

**Table 1. Average fares (nominal \$) by fare classification and regulatory status (standard deviation)**

	First or business	Full Economy	Discount Economy
2005			
Traditional	827 (691)	403 (251)	323 (206)
Open skies	586 (388)	289 (153)	184 (126)
2006			
Traditional	883 (756)	397 (241)	301 (178)
Open skies	611 (452)	289 (152)	175 (130)
2007			
Traditional	975 (851)	418 (253)	309 (181)
Open skies	647 (505)	297 (159)	182 (132)
2008			
Traditional	969 (831)	419 (256)	310 (192)
Open skies	701 (641)	205 (172)	190 (144)
2009			
Traditional	1000 (884)	389 (247)	307 (213)
Open skies	596 (524)	245 (142)	164 (123)

**Table 2. Average number of monthly flights (including both direct and connecting flights) by regulatory status (standard deviation)**

	Number of monthly direct and connecting flights	Number of monthly market passengers in thousands
2005		
Traditional	382 (293)	39.50 (37.51)
Open skies	407 (277)	34.41 (25.23)
2006		
Traditional	399 (292)	41.85 (38.74)
Open skies	418 (283)	36.35 (24.09)
2007		
Traditional	409 (287)	44.53 (40.24)
Open skies	446 (283)	39.68 (24.56)
2008		
Traditional	417 (277)	43.93 (37.35)
Open skies	452 (276)	40.11 (23.71)
2009		
Traditional	424 (267)	43.54 (34.86)
Open skies	433 (255)	39.52 (22.31)

**Table 3. Equations, endogenous variables, and instruments**

Equations	Endogenous variables	Source of endogeneity	Instruments
Expenditure share equations (equation (1) in the text)	Segment prices ( $p_{gmt}$ ) and price index ( $P_{mt}$ )	Correlation with random market effects and simultaneity bias	Demeaned segment average taxes
	Market expenditure ( $E_{mt}$ )	Correlation with random market effects and simultaneity bias	Demeaned market population and income-per-capita, which affect market expenditure by affecting market demand.
Market demand equation (equation (6) in the text)	Segment prices ( $p_{gmt}$ ) and price index ( $P_{mt}$ )	Correlation with random market effects and simultaneity bias	Same as those in the share equations
	Market population and per-capita-income ( $N_{mt}, I_{mt}$ )	Correlation with random market effects	Demeaned market population and per-capita income
	Number of flights ( $K_{mt}$ )	Correlation with both random market effects and random market trends; simultaneity bias	Demeaned first-order difference of last year's log number of flights
Equilibrium capacity utilization equation (equation (7) in the text)	Presence of alliance ( $A_{mt}$ )	Correlation with random market effects	Demeaned alliance presence
	Regulatory status ( $OSA_{mt}^s$ )	Correlation with random market effects and simultaneity bias	Demeaned imports and exports between the two countries
	Market population and per-capita-income ( $N_{mt}, I_{mt}$ )	Correlation with random market effects	Demeaned market population and per-capita income
	Number of carriers ( $C_{mt}$ )	Correlation with both random market effects	Demeaned number of carriers
Segment fare equations (equation (8) in the text)	Regulatory status ( $OSA_{mt}^s$ )	Correlation with random market effects and simultaneity bias	Demeaned imports and exports between the two countries
	Number of passengers ( $Q_{mt}$ )	Correlation with random market effects and simultaneity bias	Demeaned market population and income-per-capita, which affect market demand
	Number of carriers ( $C_{mt}$ ) and presence of alliance ( $A_{mt}$ )	Correlation with random market effects	Demeaned number of carriers and alliance presence
	Short-run fluctuation in equilibrium capacity utilization ( $e_{mt}$ )	Correlation with random market effects	Demeaned equilibrium capacity utilization
Market structure equation (equation (9) in the text)	Regulatory status ( $OSA_{mt}^s$ )	Correlation with random market effects and with random market trend	Demeaned first-order difference of regulatory status
	Market fare revenue ( $R_{mt}$ )	Simultaneity bias and correlation with both random market effects and random market trend	The price of crude oil
	Presence of an airline alliance ( $A_{mt}$ )	Correlation with random market effects	Demeaned first-order difference of the presence of an alliance

**Table 4. GMM top-level demand estimates (standard errors)**

	Dependent variable: log number of market passengers	Dependent variable: log number of market passengers
	Full Sample	U.S. International Routes Only
Log price index	-0.3064 (0.1247)	-0.4680 (0.1843)
Log number of flights	0.2625 (0.1311)	0.1845 (0.0982)
Log distance	0.0910 (0.0588)	0.1756 (0.0724)
Log geometric mean population of the end-point countries	2.1275 (0.7478)	4.0369 (1.9514)
Log geometric mean of income per capita of the end-point countries	0.3701 (0.1433)	1.2048 (0.2995)
Regional dummies included	Yes	Yes
Country dummies included	Yes	Yes
Year dummies included	Yes	Yes
Monthly dummies included	Yes	Yes
Random market effects taken into account	Yes	Yes
Number of markets (directional routes) <sup>a</sup>	408	66
Number of observations	17572	2940

<sup>a</sup>As noted in footnote 11, market demand is estimated using lagged variables as instruments, which slightly reduces the number of markets in the final estimation using the full sample.

**Table 5. GMM bottom-level demand (expenditure shares) estimates (standard errors)**

	(1)	(2)	(3) <sup>a</sup>
	Revenue share of segment 1 (business or first-class; $g = 1$ )	Revenue share of segment 2 (economy full; $g = 2$ )	Revenue share of segment 3 (economy discount or other; $g = 3$ )
<b>Full Sample</b>			
Constant	0.2236 (0.0007)	0.1511 (0.0009)	0.6253 (0.0015)
Log distance	0.0521 (0.0051)	-0.1094 (0.0103)	0.0573 (0.0113)
Log real expenditure	0.0697 (0.0263)	-0.3417 (0.0528)	0.2720 (0.0548)
<i>Interaction of log segment prices</i>			
segment $g$ and segment 1: $\gamma_{g1}$	-0.0698 (0.0161)	0.0438 (0.0148)	0.0260 (0.0142)
segment $g$ with segment 2: $\gamma_{g2}$	0.0438 (0.0148)	-0.0650 (0.0186)	0.0212 (0.0108)
segment $g$ with segment 3: $\gamma_{g3}$	0.0260 (0.0142)	0.0212 (0.0108)	-0.0472 (0.0226)
Number of markets (routes)	415	415	415
Number of observations	22638	22638	22638
<b>U.S. International Routes Only</b>			
Constant	0.3308 (0.0028)	0.1070 (0.0026)	0.5622 (0.0024)
Log distance	0.0387 (0.0075)	-0.0369 (0.0057)	-0.0018 (0.0095)
Log real expenditure	-0.0612 (0.0596)	0.0886 (0.0390)	-0.0274 (0.0743)
<i>Interaction of log segment prices</i>			
segment $g$ with segment 1: $\gamma_{g1}$	-0.0352 (0.0157)	0.0221 (0.0083)	0.0131 (0.0178)
segment $g$ with segment 2: $\gamma_{g2}$	0.0221 (0.0083)	-0.0751 (0.0164)	0.0530 (0.0167)
segment $g$ with segment 3: $\gamma_{g3}$	0.0131 (0.0178)	0.0530 (0.0167)	-0.0661 (0.0304)
Number of markets (routes)	66	66	66
Number of observations	3766	3766	3766
Regional dummies included	Yes	Yes	--
Country dummies included	Yes	Yes	--
Year dummies included	Yes	Yes	--
Monthly dummies included	Yes	Yes	--
Random market effects taken into account	Yes	Yes	--

<sup>a</sup> Parameter values of this equation are obtained from the parametric restrictions in equations (3), (4), and (5). The standard errors are calculated by using the bootstrap technique.

**Table 6. GMM estimates of equilibrium capacity utilization (standard errors)**

	(1)	(2)	(3)	(4)
	Full	Full	U.S.	U.S.
	Sample	Sample	International	International
			Routes Only	Routes Only
Log number of market passengers in a month	0.6588 (0.0048)	0.6174 (0.0088)	0.7347 (0.0274)	0.6825 (0.0203)
Short-run open skies dummy (1 if an OS agreement was signed after 2005; 0 otherwise)		0.1181 (0.0591)		0.1605 (0.0534)
Long-run open skies dummy (1 if an OS agreement was signed before 2000; 0 otherwise)		-0.0455 (0.0748)		-0.0026 (0.3441)
Log geometric mean population of the end-point countries		0.3460 (0.2381)		2.2522 (1.2726)
Log geometric mean of income per capita of the end-point countries		0.3205 (0.0473)		0.2598 (0.1734)
Log number of carriers		0.0282 (0.0109)		0.0999 (0.0337)
Presence of an airline alliance		-0.0158 (0.0120)		0.0324 (0.0523)
Log distance		-0.2020 (0.0096)		-0.4946 (0.0175)
Log number of cities connected to the end-point airports		0.4866 (0.0327)		0.8522 (0.0408)
Maximal historical average rainfall at the end-point cities in a month <sup>a</sup>		-0.0432 (0.0324)		-0.3864 (0.0915)
Maximal temperature difference between January and July at the end-point cities <sup>b</sup>		-0.0061 (0.0008)		-0.0135 (0.0012)
Regional dummies included	No	Yes	No	Yes
Country dummies included	No	Yes	No	Yes
Year dummies included	No	Yes	No	Yes
Month dummies included	No	Yes	No	Yes
Random market effects taken into account	Yes	Yes	Yes	Yes
Number of markets (non-directional routes)	415	415	66	66
Number of observations	22638	22638	3766	3766

<sup>a</sup> This variable is measured as the maximal value of the historical average monthly rainfall (000's mm) at the two end-point cities. Data were obtained from airport websites.

<sup>b</sup> This variable is measured as the maximal value of the difference in the average temperature between July and January at the two end-point cities. Data were obtained from airport websites.

**Table 7. Estimated demand and flight elasticities [5%-ile, 95%-ile]**

	% change in demand of business or first-class	% change in demand of economy full	% change in demand of economy discount	% change in total market demand	% change in number of monthly flights
<b>Full Sample<sup>a</sup></b>					
One percent increase in the price of business or first-class	-1.36 [-1.52, -1.22]	0.63 [0.51, 0.77]	0.01 [-0.06, 0.04]	-0.06 [-0.10, -0.02]	-0.04 [-0.06, -0.01]
One percent increase in the price of economy full	0.26 [0.17, 0.34]	-1.14 [-1.37, -0.91]	0.09 [0.02, 0.17]	-0.07 [-0.10, -0.03]	-0.04 [-0.06, -0.02]
One percent increase in the price of economy discount	0.63 [0.40, 0.89]	0.91 [0.63, 1.24]	-0.56 [-0.80, -0.35]	-0.24 [-0.40, -0.08]	-0.15 [-0.25, -0.05]
Overall price (one percent increase in the prices of all segments)	-0.48 [-0.78, -0.18]	0.05 [-0.16, 0.21]	-0.52 [-0.81, -0.21]	-0.39 [-0.58, -0.15]	-0.23 [-0.36, -0.09]
One percent increase in the number of monthly flights	0.34 [0.04, 0.60]	-0.03 [-0.34, 0.27]	0.37 [0.04, 0.63]	0.28 [0.03, 0.46]	--
<b>U.S. International Routes Only<sup>a</sup></b>					
One percent increase in the price of business or first-class	-1.08 [-1.28, -0.89]	0.13 [-0.28, 0.58]	-0.03 [-0.18, 0.09]	-0.14 [-0.24, -0.05]	-0.10 [-0.16, -0.03]
One percent increase in the price of economy full	0.13 [-0.02, 0.26]	-1.73 [-1.89, -1.56]	0.17 [0.07, 0.25]	-0.06 [-0.11, -0.01]	-0.04 [-0.08, -0.01]
One percent increase in the price of economy discount	0.61 [0.35, 0.88]	1.20 [0.72, 1.72]	-0.70 [-0.96, -0.43]	-0.32 [-0.54, -0.10]	-0.21 [-0.37, -0.07]
Overall price (one percent increase in the prices of all segments)	-0.38 [-0.76, -0.14]	-0.47 [-0.93, -0.17]	-0.57 [-1.02, -0.26]	-0.53 [-0.97, -0.24]	-0.36 [-0.67, -0.17]
One percent increase in the number of monthly flights	0.12 [0.01, 0.28]	0.17 [0.01, 0.37]	0.20 [0.01, 0.42]	0.18 [0.01, 0.36]	--

<sup>a</sup> The elasticities are evaluated at the sample mean of the explanatory variables using Algorithm 1 in appendix C. We calibrate the intercepts of the demand equations and the capacity utilization equation so that when those equations are evaluated at the sample means of the explanatory variables, our model replicates the sample means of the market outcomes, which we use as the benchmark for the elasticity calculations. The sample means for the full sample are: market passengers 41,755; monthly flights 456; segment expenditure shares 0.22 (business plus), 0.15 (economy full), and 0.63 (economy discount); and segment prices (fare + tax) \$870 (business plus), \$406 (economy full), and \$299 (economy discount). The sample means for U.S. international routes only are: market passengers 38,000; monthly flights 409; segment expenditure shares 0.33 (business plus), 0.11 (economy full), and 0.56 (economy discount); and segment prices (fare + tax) \$1537 (business plus), \$506 (economy full), and \$407 (economy discount). We use bootstrap techniques to construct the 95% confidence interval.

**Table 8. GMM estimates of the fare equations (standard errors) <sup>a</sup>**

	(1)	(2)	(3)
	Log fare of segment 1 (business plus)	Log fare of segment 2 (economy full)	Log fare of segment 3 (economy discount or other)
<b>Full Sample</b>			
Short-run open skies dummy	-0.5726 (0.1286)	-0.7019 (0.0830)	-0.4996 (0.0796)
Long-run open skies dummy	-0.2041 (0.0264)	-0.2836 (0.0195)	-0.1492 (0.0171)
Log number of market passengers in a month	0.7224 (0.1032)	0.1832 (0.0940)	0.2276 (0.0728)
Capacity utilization <sup>b</sup>	-0.0198 (0.0186)	-0.0582 (0.0140)	-0.0229 (0.0107)
Log number of carriers	-0.1724 (0.0309)	-0.0185 (0.0267)	-0.0217 (0.0204)
Log distance	0.6431 (0.0295)	0.3210 (0.0263)	0.3812 (0.0200)
Log distance × crude oil price	0.0196 (0.0164)	0.0573 (0.0142)	0.0609 (0.0106)
Presence of an airline alliance	-0.0248 (0.0198)	-0.0064 (0.0140)	-0.0124 (0.0103)
Maximal historical average monthly rainfall between the end-point cities <sup>c</sup>	0.2722 (0.0540)	0.0682 (0.0427)	0.0258 (0.0343)
Maximal temperature difference between January and July at the end-point cities <sup>d</sup>	0.0172 (0.0011)	0.0121 (0.0083)	0.0108 (0.0007)
Number of markets (routes)	415	415	415
Number of observations	22638	22638	22638
<b>U.S. International Routes Only</b>			
Short-run open skies dummy	-0.4886 (0.0456)	-0.2621 (0.0375)	-0.2476 (0.0436)
Long-run open skies dummy	-0.2509 (0.0480)	-0.2058 (0.0412)	-0.2412 (0.0448)
Log number of market passengers in a month	0.2945 (0.1043)	0.3121 (0.1009)	0.5715 (0.1278)
Capacity utilization <sup>b</sup>	-0.0163 (0.0210)	-0.0046 (0.0188)	0.0157 (0.0273)
Log number of carriers	-0.0798 (0.0412)	-0.0411 (0.0392)	-0.1378 (0.0515)
Log distance	0.2943 (0.0309)	0.0820 (0.0315)	0.1609 (0.0424)
Log distance × crude oil price	0.0961 (0.0226)	0.0928 (0.0229)	0.0783 (0.0301)
Presence of an airline alliance	-0.2050 (0.0514)	-0.1059 (0.0538)	-0.2641 (0.0770)
Maximal historical average monthly rainfall between the end-point cities <sup>c</sup>	0.1712 (0.1200)	0.2102 (0.1223)	0.3202 (0.1512)
Maximal temperature difference between January and July at the end-point cities <sup>d</sup>	0.0224 (0.0016)	0.0176 (0.0014)	0.0146 (0.0019)
Number of markets (routes)	66	66	66
Number of observations	3766	3766	3766

<sup>a</sup> Region, country, year and month fixed effects are included in all the regressions.

<sup>b</sup> Capacity utilization is constructed by  $\log(K_{mt}) - 0.6174\log(Q_{mt})$  in the full sample and  $\log(K_{mt}) - 0.6825\log(Q_{mt})$  in the U.S. subsample.

<sup>c</sup> This variable is measured as the maximal value of the historical average monthly rainfall (000's mm) at the two end-point cities. Data were obtained from airport websites.

<sup>d</sup> This variable is measured as the maximal value of the difference in the average temperature between July and January at the two end-point cities. Data were obtained from airport websites.

**Table 9. GMM estimates of the market structure equation (standard errors)**

	Log number of carriers Full Sample	Log number of carriers U.S International Routes Only
Short-run open skies dummy (1 if an OS agreement was signed after 2005; 0 otherwise)	-0.2222 (0.1205)	-0.1484 (0.0891)
Long-run open skies dummy (1 if an OS agreement was signed before 2000; 0 otherwise)	0.1684 (0.0270)	0.2279 (0.0803)
Log total fare revenue in a month	0.5336 (0.0783)	0.2171 (0.0582)
Presence of an airline alliance	0.1620 (0.0209)	0.2765 (0.0679)
Log distance	0.1139 (0.0204)	0.2098 (0.0227)
Log total number of carriers in the end-point countries	0.5501 (0.0416)	0.3998 (0.0785)
Log number of cities connected to the end-point airports	-0.2638 (0.0431)	-0.1077 (0.0542)
Regional dummies included	Yes	Yes
Country dummies included	Yes	Yes
Year dummies included	Yes	Yes
Month dummies included	Yes	Yes
Random market effects taken into account	Yes	Yes
Number of markets (routes)	415	66
Number of observations	22275	3709

**Table 10. Initial (short-run) effects of eliminating open-skies agreements on U.S. international routes that were signed between January 1, 2005 and December 31, 2009 <sup>a</sup>**

	Observed outcomes after signing OSA	Simulated change from eliminating open skies agreements
<i>Average segment full price in \$ [5%-ile, 95%-ile]</i>		
First class or business	1491 [214, 3276]	+50% [+38%, +54%]
Economy full	497 [152, 992]	+21% [+16%, +23%]
Economy discount	308 [170, 495]	+13% [+12%, +14%]
<i>Average segment demand (number of passengers per month) [5%-ile, 95%-ile]</i>		
First class or business	8792 [1010, 20248]	-30% [-34%, -24%]
Economy full	5311 [709, 12734]	-29% [-48%, -16%]
Economy discount	28063 [8250, 63339]	-6% [-11%, +1%]
<i>Average market demand (number of passengers per month) [5%-ile, 95%-ile]</i>		
	42165 [13718, 89998]	-13% [-14%, -12%]
<i>Average number of monthly flights [5%-ile, 95%-ile]</i>		
	504 [151, 1222]	-21% [-22%, -20%]
<i>Average number of carriers per route [5%-ile, 95%-ile]</i>		
	14 [7, 23]	+17% [+16%, +19%]
<i>Annual change in travelers' aggregate welfare from negotiating open skies agreements (millions of dollars)<sup>b</sup></i>		
Pure price effects	--	-1974
Additional flight frequency effects	--	-1029
Total	--	-3003
Number of markets (routes)	26	26
Number of observations	798	798

<sup>a</sup> We calibrate the constants of the equations for each month and each market so that the simulation model replicates the observed market outcomes under the current regulatory status.

<sup>b</sup> The annual welfare gain is calculated by multiplying the estimated average monthly welfare gain in a market by the number of months in a year and the number of markets.

**Table 11. Additional long-run effects of eliminating open-skies agreements on U.S. international routes that were signed before January 1, 2000 <sup>a</sup>**

	Observed outcomes during 2005 to 2009	Simulated change from eliminating open skies agreements
<i>Average segment full price in \$ [5%-ile, 95%-ile]</i>		
First class or business	1884 [736, 3011]	+26% [+25%, +26%]
Economy full	568 [241, 1178]	+18% [+15%, +19%]
Economy discount	542 [218, 946]	+21% [+18%, +22%]
<i>Average segment demand (number of passengers per month) [5%-ile, 95%-ile]</i>		
First class or business	3930 [1368, 8948]	-12% [-14%, -10%]
Economy full	2708 [342, 7128]	-26% [-57%, -11%]
Economy discount	26249 [10383, 52045]	-9% [-10%, -7%]
<i>Average market demand (number of passengers per month) [5%-ile, 95%-ile]</i>		
	32888 [16074, 60822]	-10% [-11%, -9%]
<i>Average number of monthly flights [5%-ile, 95%- ile]</i>		
	333 [144, 611]	-8% [-9%, -8%]
<i>Average number of carriers per route [5%-ile, 95%-ile]</i>		
	17 [12, 23]	-19% [-19%, -18%]
<i>Annual change in travelers' aggregate welfare from eliminating open skies agreements (millions of dollars)<sup>b</sup></i>		
Pure price effects	--	-704
Additional flight frequency effects	--	-138
Total	--	-842
Number of markets (routes)	11	11
Number of observations	628	628

<sup>a</sup> We calibrate the constants of the equations for each month and each market so that the simulation model replicates the observed market outcomes under the current regulatory status.

<sup>b</sup> The annual welfare gain is calculated by multiplying the estimated average monthly welfare gain in a market by the number of months in a year and the number of markets.

**Table 12. Effects of signing open skies agreements (OSA) on U.S. international routes that did not have those agreements as of December 31, 2009 <sup>a</sup>**

	Observed outcomes during 2005-2009	Simulated initial change from negotiating OSA <sup>b</sup>	Simulated additional long run change from negotiating OSA <sup>c</sup>
<i>Average segment full price in \$ [5%-ile, 95%-ile]</i>			
First class or business	1458 [284, 3667]	-34% [-35%, -33%]	-20% [-21%, -19%]
Economy full	492 [164, 1078]	-18% [-19%, -17%]	-16% [-16%, -15%]
Economy discount	405 [138, 914]	-12% [-13%, -11%]	-17% [-18%, -16%]
<i>Average segment demand (number of passengers per month) [5%-ile, 95%-ile]</i>			
First class or business	5365 [423, 14336]	+41% [+31%, +48%]	+10% [+1%, +14%]
Economy full	5101 [458, 14226]	+50% [+21%, +87%]	+22% [+12%, +49%]
Economy discount	27485 [10143, 52069]	+8% [+1%, +13%]	+11% [9%, +12%]
<i>Average market demand (number of passengers per month) [5%-ile, 95%-ile]</i>			
	37952 [14956, 70623]	+16% [+15%, +17%]	+12% [+11%, +12%]
<i>Average number of monthly flights [5%-ile, 95%- ile]</i>			
	397 [146, 806]	+28% [+27%, +28%]	+10% [+9%, +10%]
<i>Average number of carriers per route [5%-ile, 95%-ile]</i>			
	12 [3, 23]	-15% [-16%, -14%]	+23% [+22%, +23%]
<i>Annual change in travelers' aggregate welfare from negotiating open skies agreements (millions of dollars)</i>			
Pure price effects	--	+1562	+1427
Additional flight frequency effects	--	+560	+222
Total	--	+2122	+1649
<i>Number of markets</i>	29	29	29
<i>Number of observations</i>	1614	1614	1614

<sup>a</sup> We calibrate the constants of the equations for each month and each market so that the simulation model replicates observed market outcomes under current the regulatory status.

<sup>b</sup> This scenario simulates the initial short-run effect of open skies agreements if the agreements were signed between 2005 and 2009.

<sup>c</sup> This scenario simulates the persistent long-run effects of open skies agreements if the agreements were signed before 2000.

**Table A1. Regression tests of the instruments in the bottom-level demand equations  
(Numbers in parentheses are standard errors.)**

Instrumental variables	(1)	(2)	(3)
	Dependent variable: Log air fare of segment 1	Dependent variable: Log air fare of segment 2	Dependent variable: Log real expenditure <sup>a</sup>
<b>Full Sample (22638 observations for each specification)</b>			
Demeaned log tax per person of segment 1	0.1573 (0.0068)		
Demeaned log tax per person of segment 2		0.4641 (0.0085)	
Demeaned log geometric mean population of the end-point countries			1.2954 (0.2931)
Demeaned log geometric mean income per capita of the end-point countries			0.3437 (0.0551)
Instruments for other endogenous variables and exogenous regressors included?	YES	YES	YES
<b>U.S. International Routes Only (3766 observations for each specification)</b>			
Demeaned log tax per person of segment 1	0.4192 (0.0194)		
Demeaned log tax per person of segment 2		0.4923 (0.0162)	
Demeaned log geometric mean population of the end-point countries			6.2845 (1.9127)
Demeaned log geometric mean income per capita of the end-point countries			0.5336 (0.2123)
Instruments for other endogenous variables and exogenous regressors included?	YES	YES	YES

<sup>a</sup> Real expenditure is constructed by using equation (2) in the text and GMM estimates of the parameters.

**Table A2. Regression tests of the instruments in the top-level demand equation  
(Numbers in parentheses are standard errors.)**

Instrumental variables	(1)	(2)	(3)	(4)
	Dependent variable: market price index <sup>a</sup>	Dependent variable: log flight frequency (number of flights)	Dependent variable: log geometric mean population of the end-point countries	Dependent variable: log geometric mean income per capita of the end-point countries
<b>Full Sample (17572 observations for each specification)</b>				
Demeaned average tax per person across segments	0.0066 (0.0002)			
Demeaned log geometric mean population of the end-point countries			0.8181 (0.3321)	
Demeaned log geometric mean income per capita of the end-point countries				0.9825 (0.0059)
Demeaned first-difference of one year lag log flight frequency		0.2229 (0.0164)		
<b>U.S. International Routes Only (2940 observations for each specification)</b>				
Demeaned average tax per person across segments	0.0046 (0.0005)			
Demeaned log geometric mean population of the end-point countries			0.9472 (0.0040)	
Demeaned log geometric mean income per capita of the end-point countries				0.9948 (0.0013)
Demeaned first-difference of one year lag log flight frequency		0.2047 (0.0316)		
Instruments for other endogenous variables and exogenous regressors included?	YES	YES	YES	YES

<sup>a</sup> Price index is constructed by using equation (2) in the text and GMM estimates of the parameters.

**Table A3. Regression tests of bilateral trade as the instrument for the short-run open-skies dummy in the equilibrium capacity utilization equation and segment fare equations<sup>a</sup>**  
**(Numbers in parentheses are standard errors.)**

Instrumental variables	(1)	(2)
	Dependent variable: the short-run open-skies dummy	Dependent variable: the short-run open-skies dummy
<b>Full Sample</b>		
Demeaned monthly trade value between the end-point countries	0.0059 (0.0002)	
Demeaned one-year lag of monthly trade value between the end-point countries		0.0041 (0.0003)
Number of obs.	22638	18019
<b>U.S. International Routes Only</b>		
Demeaned monthly trade value between the end-point countries	0.0102 (0.0004)	
Demeaned one-year lag of monthly trade value between the end-point countries		0.0097 (0.0006)
Number of obs.	3766	3009

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<sup>a</sup>Note: instruments for other endogenous variables and exogenous regressors in equilibrium capacity utilization equation and segment fare equations are included in all estimations.

**Table A4. Testing cointegration between log number of market passengers and long number of flights based on regression equation (11) in the text<sup>a</sup>**

Variables	(1)	(2)	(3)
<b>Full Sample</b>			
$\hat{e}_{m(t-1)}$	-0.4569 (0.0051)	-0.4014 (0.0059)	-0.3426 (0.0114)
$\{\Delta\hat{e}_{m(t-j)}\}_{j=1}^p$	Not included	Included and $p = 1$	Included and $p = 15$
$\tilde{X}_{mt}$ (including year and month dummies)	Not included	Included	Included
<i>Overall R</i> <sup>2</sup>	0.04	0.03	0.04
Number of observations	25849	24988	18389
<b>U.S. International Routes Only</b>			
$\hat{e}_{m(t-1)}$	-0.6059 (0.0143)	-0.5614 (0.0172)	-0.5294 (0.0369)
$\{\Delta\hat{e}_{m(t-j)}\}_{j=1}^p$	Not included	Included and $p = 1$	Included and $p = 15$
$\tilde{X}_{mt}$ (including year and month dummies)	Not included	Included	Included
<i>Overall R</i> <sup>2</sup>	0.08	0.01	0.05
Number of observations	4141	4067	3067

<sup>a</sup> Numbers in parentheses are standard errors.

**Table A5. Robustness check: GMM estimates of equilibrium capacity utilization  
(U.S. International Routes Only)**

	(1)	(2)
	Baseline results: Model 4 of Table 6 in the text using demeaned bilateral trade value as the instrument for short-run open-skies dummy (standard errors)	Using demeaned one-year lag of bilateral trade value as the instrument for short-run open- skies dummy (standard errors)
Log number of market passengers in a month	0.6825 (0.0203)	0.6785 (0.0225)
Short-run open skies dummy (1 if an OS agreement was signed after 2005; 0 otherwise)	0.1605 (0.0534)	0.1885 (0.0818)
Long-run open skies dummy (1 if an OS agreement was signed before 2000; 0 otherwise)	-0.0026 (0.3441)	0.0403 (0.0397)
Log geometric mean population of the end-point countries	2.2522 (1.2726)	2.2382 (1.7099)
Log geometric mean of income per capita of the end-point countries	0.2598 (0.1734)	0.3897 (0.2241)
Log number of carriers	0.0999 (0.0337)	0.1150 (0.0378)
Presence of an airline alliance	0.0324 (0.0523)	0.0548 (0.0577)
Log distance	-0.4946 (0.0175)	-0.5101 (0.0191)
Log number of cities connected to the end-point airports	0.8522 (0.0408)	0.8778 (0.0445)
Maximal historical average rainfall at the end-point cities in a month <sup>a</sup>	-0.3864 (0.0915)	-0.3425 (0.1007)
Maximal temperature difference between January and July at the end-point cities <sup>b</sup>	-0.0135 (0.0012)	-0.0124 (0.0013)
Regional dummies included	Yes	Yes
Country dummies included	Yes	Yes
Year dummies included	Yes	Yes
Month dummies included	Yes	Yes
Random market effects taken into account	Yes	Yes
Number of markets (non-directional routes)	66	66
Number of observations	3766	3009

<sup>a</sup> This variable is measured as the maximal value of the historical average monthly rainfall (000's mm) at the two end-point cities. Data were obtained from airport websites.

<sup>b</sup> This variable is measured as the maximal value of the difference in the average temperature between July and January at the two end-point cities. Data were obtained from airport websites.

**Table A6. Robustness check: GMM estimates of the fare equations (U.S. international routes only) <sup>a</sup>**

	(1)	(2)	(3)
	Log fare of segment 1 (business plus)	Log fare of segment 2 (economy full)	Log fare of segment 3 (economy discount or other)
<b>Baseline results presented in Table 8 of the text using demeaned bilateral trade value as the instrument for the short-run open-skies dummy and using both geometric mean population and income-per-capita of end-point countries as instruments for log number of market passengers</b>			
Short-run open skies dummy	-0.4886 (0.0456)	-0.2621 (0.0375)	-0.2476 (0.0436)
Long-run open skies dummy	-0.2509 (0.0480)	-0.2058 (0.0412)	-0.2412 (0.0448)
Log number of market passengers in a month	0.2945 (0.1043)	0.3121 (0.1009)	0.5715 (0.1278)
Capacity utilization <sup>b</sup>	-0.0163 (0.0210)	-0.0046 (0.0188)	0.0157 (0.0273)
Log number of carriers	-0.0798 (0.0412)	-0.0411 (0.0392)	-0.1378 (0.0515)
Log distance	0.2943 (0.0309)	0.0820 (0.0315)	0.1609 (0.0424)
Log distance × crude oil price	0.0961 (0.0226)	0.0928 (0.0229)	0.0783 (0.0301)
Presence of an airline alliance	-0.2050 (0.0514)	-0.1059 (0.0538)	-0.2641 (0.0770)
Maximal historical average monthly rainfall between the end-point cities <sup>c</sup>	0.1712 (0.1200)	0.2102 (0.1223)	0.3202 (0.1512)
Maximal temperature difference between January and July at the end-point cities <sup>d</sup>	0.0224 (0.0016)	0.0176 (0.0014)	0.0146 (0.0019)
Number of markets (routes)	66	66	66
Number of observations	3766	3766	3766
<b>Using demeaned one-year lag of bilateral trade value as the instrument for the short-run open-skies dummy; using only geometric mean population of end-point countries as the instrument for log number of market passengers</b>			
Short-run open skies dummy	-0.2248 (0.0840)	-0.2466 (0.0693)	-0.3925 (0.1118)
Long-run open skies dummy	-0.2033 (0.0558)	-0.3190 (0.0485)	-0.3565 (0.0811)
Log number of market passengers in a month	0.2210 (0.1982)	0.0822 (0.2235)	0.7874 (0.3381)
Capacity utilization <sup>b</sup>	0.0127 (0.0208)	0.0201 (0.0198)	0.0324 (0.0402)
Log number of carriers	-0.0934 (0.0628)	0.0396 (0.0657)	-0.1861 (0.1082)
Log distance	0.2822 (0.0351)	0.0493 (0.0352)	0.1551 (0.0613)
Log distance × crude oil price	0.0919 (0.0223)	0.1158 (0.0221)	0.0840 (0.0394)
Presence of an airline alliance	-0.1149 (0.0484)	0.0077 (0.0513)	-0.2123 (0.1125)
Maximal historical average monthly rainfall between the end-point cities <sup>c</sup>	0.1129 (0.2001)	0.0035 (0.2251)	0.5756 (0.3451)
Maximal temperature difference between January and July at the end-point cities <sup>d</sup>	0.0204 (0.0022)	0.0139 (0.0024)	0.0156 (0.0038)
Number of markets (routes)	66	66	66
Number of observations	3009	3009	3009

<sup>a</sup> Region, country, year and month fixed effects are included in all the regressions. Numbers in parentheses are standard errors.

<sup>b</sup> Capacity utilization is constructed by  $\log(K_{mt}) - 0.6174\log(Q_{mt})$  in the full sample and  $\log(K_{mt}) - 0.6825\log(Q_{mt})$  in the U.S. subsample.

<sup>c</sup> This variable is measured as the maximal value of the historical average monthly rainfall (000's mm) at the two end-point cities. Data were obtained from airport websites.

<sup>d</sup> This variable is measured as the maximal value of the difference in the average temperature between July and January at the two end-point cities. Data were obtained from airport websites.

**Table A7. U.S. international routes with open-skies agreements signed between January 1 2005 and December 31, 2009\***

Origin	Destination	Origin Country	Destination Country	Year/month of signing OSA
Boston	London Heathrow	United States	United Kingdom	2007/04
Newark	London Heathrow	United States	United Kingdom	2007/04
Washington Dulles	London Heathrow	United States	United Kingdom	2007/04
New York (JFK)	London Heathrow	United States	United Kingdom	2007/04
Los Angeles	London Heathrow	United States	United Kingdom	2007/04
Las Vegas	London Gatwick	United States	United Kingdom	2007/04
London Heathrow	Miami	United Kingdom	United States	2007/04
London Heathrow	Chicago O'Hare	United Kingdom	United States	2007/04
London Heathrow	San Francisco	United Kingdom	United States	2007/04
London Gatwick	Orlando	United Kingdom	United States	2007/04
Manchester	Orlando	United Kingdom	United States	2007/04
DUB	New York (JFK)	Ireland	United States	2007/04
New York (JFK)	Madrid	United States	Spain	2007/04
Los Angeles	Sydney	United States	Australia	2008/02
Newark	Toronto	United States	Canada	2007/03
Fort Lauderdale	Toronto	United States	Canada	2007/03
Las Vegas	Toronto	United States	Canada	2007/03
Los Angeles	Toronto	United States	Canada	2007/03
New York (LGA)	Toronto	United States	Canada	2007/03
Orlando	Toronto	United States	Canada	2007/03
Miami	Toronto	United States	Canada	2007/03
Chicago O'Hare	Toronto	United States	Canada	2007/03
Las Vegas	Vancouver	United States	Canada	2007/03
Los Angeles	Vancouver	United States	Canada	2007/03
San Francisco	Vancouver	United States	Canada	2007/03
Fort Lauderdale	Montreal	United States	Canada	2007/03

\*The U.S. signed an open-skies agreement with Japan at the end of 2010. The 26 routes consist of 5 country pairs.

**Table A8. U.S. international routes governed by open-skies agreements before 2000<sup>a</sup>**

Origin	Destination	Origin Country	Destination Country
Amsterdam	New York (JFK)	Netherlands	United States
Rome	New York (JFK)	Italy	United States
Frankfurt	New York (JFK)	Germany	United States
Frankfurt	San Francisco	Germany	United States
Incheon	New York (JFK)	South Korea	United States
Incheon	Los Angeles	South Korea	United States
Incheon	San Francisco	South Korea	United States
New York (JFK)	Milan	United States	Italy
Los Angeles	Taipei	United States	Taiwan
Lima	Miami	Peru	United States
San Francisco	Taipei	United States	Taiwan

<sup>a</sup>The 11 routes consist of 6 country pairs.

**Table A9. U.S. international routes not governed by open-skies agreements as of December 31, 2009\***

Origin	Destination	Origin Country	Destination Country
Bogota	Miami	Colombia	United States
Caracas	Miami	Venezuela	United States
Cancun	New York (JFK)	Mexico	United States
Cancun	Miami	Mexico	United States
Newark	Tel Aviv	United States	Israel
Buenos Aires	Miami	Argentina	United States
Fort Lauderdale	Kingston	United States	Jamaica
Guadalajara	Los Angeles	Mexico	United States
Sao Paulo	New York (JFK)	Brazil	United States
Sao Paulo	Miami	Brazil	United States
Hong Kong	New York (JFK)	Hong Kong	United States
Hong Kong	Los Angeles	Hong Kong	United States
Hong Kong	San Francisco	Hong Kong	United States
Honolulu	Kansai	United States	Japan
Honolulu	Tokyo Narita	United States	Japan
New York (JFK)	Mexico City	United States	Mexico
New York (JFK)	Tokyo Narita	United States	Japan
New York (JFK)	Piarco	United States	Trinidad And Tobago
New York (JFK)	Santo Domingo	United States	Dominican Republic
New York (JFK)	Santiago	United States	Dominican Republic
New York (JFK)	Tel Aviv	United States	Israel
Los Angeles	Mexico City	United States	Mexico
Los Angeles	Manila	United States	Philippines
Los Angeles	Tokyo Narita	United States	Japan
Mexico City	Miami	Mexico	United States
Miami	Port Au Prince	United States	Haiti
Miami	Santo Domingo	United States	Dominican Republic
Miami	San Jose	United States	Costa Rica
Tokyo Narita	San Francisco	Japan	United States

\*The U.S. signed an open-skies agreement with Japan at the end of 2010. The 29 routes consist of 15 country pairs.