets had between 2 and 9 reported O&D passengers. However, in total, these markets accounted for only 0.15% of all reported passenger itineraries for the year. The top 50 markets accounted for 11.8% of all reported passenger itineraries, with the largest O&D airport-pair market, between New York Kennedy International Airport (JFK) and Los Angeles International Airport (LAX), accounting for 0.55% of all reported passenger itineraries. Thus 29,542 airport-pair markets with 10 or more reported O&D passengers and ranked below the top 50 markets accounted for about 88% of all reported passenger itineraries.

The size of airport-pair markets declines very quickly below the top 1,000 markets. The largest market in 2010, between JFK and LAX, had 236,414 O&D passengers. The 50th largest market, between Boston Logan International Airport (BOS) and New York LaGuardia International Airport (LGA), had 77,452 O&D passengers, while the 1,000th largest market had 9,627 O&D passengers. The largest 1,000 markets accounted for 66% of all reported passenger itineraries. The 5,000th largest market had only 818 O&D passengers and the largest 5,000 markets accounted for 92% of all reported passenger itineraries.

Selecting the Smaller Sample Markets

The 50 airport-pair markets smaller than the top 50 were selected by calculating 50 equal percentile increments between 11.8% and 99.8% (thus excluding the markets with less than 10 O&D passengers in 2010) and determining the market that corresponds to this cumulative percentage of the total reported passenger itineraries. The resulting markets are shown in Table 1.

Table 1. Selected Domestic Markets

Market No.	Rank	Market	O&D Passengers	Percent Total	Cumulative Percent
1	1	JFK-LAX	236,414	0.55%	0.5%
2	2	LAX-SFO	196,385	0.46%	1.0%
3	3	LGA-ORD	183,842	0.43%	1.4%
4	4	JFK-SFO	169,000	0.39%	1.8%
5	5	ATL-LGA	145,832	0.34%	2.2%
6	6	FLL-LGA	141,634	0.33%	2.5%
7	7	HNL-OGG	133,048	0.31%	2.8%
8	8	LAS-SFO	126,910	0.29%	3.1%
9	9	SAN-SFO	115,391	0.27%	3.4%
10	10	MCO-PHL	113,025	0.26%	3.6%
11	11	EWR-MCO	108,302	0.25%	3.9%
12	12	HNL-LAX	103,146	0.24%	4.1%
13	13	DEN-PHX	102,600	0.24%	4.4%
14	14	LAX-ORD	101,992	0.24%	4.6%
15	15	DEN-LAX	99,659	0.23%	4.8%
16	16	BOS-SFO	99,161	0.23%	5.1%
17	17	HNL-ITO	96,726	0.22%	5.3%
18	18	LAX-SEA	96,259	0.22%	5.5%
19	19	LAS-LAX	94,116	0.22%	5.7%
20	20	JFK-MCO	93,251	0.22%	5.9%
21	21	BOS-LAX	91,042	0.21%	6.1%
22	22	BOS-BWI	90,464	0.21%	6.4%
23	23	DEN-LAS	90,055	0.21%	6.6%
24	24	DAL-HOU	89,610	0.21%	6.8%
25	25	BOS-ORD	88,840	0.21%	7.0%
26	26	BOS-MCO	88,693	0.21%	7.2%
27	27	MCO-SJU	88,664	0.21%	7.4%
28	28	HNL-LIH	88,406	0.21%	7.6%
29	29	IAD-LAX	87,017	0.20%	7.8%
30	30	DFW-ORD	86,989	0.20%	8.0%
31	31	ATL-DFW	86,912	0.20%	8.2%
32	32	SEA-SFO	85,244	0.20%	8.4%
33	33	ORD-SFO	85,196	0.20%	8.6%
34	34	HNL-KOA	85,113	0.20%	8.8%
35	35	JFK-LAS	84,364	0.20%	9.0%
36	36	DCA-ORD	84,353	0.20%	9.2%
37	37	JFK-SJU	82,893	0.19%	9.4%
38	38	IAD-SFO	82,741	0.19%	9.6%
39	39	DTW-MCO	82,557	0.19%	9.8%
40	40	DFW-LGA	82,499	0.19%	10.0%
41	41	EWR-FLL	81,531	0.19%	10.1%

Table 1. Selected Domestic Markets (cont.)

Market No.	Rank	Market	O&D Passengers	Percent Total	Cumulative Percent
42	42	BWI-MCO	80,595	0.19%	10.3%
43	43	LAS-SEA	80,069	0.19%	10.5%
44	44	LGA-MIA	79,749	0.19%	10.7%
45	45	BUR-OAK	79,328	0.18%	10.9%
46	46	FLL-JFK	79,143	0.18%	11.1%
47	47	EWR-ORD	78,930	0.18%	11.2%
48	48	ATL-FLL	78,836	0.18%	11.4%
49	49	ATL-LAX	77,929	0.18%	11.6%
50	50	BOS-LGA	77,452	0.18%	11.8%
51	60	EWR-SFO	69,309	0.16%	13.6%
52	71	LAX-PHX	64,361	0.15%	15.3%
53	83	DEN-DFW	60,049	0.14%	17.1%
54	97	DEN-ORD	54,741	0.13%	18.8%
55	111	BOS-DEN	50,932	0.12%	20.6%
56	126	LAS-PHL	48,532	0.11%	22.4%
57	141	DEN-IAH	46,439	0.11%	24.1%
58	158	JFK-TPA	43,785	0.10%	25.9%
59	175	EWR-IAH	41,720	0.10%	27.6%
60	194	LGA-PBI	39,263	0.09%	29.4%
61	213	BWI-LAX	37,302	0.09%	31.2%
62	234	MCO-STL	34,529	0.08%	32.9%
63	255	EWR-RSW	32,849	0.08%	34.7%
64	279	PDX-SJC	30,676	0.07%	36.4%
65	303	LAX-STL	28,285	0.07%	38.2%
66	330	MIA-SJU	26,881	0.06%	40.0%
67	358	MCO-SEA	25,831	0.06%	41.7%
68	388	PDX-SFO	24,428	0.06%	43.5%
69	419	AUS-ORD	22,756	0.05%	45.2%
70	452	ATL-JAX	21,480	0.05%	47.0%
71	487	MCO-SFO	20,218	0.05%	48.8%
72	524	BNA-TPA	18,979	0.04%	50.5%
73	564	MCO-SAT	17,688	0.04%	52.3%
74	607	HNL-PHX	16,382	0.04%	54.0%
75	654	MSY-TPA	15,274	0.04%	55.8%
76	703	ATL-RSW	14,037	0.03%	57.6%
77	757	BNA-HOU	13,072	0.03%	59.3%
78	816	MKE-SEA	11,945	0.03%	61.1%
79	880	BNA-JAX	10,869	0.03%	62.8%
80	951	MCO-SMF	9,823	0.02%	64.6%
81	1,029	AUS-LGA	8,945	0.02%	66.4%
82	1,115	COS-LAS	8,058	0.02%	68.1%

Table 1. Selected Domestic Markets (cont.)

Market No.	Rank	Market	O&D Passengers	Percent Total	Cumulative Percent
83	1,211	OGG-SJC	7,318	0.02%	69.9%
84	1,318	CLT-PDX	6,505	0.02%	71.6%
85	1,437	IND-SNA	5,800	0.01%	73.4%
86	1,572	BUF-SAN	5,142	0.01%	75.2%
87	1,725	LGB-PHX	4,546	0.01%	76.9%
88	1,897	LAS-SMX	3,973	0.01%	78.7%
89	2,095	ITO-LIH	3,480	0.01%	80.4%
90	2,326	IND-MHT	2,955	0.01%	82.2%
91	2,597	BHM-EWR	2,527	0.01%	84.0%
92	2,920	BOS-PSP	2,069	0.00%	85.7%
93	3,320	OMA-SDF	1,657	0.00%	87.5%
94	3,828	RIC-SYR	1,300	0.00%	89.2%
95	4,482	JAN-MCI	994	0.00%	91.0%
96	5,371	GEG-MFR	714	0.00%	92.8%
97	6,638	MAF-TPA	488	0.00%	94.5%
98	8,594	BHM-CRW	298	0.00%	96.3%
99	12,235	AVP-COS	138	0.00%	98.0%
100	27,408	HON-LAX	13	0.00%	99.8%

For each of the 50 smallest sample airport-pair markets, a weight was calculated as the half the difference between the cumulative percentile of O&D passengers of the next larger market and that of the next smaller market divided by the percent of total O&D passengers in the sample market. Thus this weight accounts for the O&D passengers in the markets not included in the sample. A weight was assigned to the 50th largest market to account for half the passengers in the markets between the 50th largest market and the 51st market in the sample.

2.2 Selecting International Airport-pair Markets.

In the case of international markets, a somewhat different approach was required for two reasons. First, although the international DB1B dataset provides data on passenger traffic in international airport-pair markets, the DB1B data is only reported by U.S. flag airlines and therefore excludes most passenger traffic on foreign flag airlines. Some passenger traffic on foreign flag airlines will get reported in the international DB1B data if the passengers fly on code-share tickets (in which case the U.S. code-sharing airline will report the traffic) or the full itinerary of the international trip includes domestic segments operated by a U.S. carrier (which will report the full itinerary, including the international segments). Nonetheless, in many markets the absence of data from foreign flag airlines could omit a significant proportion of the traffic. However, both U.S. and foreign flag airlines report passenger traffic on Schedule T-100 for flight segments beginning or ending in the U.S. These data

include both segment passengers (those on board when the flight departs from or arrives in the U.S.) as well as market passengers (or on-flight origin and destination). Therefore this dataset can be used to identify the top 30 international airport-pair markets, based on the flight origin and destination rather than the true trip origin and destination.

The second reason for a different approach is that many international passengers connect at a foreign hub airport to flights to their international final destination or from flights from their inbound trip origin. Although these connecting flights beyond the flight origin or destination of the international flight are part of the international trip and need to be considered in analyzing the change in consumer surplus and spending, the large number of such foreign trip origins and destinations and the data limitations discussed preclude using the same approach used for the domestic markets.

Instead, the international markets included in the sample were selected based on the passenger traffic on scheduled flights between the U.S. gateway and the first foreign flight destination or last foreign flight origin (*i.e.* the flight segment passengers), as reported in Schedule T-100. The T-100 data is reported monthly, but the dataset is much smaller than the DB1B data so it was possible to export the passenger counts for 2010 for each international segment with a U.S. origin directly to a Microsoft Excel file, summed separately for outbound and inbound passengers on U.S. and foreign flag airlines. The analysis was restricted to scheduled traffic because the analysis of domestic markets using the DB1B data was also restricted to passengers on scheduled flights (airlines only report scheduled traffic to the DB1B database).

In 2010 there were 2,308 airport-pair markets with nonstop service between a U.S. gateway and a foreign airport, with total passenger traffic in both directions of some 158,407,000 passengers. The top 30 markets accounted for 18.0% of all arriving and departing international passengers and the top 15 markets accounted for 11.2% of all such passengers. The largest airport-pair market was between JFK and London Heathrow Airport (LHR). This market carried about 2,502,000 passengers in 2010 and accounted for 1.58% of all arriving and departing international passengers. The 15th largest market was between BOS and LHR, and carried about 852,000 passengers, accounting for 0.54% of all arriving and departing international passengers.

The top 100 international markets accounted for 38.7% of all arriving and departing international passengers and the 100th largest market carried about 344,000 passengers. The top 1,000 international markets accounted for 99.2% of all arriving and departing international passengers and the 1,000th largest market carried about 11,200 passengers. Of the 2,308 airport-pair markets with nonstop international service, 1,202 carried more than a 1,000 arriving and departing passengers, while 310 markets carried less than 100 arriving and departing passengers. A market with one daily flight carrying an average of 100 passengers in each direction would account for 73,000 passengers per year, which would have been the 603rd largest market. Thus, well over half the international markets had very

infrequent service or were served by small aircraft and a significant proportion of the markets only had a handful of flights (possibly only one) during the year.

Selecting the Smaller Sample Markets

The 15 international airport-pair markets smaller than the top 15 were selected in the same way as the sample of smaller domestic markets by calculating 15 equal percentile increments between 11.2% (the 15th largest market) and 99.7% (corresponding to the smallest market with more than 100 passengers per week in 2010) and determining the market that corresponds to this cumulative percentage of the total international passengers. The resulting markets are shown in Table 2.

Weights were then calculated for 16 smallest markets in the sample in the same way as for the domestic sample of airport-pair markets to account for the passengers in markets not included in the sample.

3 PASSENGER TRAFFIC AND AIRFARE DATA FOR EACH AIRPORT-PAIR MARKET

The DB1D market data used to select the domestic airport-pair markets provides a direct measure of the number of air passenger trips in each market, although this needs to be factored up to account for the sample rate of the O&D survey. In the case of the international airport-pair markets some additional steps are necessary to reconcile the passenger counts in the international Schedule T-100 data with the passenger itinerary data in the international DB1B data.

3.1 Domestic Passenger Trips

Determining the passenger traffic for each domestic market for use in the consumer surplus analysis from the domestic O&D passenger itinerary counts involved two steps. The first step was to calculate the number of O&D passengers in each market who paid a valid, non-zero airfare (termed "fared passengers"). It was assumed that passengers traveling on a bulk fare or "zero fare" would not be influenced by a change in airfare, so these passengers were excluded from the consumer surplus and spending analysis. It is unclear what effect a change in airfare would have on passengers traveling on itineraries with a "bad fare" [3] (there were not many of these in the data), but it was also assumed that these passengers would be unaffected by a change in airfare and were also excluded from the analysis.

The second step was to determine the sample factor for the overall reported O&D passenger itineraries by comparing the total number of enplanements in the reported itineraries to the number of enplanements on each segment of the itineraries reported on Schedule T-100. The number of enplanements in the reported itineraries can be obtained from the Coupon dataset of the DB1B database, which provides one record for each coupon in the ticket for each itinerary. Each ticket coupon corresponds to one flight segment in the itinerary, and thus the number of coupons is equivalent to the number of enplanements in the itinerary.

Table 2. Selected International Markets

[3]. Those judged by the BTS as being unreasonably high for the market in question and flagged as "bad fares" in the DB1B data.

Market No.	Rank	Market	Passengers	Percent Total	Cumulative Percent
1	1	JFK-LHR	2,501,546	1.58%	1.6%
2	2	HNL-NRT	1,796,314	1.13%	2.7%
3	3	LAX-LHR	1,388,367	0.88%	3.6%
4	4	LAX-NRT	1,210,267	0.76%	4.4%
5	5	JFK-CDG	1,159,089	0.73%	5.1%
6	6	ORD-LHR	1,110,231	0.70%	5.8%
7	7	EWR-LHR	1,065,842	0.67%	6.5%
8	8	LAX-SYD	1,057,679	0.67%	7.1%
9	9	GUM-NRT	1,040,180	0.66%	7.8%
10	10	LAX-TPE	962,908	0.61%	8.4%
11	11	SFO-HKG	901,765	0.57%	9.0%
12	12	IAD-LHR	897,747	0.57%	9.5%
13	13	LAX-ICN	892,273	0.56%	10.1%
14	14	ORD-FRA	866,733	0.55%	10.6%
15	15	BOS-LHR	851,728	0.54%	11.2%
16	27	IAD-FRA	659,532	0.42%	17.1%
17	43	JFK-ICN	551,870	0.35%	23.0%
18	61	MIA-YYZ	474,242	0.30%	28.9%
19	83	MIA-MAD	395,503	0.25%	34.8%
20	109	JFK-CUN	327,196	0.21%	40.7%
21	140	PHL-CUN	284,627	0.18%	46.6%
22	175	IAD-MUC	249,881	0.16%	52.5%
23	216	BOS-AMS	210,420	0.13%	58.4%
24	264	ORD-YOW	180,930	0.11%	64.3%
25	320	LAS-MEX	157,582	0.10%	70.2%
26	385	IAH-GIG	135,049	0.09%	76.1%
27	461	TPA-LGW	112,557	0.07%	82.0%
28	555	BOS-SNN	87,212	0.06%	87.9%
29	691	SLC-CUN	52,114	0.03%	93.8%
30	1,087	IAH-TGZ	5,219	0.00%	99.7%

While it would be possible to calculate a separate sample factor for each unique flight segment, the Research Team considered that using a constant sample factor for the year, based on the total number of passenger itineraries was sufficiently accurate within the limitations of the overall analysis.

As T-100 segment data includes passengers making true domestic O&D trips, as well as passengers on domestic segments of international trips, adjustments were made in the total number of passenger enplanements in each quarter in the T-100 data for passengers on domestic segments of international trips. If an international itinerary has one or more domestic segments (e.g. an itinerary Las Vegas-New York-London), the passengers on those domestic segments are not included in the domestic DB1B dataset, but they are counted in

the T-100 segment data for each segment, which does not consider the true O&D of each passenger. Since the international DB1B dataset includes the full itinerary, including any domestic segments, this dataset was used to obtain an estimate of the number of passenger enplanements generated by domestic segments of international trips, as discussed in the next section. Subtracting this number of enplanements from the total domestic enplanements given by the T-100 data gave an estimate of the number of enplanements by passengers making purely domestic O&D trips.

The ratio of the total number of enplanements by passengers making purely domestic O&D trips to the number of enplanements given by the DB1B coupon data gave the sample factor that was used to expand the results of the consumer surplus and spending analysis based on the domestic DB1B itineraries to the total traffic. The resulting sample factor for 2010 was calculated as 9.80 (to two decimal places). This is 2 percent less than would be expected if the domestic DB1B dataset was a true 10 percent sample.

It is not clear why the domestic O&D data appears to have been slightly over-sampled. Whatever the reason for the over-sampling, use of the sample factor of 9.80 ensured that the expansion of the analysis results from the domestic O&D survey itineraries was consistent with the reported traffic from the T-100 data.[4]

3.2 International Passenger Trips

The international DB1B data used in the analysis was obtained from a commercial vendor, the international low-level O&D survey dataset marketed by Data Base Products, Inc. This dataset combined the ticket, market, and coupon data from the international DB1B data maintained by BTS into a single record for each directional trip with separate fields for each segment of the trip, as well as the allocated fare for the directional journey. Because of the structure of the dataset some processing of the data was necessary to extract the itineraries that involved the selected international markets. Since the consumer surplus analysis for international trips was based on passengers on nonstop flight segments to or from a U.S. gateway airport, determined from Schedule T-100 data, the itineraries in the international O&D dataset were analyzed to identify the first U.S. gateway in the itinerary, as well as the

[4]. It is possible that the number of domestic segments of international trips was over-estimated. Another possible explanation for the discrepancy arises from the difference in reporting of T-100 data and O&D data. The T-100 data are reported by month based on when the segment was flown, while the O&D data gets reported quarterly based on when the first reportable segment of the complete itinerary is flown. Therefore if traffic is growing, such that traffic levels in December 2010 were higher than in December 2009 (indeed, domestic enplanements on U.S. carriers were 2.6% higher in December 2010 compared to December 2009), this would give more O&D segments reported for the year than were in fact flown during the year (since some of the return legs of trips starting in December would have been flown in January). Also, the entire itinerary gets reported when the first reportable segment is flown, whether or not the passenger subsequently cancels or changes the downstream itinerary (which the reporting carrier may not be aware of), so some segments of an itinerary get reported that are not in fact flown.

second U.S. gateway in the case of itineraries with two U.S. gateways *(e.g.* an itinerary Tokyo-Los Angeles-New York-London). Itineraries were classified into four types of trip: local, beyond, through, and domestic O&D trips with international segments (*e.g.* Seattle-Toronto-New York).

Local itineraries are passengers with a trip origin and destination at each end of the nonstop flight segment. *Beyond* itineraries are trips to or from the U.S. that involve connections at the U.S. gateway, the foreign end of the nonstop flight segment, or both. *Through* itineraries are trips via one or more U.S. gateway airports but with both the trip origin and destination outside the U.S. (*e.g.* an itinerary Mexico City-Miami-Paris or Sydney-San Francisco-Chicago-Ottawa).

The enplaned passengers in each of the selected markets could include passengers traveling on each of the above types of itinerary. However, through passengers were not included in the consumer surplus analysis because they would generally not be U.S. residents. The proportion of local and beyond passengers in each nonstop market was calculated from the O&D itinerary data and separate average airfares were calculated for local and beyond passengers, since generally itineraries involving connections either in the U.S. or abroad have higher fares than local trips between a U.S. gateway and the foreign end of a nonstop flight segment.

The proportions of local and beyond passengers in each market, together with the associated average fares, were calculated separately for passengers on U.S. flag and foreign flag airlines for each sample nonstop market. Although foreign flag airlines do not report data to the 10% O&D Survey, enough passengers on those airlines fly on code-share tickets issued by U.S. airlines or have domestic flight segments in their itinerary (and thus their complete itinerary was reported) that it proved possible to estimate the proportion of local and beyond passengers and the respective average fares for nonstop international segments operated by foreign flag airlines.

Domestic Segments of International Trips

In order to calculate the domestic O&D survey expansion factor for domestic trips, as discussed above, it was necessary to estimate the total number of domestic segments flown as part of international trips. Since domestic segments would generally be flown by U.S. carriers, these should be fully reported in the O&D data, even if the international segments are flown on foreign flag airlines. In a few cases, foreign flag airlines may operate domestic segments as an extension of an international flight (*e.g.* a flight from London to Washington, DC may continue on to San Diego, although the airline would not be allowed to sell tickets between Washington and San Diego). The itineraries in the international O&D dataset were analyze to identify the number of domestic segments operated by U.S. carriers.

The passenger counts for each itinerary in the international O&D dataset were expanded by a factor of 10 from the counts reported in the BTS data, assuming a true 10 percent sample. This was not a concern for the calculation of the proportions of local and beyond passengers or for the calculation of average airfares, but it could affect the estimate of passengers on domestic segments of international trips if in fact there was any over- or under-reporting of international itineraries with domestic segments.

The international O&D data only provides details for the first five flight segments on a directional itinerary, although the number of segments in each itinerary (the number of coupons) is given. It was assumed that for itineraries with more than five segments, if the last connecting point specified and the final destination were both domestic and the fifth segment was flown on a U.S. carrier, then the missing segments were all domestic on a U.S. carrier. It is possible that some of these segments were in fact international. However, there were only about 6,900 enplanements covered by these segments, so this is not enough to explain the apparent over-sampling of the domestic O&D data. In any case, any overestimation due to these assumptions would be offset by underestimation due to the reverse situation where the missing segments were assumed to be international but some of them were in fact domestic.

3.3 Airfares

The DB1B data includes the airfare paid for each itinerary. Therefore these data can be used to calculate the average airfare paid for passenger trips in each market. In general, the average airfare in a given market will be different (although typically not by much) for trips made in each direction. However, several adjustments needed to be made in the calculations.

First, some passengers travel on bulk fares (*e.g.* airfares that are included in a tour package) that are negotiated between the tour operator or other agency issuing a ticket using a bulk fare and the airline. Passengers traveling on bulk fares are flagged in the DB1B data, but the airfare is shown as zero in the data.

Second, some passengers travel on frequent flier award tickets or other tickets at a zero or very low fare for the market (*e.g.* airline personnel traveling on a space-available basis or travelers using vouchers issued in compensation for denied boarding). Since the airlines are required to include government fees and taxes in the reported airfare for each itinerary in the DB1B data, and some fees and taxes are charged on frequent flier award tickets or other tickets with a zero or very low fare, there are a number of itineraries in the data with zero or very low fares. In the case of domestic trips, it was assumed that any airfare of $20 or less for the directional trip was in this category and these itineraries were classified as a zero-fare trip. In the case of international trips, the dataset already included a fare type code that distinguished between fared and zero-fare passengers, on the basis of criteria set

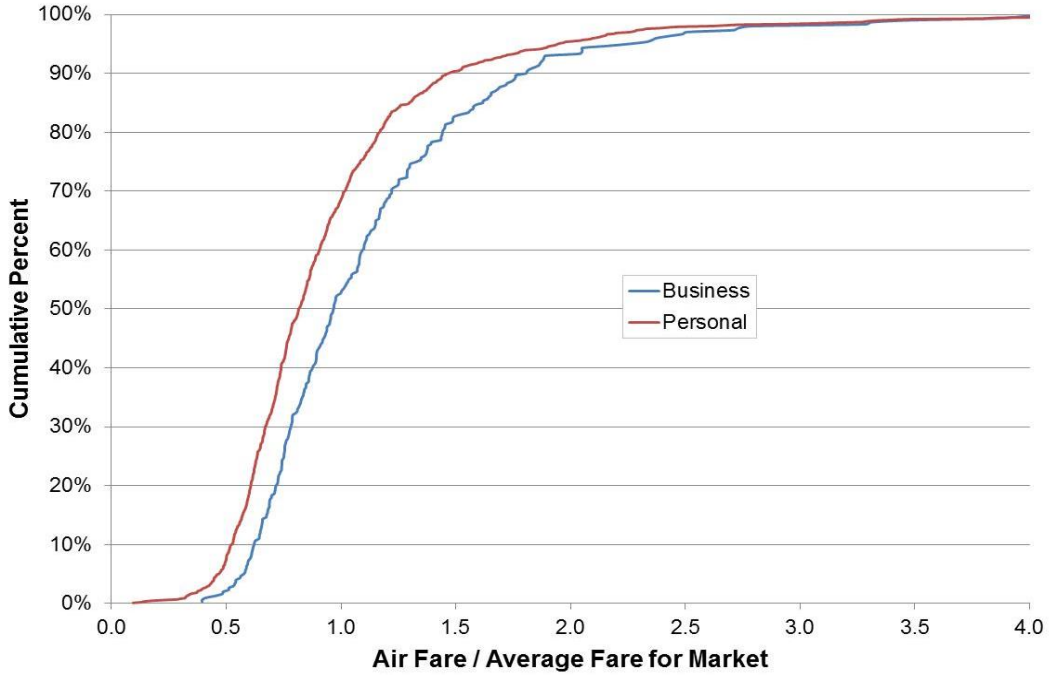
by Data Base Products. Passengers traveling on bulk fares or making zero-fare trips were excluded from the calculations of the average paid fare for each market.

Third, as noted above, some itineraries in the DB1B data had fares that were judged by the BTS as being unreasonably high for the market in question and were flagged as "bad fares" in the DB1B data. These itineraries were also excluded from the calculations of the average paid fare for each market.

Airfares for Personal Trips

The average airfare in each market for personal trips cannot be obtained directly from the DB1B domestic or international datasets, since the reported data do not contain any information on trip purpose. Therefore, it was necessary to adjust the average airfare paid for trips in the market for the difference between the average airfares paid by passengers making personal trips from those making business trips. This was done by taking advantage of the results of a survey of air travelers who made a recent domestic air trip that was undertaken in 2013 as part of ACRP Project 03-19, *Passenger Value of Time, Benefit Cost Analysis, and Airport Capital Investment Decisions*. This survey asked respondents about their most recent domestic air trip, including the airfare that they paid and their trip purpose. The reported fares were compared to the average fare in that market and separate distributions of the ratio of the reported fare to the average fare were developed for personal and business trips, as shown in Figure 1.

Figure 1. Cumulative Distribution of Domestic Airfares by Trip Purpose



Source: Analysis of reported airfares paid for their most recent domestic air trip by respondents to a web-based survey of air travelers undertaken as part of ACRP Project 03-19, Passenger Value of Time, Benefit Cost Analysis, and Airport Capital Investment Decisions.

These results suggest that passengers making personal trips are able to use somewhat lower fares on average than passengers making business trips, with the average fare for personal trips being about 94% of the average fare for all trips. This factor was used to adjust the average fare in each market obtained from the DB1B data in the current analysis to give an assumed average fare for personal trips.

Since the ACRP 03-19 survey did not include international trips it was assumed that the same relationship between the average fare for personal trips and the average fare for all trips also held for international trips.

4 TRIP PURPOSE AND INTERNATIONAL TRIPS BY U.S. RESIDENTS

The passenger traffic and airfare data described in the preceding section cover air trips that were made for all trip purposes, since the DB1B and T-100 data contain no information on trip purpose. In addition, the data on international trips cover travel by both U.S. residents and visitors to the U.S. Therefore in order to perform the consumer surplus analysis for air passengers making personal trips and only for international trips by U.S. residents, estimates of travel by trip purpose were developed for each of the sample markets and the split between travel by U.S. residents and visitors for each of the sample international markets.

4.1 Trip Purpose

In order to estimate the proportion of passenger trips in a given market that were undertaken for personal purposes, data from the most recent air passenger surveys performed at 11 airports that were available to the research team were analyzed to determine the split between personal and business travel in the markets included in the sample.

Air passenger survey data were obtained from surveys performed at the following airports in the year indicated:

- Atlanta Hartsfield-Jackson International Airport (ATL), 2009
- Boston Logan International Airport (BOS), 2010
- Burbank Bob Hope Airport (BUR), 2012
- Los Angeles International Airport (LAX), 2011
- New York Kennedy International Airport (JFK), 2007
- New York LaGuardia International Airport (LGA), 2007
- Newark International Airport (EWR), 2007
- Oakland International Airport (OAK), 2006
- Phoenix Sky Harbor International Airport (PHX), 2012
- San Diego International Airport (SAN), 2012
- San Francisco International Airport (SFO), 2006

In some cases, the survey response data was made available by the survey sponsors and was analyzed by the Research Team. In the case of the three New York Airports, the data was extracted from the tabulations in the published survey report. In other cases, the survey sponsors performed specific tabulations to generate the data required for the analysis.

Domestic Markets

These surveys included respondents who were making trips in many of the sample domestic markets. In the case of some markets, survey data was available from different surveys performed at the airports at each end of the market. All but four of the surveys distinguished between residents of the region where the airport was located and visitors to the region, so in general it was possible to obtain separate estimates of the trip purpose split for outbound trips in each direction. In cases where the residency of the travelers was not available, the trip purpose split was assumed to be the same in both directions.

In markets where air passenger survey data were available from surveys performed at the two airports at either end of the market, the proportion of personal trips for originating trips in each direction was calculated as the average of the proportion given by each survey. Since passengers who were classified as residents of the local area in one survey would be considered as visitors in the other survey, the average proportion in each direction was based on the average of the proportion of personal trips by residents in the survey at the origin airport and the proportion by visitors from the survey at the destination airport.

For domestic markets for which survey data was available for one end of the market but there was no data for the destination airport in the survey or the number of responses in the surveys was considered too small to be representative, the average proportion of personal trips for travel to or from the survey airport across all domestic markets was used. For markets for which no survey data was available for the airports at either end of the market, the average proportion of personal trips for travel to the two airports at each end of the market from surveys performed at ATL, LAX, PHX, and SFO was used. In the case of two markets in Hawaii, between Honolulu and Kona, and between Hilo and Lihue, the average proportion of personal trips across all smaller markets (those with less than 20 respondents in each survey) from the four surveys used for other markets for which no survey data was available was used. It was felt that using the average proportion of personal trips for travel to airports in Hawaii from mainland airports would overstate the proportion of personal trips on inter-island flights, which were assumed to have a trip purpose composition more like smaller mainland markets.

Of the 100 sample markets, 11 had survey data for airports at both ends of the market, 45 had survey data for an airport at only one end of the market, and 44 had no survey data for the airports at either end of the market. However, of the 50 largest of the sample markets, 37 had survey data for the airports at one or both ends of the market, and of the 20 largest

of the sample markets, all but three had survey data for airports at one or both ends of the market.

The resulting proportions of personal trips in each of the sample markets are shown in the domestic calculation worksheet discussed below.

International Markets

For the international markets, the proportion of personal trips was estimated from the results of a survey of international air travelers departing from U.S. airports that is undertaken annually for the Office of Travel and Tourism Industries (OTTI) of the U.S. Department of Commerce. Data tabulations were obtained for the OTTI survey performed in 2011. The OTTI survey tabulations included separate tables for trips by U.S. residents and foreign visitors that gave the main purpose of the trip in eight categories. Trips for business/professional and convention/conference purposes were considered to be business trips and the other six categories (leisure/recreation/holidays, visit friends/relatives, study/teaching, religion/ pilgrimages, health treatment, and "other") were considered to be personal trips. The tabulations gave the trip purpose for U.S. residents by broad world regions and selected countries visited and the trip purpose for foreign visitors by world region and country of residence. The tabulation for U.S. residents on identified two counties visited, Japan and the United Kingdom (U.K.). Europe was divided into Western and Eastern Europe, with the rest of the world divided into seven regions. Therefore the proportion of personal trips by U.S. residents for each of the sample international markets was based on the relevant world region, except for airports in Japan or the U.K. The proportion of personal trips for travel to Asia and Western Europe shown in the tabulation was adjusted to remove respondents traveling to Japan or the U.K.

Since not all the sample markets were included in the OTTI survey (which does not cover travel to Canada or Mexico), the OTTI survey results were supplemented with estimated proportions of personal trips by U.S. residents derived from some of the airport air passenger surveys. Although none of the sample international markets that were not included in the OTTI survey involved airports for which air passenger surveys were available, the proportions were estimated from survey data to the international airport in question from U.S. airports for which data was available and that were judged to have similar air travel characteristics in the market to that destination. For example, for the market between Miami and Toronto, data from the air passenger survey at PHX for trips to Toronto were used, on the assumption that travelers to Canada from Miami and Phoenix are likely to have a similar trip purpose distribution.

Because the OTTI survey tabulations only provide trip purpose information by world region for U.S. residents (other than travel to Japan and the U.K.), whereas the tabulations for foreign visitors provide trip purpose by country of residence, the data for visitors is more market specific and it was felt that the combined proportions for residents and visitors may be closer to the actual proportion for resident trips to a given country than the proportions

for U.S. residents at the world region level. The combined proportion of personal trips in each of the sample markets was calculated using the split between trips by U.S. residents and foreign visitors in the market determined as described in the following section.

The resulting proportions of personal trips in each of the sample markets are shown in the international calculation worksheet discussed below.

4.2 Proportion of International Travel by U.S. Residents

The OTTI survey data were also used to determine the proportion of U.S. residents in each international market, in order to estimate the number of trips by U.S. residents in each market from the T-100 passenger counts. The OTTI survey tabulations included separate tables for trips by U.S. residents and foreign visitors that gave the percentage of U.S. residents making international trips to selected countries and percentage of visitors who were residents of each of these countries. The survey tables also gave the total number of international passengers to the world regions covered by the survey (*i.e.* excluding Canada and Mexico) who were U.S. residents or visitors, based on the customs forms submitted by each arriving passenger. It was thus possible to calculate the proportion of visitor trips for international travelers to each country.

As with the survey data on trip purpose, the survey tabulations were at the country level rather than the airport level and did not include all countries. However, all the sample markets other than those to Canada and Mexico were to airports in countries included in the survey tabulations.

For the sample markets that were not included in the OTTI survey, the proportions were estimated from air passenger survey data for trips to the international airport in question from the U.S. airports that were used to estimate the proportion of personal trips, since these were assumed to have similar air travel composition for trips to the international airport.

The resulting proportions of trips by U.S. residents (shown as percentage of total trips made by foreign visitors, from which the percentage of trips by U.S residents can be derived) in each of the sample markets are shown in the international calculation worksheet discussed below.

5 CALCULATING THE CHANGE IN CONSUMER SURPLUS AND SPENDING

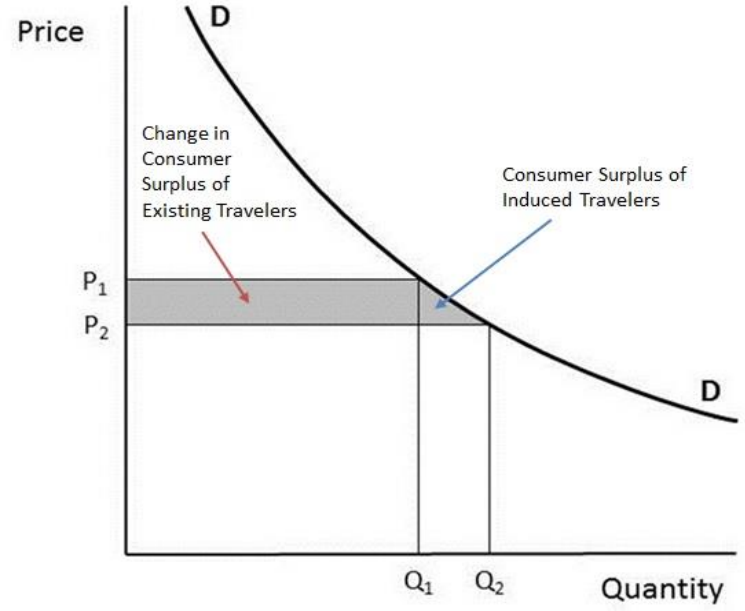
The change in consumer surplus and spending on airfares for a given change in airfare for each of the sample markets was calculated based on the number of existing air passenger trips and the average airfare paid by those passengers, together with the change in the number of air passenger trips at the new average airfare. The change in the number of air passenger trips was calculated from the assumed elasticity of demand with respect to airfare. The general principles behind the calculations are illustrated in Figure 2, which shows the increase in passenger traffic from Q_1 to Q_2 for a reduction in price (airfare) from P_1 to P_2.

The elasticity of demand with respect to airfare is defined as the percent change in passenger trips for a one percent change in airfare, and is given by:

$$\varepsilon = \frac{dQ}{Q} \Big/ \frac{dP}{P} = \frac{dQ}{dP} \cdot \frac{P}{Q}$$

The change in consumer surplus is shown by the shaded area in Figure 2. The rectangular portion of the shaded area represents the increase in consumer surplus for the existing travelers. The triangular portion of the shaded area represents the increase in consumer surplus of the new travelers attracted to the market by the reduction in fare (induced travelers).

Figure 2. Change in Consumer Surplus from a Reduction in Airfare



The logic behind this is that it is assumed that each incremental new passenger in a market is attracted to the market at an airfare equal to their previous spending on other goods or services for which their consumer surplus is zero, since if this is not the case deciding to purchase an air trip in the market at an airfare for which their consumer surplus is zero[5] would reduce their overall consumer surplus, so they would have no reason to change their spending. Therefore, if the airfare drops to P_2, their new consumer surplus is given by the difference between P_2 and the fare at which they became the marginal consumer, given by the height of the demand function above P_2 at the passenger traffic level at which they become the marginal consumer. Summed across all the induced air travelers, this gives the triangular area shown in Figure 2.

The change in spending on airfares resulting from the reduction in fare consists of the difference between two components: the reduction in spending on airfares by the existing travelers, which is the same as their increase in consumer surplus (shown by the rectangular portion of the shaded area in Figure 2), and the new spending by travelers attracted to the market, which is given by the rectangular area below P_2 between Q_1 and Q_2. It can be seen from Figure 2 that this is equal to $P_2Q_2 - P_1Q_1$, where a positive value represents an increase in spending.

5.1 Demand Elasticity

The demand elasticity values used in the calculations were based on a review of the literature on air travel demand modeling performed in 2002 by Gillen, Morrison and Stewart, as part of a study for the Canadian Department of Finance.[6] A review of recent literature on air travel demand modeling undertaken for the current study identified a number of more recent reviews of air travel demand elasticity, but these generally cited the Gillen *et al.* study as the most comprehensive to date. The Gillen *et al.* study grouped the elasticity values found in previous studies into different types of air travel market, distinguishing between U.S. domestic versus international markets, and short-haul versus long-haul domestic markets, where short-haul markets were defined as those of 1,500 miles or less.

The authors found that the demand elasticity for a given type of air travel market varied widely across previous modeling studies. Their report presented distributions of the demand elasticity values from the previous studies and calculated the median value for

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5. The consumer surplus of the marginal consumer at a given price is always zero or they would not be the marginal consumer.

6. Gillen, David W., William G. Morrison and Christopher Stewart, *Air Travel Demand Elasticities: Concepts, Issues and Measurement*, Final Report, Prepared for the Department of Finance Canada, School of Business & Economics, Wilfred Laurier University, Waterloo, Canada, December 2002.

each type of air travel market. The median value of demand elasticity for non-business travel in U.S. domestic short-haul markets was found to be -1.5, that for non-business travel in U.S. domestic long-haul markets was found to be -1.1, and that for non-business travel in international markets was found to be -1.04. These values were used in the consumer surplus analysis for the relevant markets, where domestic markets were classified as short-haul or long-haul on the basis of the average distance flown. It was assumed that each of the sample markets in each of the three types had the same demand elasticity.

5.2 Change in Consumer Surplus

The change in consumer surplus for a given change in average airfare *ΔP* and assuming a constant elasticity ε is derived as follows (retaining the notation shown in Figure 2 for consistency):

$$\frac{dQ}{dP} = \varepsilon \frac{Q}{P}$$

implies a demand function:

$$Q = Q_0 \left(\frac{P}{P_0}\right)^{\varepsilon}$$

where P_0 and Q_0 are values at some point on the demand function (such as the current price and quantity). Hence for a (positive) change in price ΔP from P_0 to P_1 ($P_0 + \Delta P$) the change in consumer surplus ΔCS is given by:

$$\Delta CS = -\int_{p_0}^{p_1} Q\ dP = -\frac{Q_0}{P_0^{\varepsilon}} \int_{P_0}^{P_1} P^{\varepsilon}\ dP = -\frac{Q_0}{P_0^{\varepsilon}} \left[\frac{P^{1+\varepsilon}}{(1+\varepsilon)}\right]_{P_0}^{P_1}$$

$$= -\frac{Q_0}{(1+\varepsilon)P_0^{\varepsilon}}[P_1^{1+\varepsilon} - P_0^{1+\varepsilon}] = -\frac{P_0 Q_0}{(1+\varepsilon)}\left[\left(\frac{P_1}{P_0}\right)^{1+\varepsilon} - 1\right]$$

$$= -\frac{P_0 Q_0}{(1+\varepsilon)}\left[\left(1+\frac{\Delta P}{P_0}\right)^{1+\varepsilon} - 1\right]$$

5.3 Change in Spending

The change in spending ΔE for a given change in average airfare ΔP and assuming a constant elasticity ε is derived as follows:

$$\Delta E = P_1 Q_1 - P_0 Q_0 = Q_0\left(\frac{P_1^{1+\varepsilon}}{P_0^{\varepsilon}} - P_0\right) = P_0 Q_0\left(\left(\frac{P_1}{P_0}\right)^{1+\varepsilon} - 1\right)$$

$$= P_0 Q_0\left(\left(1+\frac{\Delta P}{P_0}\right)^{1+\varepsilon} - 1\right) = -(1+\varepsilon)\,\Delta CS$$

5.4 Performing the Calculations

The calculations of the changes in consumer surplus and spending for a given change in the three approaches for defining the change of airfare were performed by creating a Microsoft Excel workbook with separate worksheets for domestic air trips and international air trips. The data and calculations for each of the sample markets is a row in the worksheet. The column definitions for each worksheet are shown in Table 3 and Table 4.

A number of key input assumptions are shown in cells above the column headings. These comprise:

- The assumed elasticity of demand with respect to a change in airfare for personal air trips. For domestic trips separate demand elasticity values are given for short-haul and long-haul trips. For international trips, only one value is given, for all trips.
- The average fare for personal trips as a percentage of the average fare for all trips.
- The assumed change in airfares, expressed in each of the three alternative approaches.

The calculation formulae in the worksheets refer to the values in these cells. Thus by changing the values in these cells, the user can perform alternative calculations for different input assumptions.

The total change in consumer surplus and spending is shown in the final rows of the worksheets and also in a Summary worksheet that is linked to the totals on the domestic and international worksheets. Thus the Summary worksheet automatically updates if any of the input assumptions on the domestic or international worksheets are changed.

The Microsoft Excel worksheets are included as Technical Appendix 2A. The user can change the input assumptions in the cells above the column headings highlighted in yellow, but the remainder of the worksheets are projected to prevent the user from inadvertently changing either the data or the formulae, although the user can view the formulae to see how the values are calculated.

Table 3. Domestic Market Calculation Worksheet Columns

Column	Heading	Content
A	Mkt No	Sequence number of market in sample
B	Rank	Rank order number from all domestic markets
C	Market	Market (defined as A to B) - both directions
D	Mkt Pax	Total DB1B passengers in market – both directions
E	Pct Total	Percent of total DB1B passengers in all markets
F	Cum Pct	Cumulative percentage of total DB1B passengers
G	Weight	Weight assigned to market to cover non-sample markets
H	Dist	Market nonstop distance (miles)

Table 3. Domestic Market Calculation Worksheet Columns (cont.).

Column	Heading	Content
	Market Direction A-B	Calculations for outbound trips in direction from A to B
I	Dir Pax	Total passengers in market direction
J	Out Pax	Outbound passengers in market direction
	Paid Fares (>$20)	Number of DB1B passengers on paid fares over $20
K	Dir Pax	Total passengers in market direction
L	Out Pax	Outbound passengers in market direction
M	Ret Pax	Return passengers in reverse direction
	Average Paid Fare	Average paid fare (one-way)
N	Dir Pax	By total passengers in market direction
O	Out Pax	By outbound passengers in market direction
P	Ret Pax	By return passengers in reverse direction
Q	Avg Dist Flown	Average distance flown for market (miles)
R	1+ε	1 + Demand elasticity
S	Percent Personal	Percent of trips in market for personal purposes
	Change in CS ($m)	Change in consumer surplus ($m) for:
	Fare change	
T	$1 drop	$1 fare drop
U	1% drop	1% fare drop
V	Fare/mi – 1¢ drop	Fare drop of 1 cent per mile
	Change in Expenditure ($m) for:	
	Fare change	
W	$1 drop	$1 fare drop
X	1% drop	1% fare drop
Y	Fare/mi – 1¢ drop	Fare drop of 1 cent per mile
	Market Direction B-A	Calculations for outbound trips in direction from B to A
Z	Dir Pax	Total passengers in market direction B-A
AA	Out Pax	Outbound passengers in market direction B-A
	Paid Fares (>$20)	Number of DB1B passengers on paid fares over $20
AB	Dir Pax	Total passengers in market direction B-A
AC	Out Pax	Outbound passengers in market direction B-A
AD	Ret Pax	Return passengers in reverse direction
	Average Paid Fare	Average paid fare (one-way)
AE	Dir Pax	By total passengers in market direction B-A
AF	Out Pax	By outbound passengers in market direction B-A
AG	Ret Pax	By return passengers in reverse direction
AH	Avg Dist Flown	Average distance flown for market (miles)
AI	1+ε	1 + demand elasticity
AJ	Percent Personal	Percent of trips in market for personal purposes
	Change in CS ($m)	Change in consumer surplus ($m) for:
	Fare change	
AK	$1 drop	$1 fare drop
AL	1% drop	1% fare drop
AM	Fare/mi – 1¢ drop	Fare drop of 1 cent per mile

Table 3. Domestic Market Calculation Worksheet Columns (cont.).

Column	Heading	Content
	Change in Expenditure ($m) for:	
	Fare change	
AN	$1 drop	$1 fare drop
AO	1% drop	1% fare drop
AP	Fare/mi – 1¢ drop	Fare drop of 1 cent per mile
	Induced Expenditure ($m) (attracted travelers – both directions) for:	
	Fare change	
AR	$1 drop	$1 fare drop *(not calculated)*
AS	1% drop	1% fare drop
AT	Fare/mi – 1¢ drop	Fare drop of 1 cent per mile *(not calculated)*
	Change in Expenditure ($m) (existing travelers - both directions) for:	
	Fare change	
AU	$1 drop	$1 fare drop *(not calculated)*
AV	1% drop	1% fare drop
AW	Fare/mi – 1¢ drop	Fare drop of 1 cent per mile *(not calculated)*

Table 4. International Market Calculation Worksheet Columns

Column	Heading	Content
A	Mkt No	Sequence number of market in sample
B	Rank	Rank order number from all domestic markets
C	Market	Market (defined as A to B) - both directions
D	Pax	Total T-100 passengers in market – both directions
E	Pct Total	Percent of total T-100 passengers in all markets
F	Cum Pct	Cumulative percentage of total T-100 passengers
G	Weight	Weight assigned to market to cover non-sample markets
H	Dist	Market nonstop distance (miles)
I	Pct Vis	Percent of foreign visitors in market
J	Pct Pers	Percent of all trips in market for personal purposes
	Market Direction A-B	Calculations for one-way trips in direction from A to B
K	Dir Pax	Total passengers in market direction
L	US Car Pax	Passengers on US carriers in market direction
M	FF Car Pax	Passengers on foreign flag carriers in market direction
	Mkt OD Pax	Passengers in market direction from DB1B data
N	US Car	Passengers on US carriers (DB1B count x 10)
O	FF Pax	Passengers on foreign flag carriers (DB1B count x 10)
	Fared Pax as Percent Total Pax: Percent paying a valid (non-zero) fare	
	US Carriers	Percent of passengers on US carriers
P	Local	Making a local (non-stop) trip
Q	Beyond	Connecting at either or both ends of the market
	FF Carriers	Percent of passengers on foreign flag carriers
R	Local	Making a local (non-stop) trip
S	Beyond	Connecting at either or both ends of the market

Table 4. International Market Calculation Worksheet Columns (cont.)

Column	Heading	Content
	Average Paid Fare	Average paid fare (one-way)
	US Carriers	Passengers on US carriers
T	Local	Making a local (non-stop) trip
U	Cnx Seg	Average pro-rated fare in market for beyond trips
V	Beyond	Connecting at either or both ends of the market
	FF Carriers	Passengers on foreign flag carriers
W	Local	Making a local (non-stop) trip
X	Cnx Seg	Average pro-rated fare in market for beyond trips
Y	Beyond	Connecting at either or both ends of the market
Z	1+ε	1 + Demand elasticity
	Change in CS ($m) - Res: Change in consumer surplus (US Residents) for:	
	Fare change	
AA	$1 drop	$1 fare drop
AB	1% drop	1% fare drop
AC	Fare/mi – 1¢ drop	Fare drop of 1 cent per mile
	Change in CS ($m) - Vis: Change in consumer surplus (Foreign Visitors) for:	
	Fare change	
AD	$1 drop	$1 fare drop
AE	1% drop	1% fare drop
AF	Fare/mi – 1¢ drop	Fare drop of 1 cent per mile
	Change in Expenditure ($m) - Res: Change in expenditure (US Residents) for:	
	Fare change	
AG	$1 drop	$1 fare drop
AH	1% drop	1% fare drop
AI	Fare/mi – 1¢ drop	Fare drop of 1 cent per mile
	Change in Expenditure ($m) - Vis: Change in expenditure (Foreign Visitors) for:	
	Fare change	
AJ	$1 drop	$1 fare drop
AK	1% drop	1% fare drop
AL	Fare/mi – 1¢ drop	Fare drop of 1 cent per mile
	Market Direction B-A	Calculations for one-way trips in direction from B to A
AM	Dir Pax	Total passengers in market direction
AN	US Car Pax	Passengers on US carriers in market direction
AO	FF Car Pax	Passengers on foreign flag carriers in market direction
	Mkt OD Pax	Passengers in market direction from DB1B data
AP	US Car	Passengers on US carriers (DB1B count x 10)
AQ	FF Pax	Passengers on foreign flag carriers (DB1B count x 10)
	Fared Pax as Percent Total Pax: Percent paying a valid (non-zero) fare	
	US Carriers	US Carriers
AR	Local	Local
AS	Beyond	Beyond
	FF Carriers	FF Carriers
AT	Local	Local

Table 4. International Market Calculation Worksheet Columns (cont.)

Column	Heading	Content
AU	Beyond	Beyond
	Average Paid Fare	Average paid fare (one-way)
	US Carriers	Passengers on US carriers
AV	Local	Making a local (non-stop) trip
AW	Cnx Seg	Average pro-rated fare in market for beyond trips
AX	Beyond	Connecting at either or both ends of the market
	FF Carriers	Passengers on foreign flag carriers
AY	Local	Making a local (non-stop) trip
AZ	Cnx Seg	Average pro-rated fare in market for beyond trips
BA	Beyond	Connecting at either or both ends of the market
BB	1+ε	1 + Demand elasticity
	Change in CS ($m) - Res: Change in consumer surplus (US Residents) for:	
	Fare change	
BC	$1 drop	$1 fare drop
BD	1% drop	1% fare drop
BE	Fare/mi – 1¢ drop	Fare drop of 1 cent per mile
	Change in CS ($m) - Vis: Change in consumer surplus (Foreign Visitors) for:	
	Fare change	
BF	$1 drop	$1 fare drop
BG	1% drop	1% fare drop
BH	Fare/mi – 1¢ drop	Fare drop of 1 cent per mile
	Change in Expenditure ($m) - Res: Change in expenditure (US Residents) for:	
	Fare change	
BI	$1 drop	$1 fare drop
BJ	1% drop	1% fare drop
BK	Fare/mi – 1¢ drop	Fare drop of 1 cent per mile
	Change in Expenditure ($m) - Vis: Change in expenditure (Foreign Visitors) for:	
	Fare change	
BL	$1 drop	$1 fare drop
BM	1% drop	1% fare drop
BN	Fare/mi – 1¢ drop	Fare drop of 1 cent per mile
	US Residents	
	Induced Expenditure ($m) - Res (attracted travelers – both directions) for:	
	Fare change	
BP	$1 drop	$1 fare drop *(not calculated)*
BQ	1% drop	1% fare drop
BR	Fare/mi – 1¢ drop	Fare drop of 1 cent per mile *(not calculated)*
	Change in Expenditure ($m) - Res (existing travelers - both directions) for:	
	Fare change	
BS	$1 drop	$1 fare drop *(not calculated)*
BT	1% drop	1% fare drop
BU	Fare/mi – 1¢ drop	Fare drop of 1 cent per mile *(not calculated)*

Table 4. International Market Calculation Worksheet Columns (cont.)

Column	Heading	Content
	Foreign Visitors	
	Induced Expenditure ($m) - Vis (attracted travelers – both directions) for:	
	Fare change	
BW	$1 drop	$1 fare drop *(not calculated)*
BX	1% drop	1% fare drop
BY	Fare/mi – 1¢ drop	Fare drop of 1 cent per mile *(not calculated)*
	Change in Expenditure ($m) - Vis (existing travelers - both directions) for:	
	Fare change	
BZ	$1 drop	$1 fare drop *(not calculated)*
CA	1% drop	1% fare drop
CB	Fare/mi – 1¢ drop	Fare drop of 1 cent per mile *(not calculated)*