Supplemental Appendix:

Identifying Tax Compliance from Variation in Tax Policy: Theory and Empirics

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B.1. Additional Descriptive Statistics

Table B.1—: Summary of Tax Introductions

Tax Intro	City	Metro	Initial Tax	Max. Tax
Feb. 2015	Washington	Washington DC	7.25	14.5
Apr. 2015	Malibu	Los Angeles	4.4	12
Jun. 2015	Charlotte	Charlotte	15.25	15.25
Jul 2015	Oakland	Oakland	14	14
	Phoenix	Phoenix	5.3	12.57
	San Diego	San Diego	5.76	10.5
Oct. 2015	Bellevue	Seattle	6.58	12.4
	Kirkland	Seattle	5.76	11
	Redmond	Seattle	5.76	11
	Santa Clara	San Jose	5.21	9.5
	Seattle	Seattle	5.26	10.5
	University Place	Seattle	6.25	12.1
	Vashon	Seattle	4.72	8.6
Nov. 2015	Jersey City	New York	6	6
	Delray Beach	Miami	6	7
	Four Corners	Orlando	7	7.5
	Four Corners	Orlando	7	7
	Kissimmee	Orlando	7	7.5
	Orlando	Orlando	6.5	12.5
	Sunny Isles Beach	Miami	7	13
	West Palm Beach	Miami	6	7
Jan. 2016	Evanston	Chicago	3.38	7.17
	Oak Park	Chicago	3.38	11.17
Apr. 2016	Cleveland Heights	Cleveland	5.5	5.5
	Lakewood	Cleveland	5.5	5.5
	Metairie	New Orleans	5	5
	New Orleans	New Orleans	5	9
Jun. 2016	Bethesda	Washington DC	7	7
	Silver Spring	Washington DC	7	7
Aug. 2016	Anchorage	Anchorage	12	12
	Los Angeles	Los Angeles	14	14
Sep. 2016	Golden	Denver	3	8.43
	Millcreek	Salt Lake City	11.6	11.6
	Salt Lake City	Salt Lake City	12.6	12.6
	Sandy	Salt Lake City	13.1	13.1
Jan. 2017	Mesa	Phoenix	14.02	14.02
	Scottsdale	Phoenix	13.92	13.92
	Tempe	Phoenix	14.07	14.07
Feb. 2017	Lakewood	Denver	5.43	5.43
May 2017	Austin	Austin	6	6
	Dallas	Dallas	6	6
	Fort Worth	Dallas	6	6
	Galveston	Houston	6	6
	Houston	Houston	6	6
Jun. 2017	Richmond	Oakland	10	10

Table B.2—: Summary Statistics by Treatment Status

Treated	N	Mean	Std. Dev.	25th Percentile	Median	75th Percentile
Book Price	1,002,668	137	87	84	116	165
Nights Booked	2,878,807	6	12	0	0	6
Tax Rate	2,878,807	7	6	0	7	14
Tax Rate, with VCA	1,823,992	11	3	8	11	14
Arriving Passengers (1000s)	2,878,807	1156	726	550	973	1778
Hotel Search	2,878,807	75	14	64	75	86
Airbnb Search	2,878,807	52	19	37	50	65

Untreated	N	Mean	Std. Dev.	25th Percentile	Median	75th Percentile
Book Price	256,741	128	72	76	107	160
Nights Booked	713,715	6	12	0	0	7
Tax Rate	N/A					
Tax Rate, with VCA	N/A					
Arriving Passengers (1000s)	713,715	1139	688	680	940	1540
Hotel Search	713,715	75	12	68	75	85
Airbnb Search	713,715	56	20	42	56	74

The table reports summary statistics of the main variables by treatment status. The top panel includes observations for treated jurisdictions. The lower panel includes observations for never treated jurisdictions. *Arriving Passengers* (in 1000s) refers to the number of passengers arriving in a metro area in a given month, excluding return flights. *Hotel Search* refers to the Google Trends search volume for the search *hotels 'metro'* in the month. and *Airbnb Search* refers to the Google Trends search volume for the search *Airbnb 'metro'* in the month. Google Trends series are standardized to the maximum search activity over the period June 2014 - November 2019.

Table B.3—: Summary Statistics by Treatment Status

Treated, Before First Tax Introduction						
	N	Mean	Std. Dev.	25th Percentile	Median	75th Percentile
Book Price	56,608	131	79	83	110	155
Nights Booked	162,721	5	11	0	0	6
Tax Rate	N/A					
Tax Rate, with VCA	N/A					
Arriving Passengers (1000s)	162,721	994	611	457	877	1612
Hotel Search	162,721	58	11	48	57	64
Airbnb Search	162,721	23	8	18	22	27

Treated, After First Tax Introduction						
	N	Mean	Std. Dev.	25th Percentile	Median	75th Percentile
Book Price	946,060	137	87	84	117	166
Nights Booked	2,716,086	6	12	0	0	7
Tax Rate	2,716,086	7	6	0	8	14
Tax Rate, with VCA	1,823,992	11	3	8	11	14
Arriving Passengers (1000s)	2,716,086	1165	732	553	973	1831
Hotel Search	2,716,086	76	14	65	76	86
Airbnb Search	2,716,086	53	18	41	51	65

Untreated, Before First Tax Introduction						
	N	Mean	Std. Dev.	25th Percentile	Median	75th Percentile
Book Price	13,487	117	60	75	100	149
Nights Booked	38,664	5	11	0	0	5
Tax Rate	N/A					
Tax Rate, with VCA	N/A					
Arriving Passengers (1000s)	38,664	941	594	565	717	1393
Hotel Search	38,664	60	11	53	60	65
Airbnb Search	38,664	26	12	21	24	30

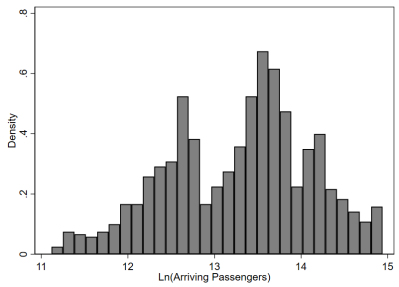
Untreated, After First Tax Introduction						
	N	Mean	Std. Dev.	25th Percentile	Median	75th Percentile
Book Price	243,254	128	73	76	108	160
Nights Booked	675,051	6	12	0	0	7
Tax Rate	N/A					
Tax Rate, with VCA	N/A					
Arriving Passengers (1000s)	675,051	1150	691	686	941	1585
Hotel Search	675,051	76	12	68	77	85
Airbnb Search	675,051	58	19	44	57	76

The table reports summary statistics of the main variables by treatment status, before and after the first tax introduction. The top two panels include observations for treated jurisdictions before and after the first tax introduction in sample. The lower two panels include observations for never treated jurisdictions before and after the first tax introduction in sample. *Arriving Passengers* (in 1000s) refers to the number of passengers arriving in a metro area in a given month, excluding return flights. *Hotel Search* refers to the Google Trends search volume for the search *hotels 'metro'* in the month. and *Airbnb Search* refers to the Google Trends search volume for the search *Airbnb 'metro'* in the month. Google Trends series are standardized to the maximum search activity over the period June 2014 - November 2019.

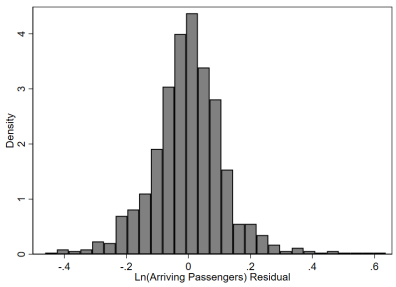
B.2. Assessing the Parallel Trend Assumption

We adopt the "honest approach" to parallel trends proposed by Rambachan and Roth (2023) to test the robustness of our findings to alternative assumptions about different trends in treated versus untreated tax jurisdictions. If we restrict the post-treatment violation of parallel trends to be no larger than the maximal pre-treatment violation of parallel trends, we obtain confidence sets that are slightly wider than the original ones but rule out a null effect on both prices and quantities. We also verify that the breakdown value for a null effect is around a violation that is twice as large as the maximal pre-treatment violation: see Figure B.3. We also construct robust confidence sets about how non-linear the difference in trends can be, allowing for linear violations of parallel trends and larger deviations from linearity. Our results are robust to linear violations and, up to the arbitrary amount $M \leq 0.03$, to nonlinear violations, where M bounds the maximum curvature of the untreated trend.

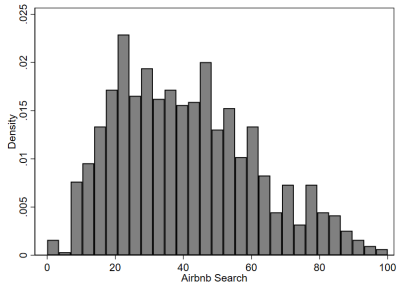
Figure B.1. : Demand Shifter Histograms



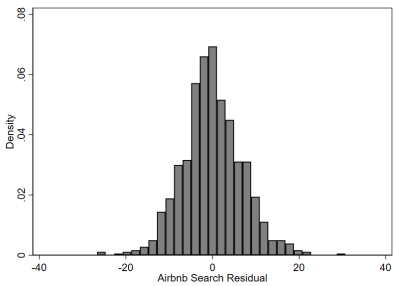
(a) Ln(Passengers)



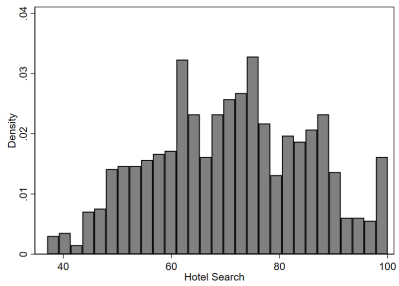
(b) Ln(Passengers) Residuals



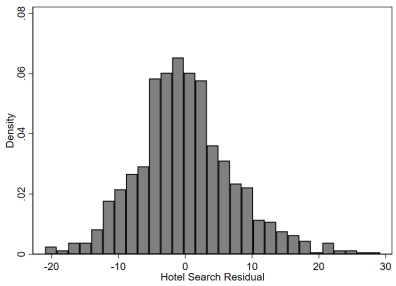
(c) Airbnb Search



(d) Airbnb Search Residuals



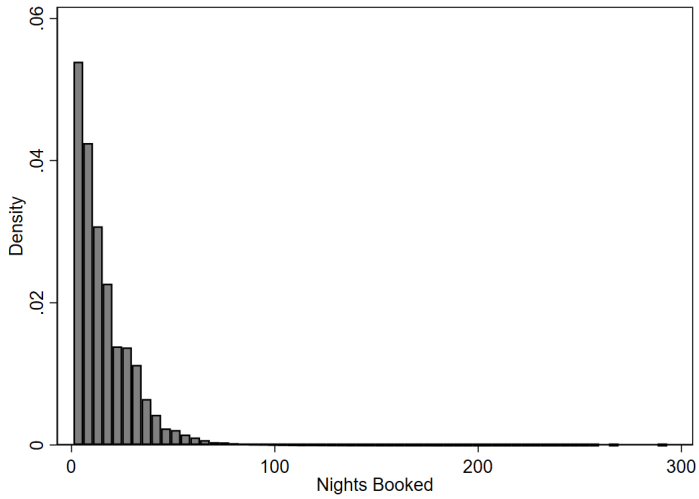
(e) Hotel Search



(f) Hotel Search Residuals

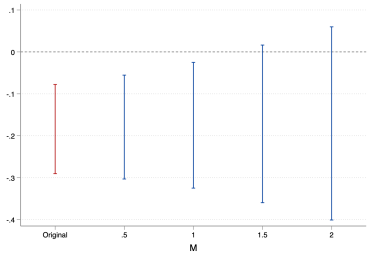
The figures report the distributions of the demand shifters. Each histogram displays the distribution of one of the shifters (Z_{mt}), using one observation per metropolitan area by month, which is the level of variation. The panels on the left side show the unconditional distribution, while the panels on the right hand side display the residualized analog. The residuals are obtained from a linear regression of (Z_{mt}) on metro and month fixed effects.

Figure B.2. : Nights Booked Histogram

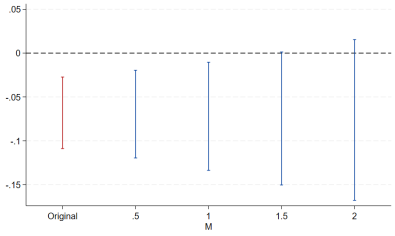


Note: Histogram of nights booked in the sample with a positive number of nights booked.

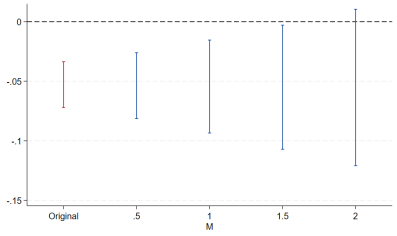
Figure B.3. : Sensitivity estimates on nights and prices based on Rambachan and Roth (2023)



(a) Sensitivity on nights booked: Poisson TWFE



(b) Sensitivity on booking prices: TWFE



(c) Sensitivity on booking prices: Sun and Abraham (2021)

The figures report a sensitivity analysis of the estimated effects on nights (Panels a) and prices (Panels b and c) to potential violations of parallel trends per Rambachan and Roth (2023). The red bar in each panel represents the 95% confidence interval of the difference-in-difference estimate for $t = 4$ months after the introduction of a VCA agreement (baseline estimates). The blue bars represent the corresponding 95% confidence intervals permitting M deviations (x-axis) from the parallel trends assumption.

B.3. Robustness and Heterogeneity

Table B.4—: Effects of Within Metro Treatment on Control Units

	Booked	ln(Booking Price)	Booked	ln(Booking Price)
1[Tax in Metro]	-0.056	-0.004		
	(0.040)	(0.007)		
ln(1 + Max. Tax)			-0.338	-0.005
			(0.349)	(0.069)
Observations	629,214	256,741	629,214	256,741
Clusters	33	33	33	33

Estimated spillover effects of within-metro treatments on control units. The sample contains listings in jurisdictions with no VCA during our sample period. 1[Tax in Metro] is an indicator for having any VCA in the same metro in the observation month. ln(1 + Max. Tax) is the highest VCA enforced tax rate in the metro in the given month. All regressions include property fixed effects and month-year fixed effects. There are 33 jurisdictions in the sample.

Table B.5—: Main Results, Including Largest Jurisdiction in Each Metro Only

			Google Searches	
			Hotels	Airbnb
Panel A: Nights Booked, Poisson TWFE				
$\ln(1+\tau_{jmt})$	-0.431	-0.424*	-0.416*	-0.289
	(0.286)	(0.251)	(0.225)	(0.232)
ln(Arrivals)		0.443***		
		(0.086)		
Google Trends			0.008***	0.010***
			(0.002)	(0.002)
Observations	2,411,942	2,411,942	2,411,942	2,411,942
Panel B: ln(Nightly Booking Price)				
$\ln(1+\tau_{jmt})$	-0.214*	-0.215**	-0.217**	-0.145**
	(0.115)	(0.087)	(0.089)	(0.065)
ln(Arrivals)		0.334***		
		(0.057)		
Google Trends			0.004***	0.005***
			(0.001)	(0.001)
Observations	976,112	976,112	976,112	976,112
Property FE	x	x	x	x
Month-Year FE	x	x	x	x
Panel C: Structural Parameter Estimates				
ε^d		-0.541	-0.532	-0.338
		(0.935)	(0.851)	(0.554)
ε^s		1.325	1.925	1.929
		(0.278)	(0.285)	(0.221)
λ_1		-0.105	0.001	-0.005
		(0.226)	(0.149)	(0.138)

Estimation of main results while including only the largest jurisdiction in each metro area. Panel A reports the reduced-form estimates of the effect of tax collection agreement on nights booked using Poisson regression. Panel B reports the reduced-form estimates on the booking price. The top row of each panel $\ln(1+\tau_{jmt})$ includes the estimated effects of tax enforcement. The first column includes no additional demand shifter. Columns 2-4 include an additional demand shifter (Z_{mt}). Column 2 includes the logarithm of incoming flight passengers. Columns 3 and 4 include the volume of searches reported in Google Trends for hotels and Airbnb in the month. Panel C includes the resulting estimates of the structural parameters using each demand shifter. The number of jurisdictions is 24. Standard errors, in parentheses, are clustered at the tax jurisdiction level. *** p<0.01, ** p<0.05, * p<0.1.

Table B.6—: Main Results, Dropping Controls in Treated Metros

			Google Searches	
			Hotels	Airbnb
Panel A: Nights Booked, Poisson TWFE				
$\ln(1+\tau_{jmt})$	-0.538*	-0.554**	-0.550**	-0.361
	(0.306)	(0.274)	(0.267)	(0.251)
ln(Arrivals)		0.468***		
		(0.065)		
Google Trends			0.009***	0.011***
			(0.002)	(0.002)
Observations	2,857,213	2,857,213	2,857,213	2,857,213
Panel B: ln(Nightly Booking Price)				
$\ln(1+\tau_{jmt})$	-0.217**	-0.235***	-0.233***	-0.134**
	(0.098)	(0.076)	(0.082)	(0.056)
ln(Arrivals)		0.332***		
		(0.046)		
Google Trends			0.004***	0.005***
			(0.001)	(0.001)
Observations	1,157,566	1,157,566	1,157,566	1,157,566
Property FE	x	x	x	x
Month-Year FE	x	x	x	x
Panel C: Structural Parameter Estimates				
ε^d		-0.725	-0.717	-0.416
		(0.747)	(0.788)	(0.475)
ε^s		1.409	1.975	2.118
		(0.209)	(0.240)	(0.242)
λ_1		-0.158	-0.045	-0.036
		(0.221)	(0.148)	(0.131)

Estimation of main results excluding control units in treated metros from the sample. Panel A reports the reduced-form estimates of the effect of tax collection agreement on nights booked using Poisson regression. Panel B reports the reduced-form estimates on booking price. The top row of each panel $\ln(1+\tau_{jmt})$ includes the estimated effects of tax enforcement. The first column includes no additional demand shifter. Columns 2-4 include an additional demand shifter (Z_{mt}). Column 2 includes the logarithm of incoming flight passengers. Columns 3 and 4 include the volume of searches reported in Google Trends for hotels and Airbnb in the month. Panel C includes the resulting estimates of the structural parameters using each demand shifter. The number of jurisdictions is 55. Standard errors, in parentheses, are clustered at the tax jurisdiction level. *** p<0.01, ** p<0.05, * p<0.1.

Table B.7—: Main Results, Conditional on Days Supplied

		Google Searches	
		Hotels	Airbnb
Panel A: Nights Booked, Poisson TWFE			
$\ln(1+\tau_{jmt})$	-0.484*	-0.466*	-0.325
	(0.261)	(0.249)	(0.238)
ln(Arrivals)	0.491***		
	(0.065)		
Google Trends		0.009***	0.011***
		(0.002)	(0.001)
Supply	0.022***	0.022***	0.022***
	(0.001)	(0.001)	(0.001)
Observations	3,118,578	3,118,578	3,118,578
Panel B: ln(Nightly Booking Price)			
$\ln(1+\tau_{jmt})$	-0.252***	-0.244***	-0.172***
	(0.079)	(0.080)	(0.059)
ln(Arrivals)	0.330***		
	(0.045)		
Google Trends		0.004***	0.005***
		(0.001)	(0.001)
Supply	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)
Observations	1,259,409	1,259,409	1,259,409
Property FE	x	x	x
Month-Year FE	x	x	x
Panel C: Structural Parameter Estimates			
ε^d	-0.647	-0.617	-0.392
	(0.779)	(0.762)	(0.498)
ε^s	1.488	2.089	2.185
	(0.242)	(0.275)	(0.269)
λ_1	-0.074	0.021	0.023
	(0.202)	(0.151)	(0.128)

Estimation of main results conditional on the number of days the property is available (nights in use plus nights available) in the given month. Panel A reports the reduced-form estimates of the effect of tax collection agreement on nights booked using Poisson regression. Panel B reports the reduced-form estimates on booking price. The top row of each panel $\ln(1+\tau_{jmt})$ includes the estimated effects of tax enforcement. The first column includes no additional demand shifter. Columns 2-4 include an additional demand shifter (Z_{mt}). Column 2 includes the logarithm of incoming flight passengers. Columns 3 and 4 include the volume of searches reported in Google Trends for hotels and Airbnb in the month. Panel C includes the resulting estimates of the structural parameters using each demand shifter. The number of jurisdictions is 78. Standard errors, in parentheses, are clustered at the tax jurisdiction level. *** p<0.01, ** p<0.05, * p<0.1.

Table B.8—: Reduced Form Estimates, Individual vs. Professional Hosts (Poisson)

			Google Searches	
			Hotels	Airbnb
Panel A: Nights Booked				
$\ln(1+\tau_{jmt}) \times < 5$	-0.619**	-0.631**	-0.619**	-0.383
	(0.313)	(0.278)	(0.269)	(0.248)
$\ln(1+\tau_{jmt}) \times \geq 5$	0.164	0.146	0.209	-0.075
	(0.255)	(0.259)	(0.240)	(0.277)
ln(Arrivals) $\times < 5$		0.472***		
		(0.065)		
ln(Arrivals) $\times \geq 5$		0.446***		
		(0.113)		
Google Trends $\times < 5$			0.009***	0.010***
			(0.001)	(0.001)
Google Trends $\times \geq 5$			0.007***	0.014***
			(0.002)	(0.002)
	3,118,578	3,118,578	3,118,578	3,118,578
Panel B: ln(Nightly Booking Price)				
$\ln(1+\tau_{jmt}) \times < 5$	-0.222*	-0.213**	-0.217**	-0.115
	(0.115)	(0.090)	(0.090)	(0.070)
$\ln(1+\tau_{jmt}) \times \geq 5$	-0.305***	-0.443***	-0.386***	-0.406***
	(0.059)	(0.071)	(0.073)	(0.083)
ln(Arrivals) $\times < 5$		0.302***		
		(0.043)		
ln(Arrivals) $\times \geq 5$		0.447***		
		(0.059)		
Google Trends $\times < 5$			0.004***	0.005***
			(0.001)	(0.001)
Google Trends $\times \geq 5$			0.005***	0.006***
			(0.001)	(0.001)
	1,259,371	1,259,371	1,259,371	1,259,371
Property FE	x	x	x	x
Month-Year FE	x	x	x	x

The table reports the reduced-form estimates of the effect of tax collection agreement on nights booked (Panel A) and booking price (Panel B) for two subsets of the sample: (i) listings from hosts with fewer than 5 listings ("Individual") and (ii) listings from hosts with 5 or more listings ("Professional"). The top two rows of each panel $\ln(1+\tau_{jmt})$ include the estimated effects of tax enforcement. The first column includes no additional demand shifter. Columns 2-4 include an additional demand shifter (Z_{mt}). Column 2 includes the logarithm of incoming flight passengers. Columns 3 and 4 include the volume of searches reported in Google Trends for hotels and Airbnb in the month. All estimates are from a single regression that includes interactions between the tax variable and indicators for hosts with fewer than 5 listings and hosts with 5 or more listings, and interactions between the demand shifter and indicators for hosts with fewer than 5 listings and hosts with 5 or more listings. The number of jurisdictions is 78. Standard errors, in parentheses, are clustered at the tax-jurisdiction level. *** p<0.01, ** p<0.05, * p<0.1.

Table B.9—: Structural Parameter Estimates, Individual vs. Professional Hosts (Poisson)

	Demand Shifter		
	Passengers	Hotels Trend	Airbnb Trend
Panel A: Hosts with < 5 Listings			
ε^d	-0.802	-0.791	-0.433
	(0.871)	(0.863)	(0.504)
ε^s	1.563	2.262	2.174
	(0.286)	(0.268)	(0.273)
λ_1	-0.191	-0.057	-0.062
	(0.191)	(0.137)	(0.134)
p-value, $H_0 : \lambda_1 > 0.1$	0.063	0.126	0.106
p-value, $H_0 : \lambda_1 > 0.2$	0.020	0.031	0.023
Panel B: Hosts with ≥ 5 Listings			
ε^d	0.262	0.340	-0.127
	(0.947)	(1.091)	(0.868)
ε^s	0.999	1.348	2.197
	(0.216)	(0.261)	(0.312)
λ_1	0.589	0.541	0.372
	(0.396)	(0.271)	(0.178)
p-value, $H_0 : \lambda_1 > 0$	0.068	0.023	0.018

The table reports the structural parameters with standard errors (in parentheses) for two subsets of the sample: (i) listings from hosts with fewer than 5 listings ("Individual") and (ii) listings from hosts with 5 or more listings ("Professional"). Structural parameter estimation based on the reduced-form results in Table B.8. Standard errors are computed from a bootstrap with 500 repetitions and clustering at the tax jurisdiction level. The first column includes estimates using the incoming flight passengers variable. Columns 2 and 3 include estimates using the volume of searches reported in Google Trends for hotels and Airbnb. The $p-$values are calculated on the basis of the parameter estimates and their standard errors, assuming normality.