Airport Costs, Capacity, and Metropolitan Economic Development

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Overview

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- Relevant Literature
- Methodology
- Model Outputs
- Estimation Model and Variables
- Data
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- Conclusions and Next Steps

Question

- **Can we identify the economic development impact of additional airport runway capacity?**

impact? →

Atlanta's airport

Atlanta MSA

Relevant Literature

- Public Capital Studies
  - Deno (1988) – mfg firm input demands
  - Duffy, Deno, and Eberts (1991) – per capita income
  - Lynde and Richmond (1992) –production costs in private sector
  - Morrison and Schwartz (1996) – mfg productivity
- Airport Specific
  - Urban Development
    - Goetz (1992) – air passenger flows and growth
    - Hakfoort et al. (2001) – employment
    - Brueckner (2003) – employment
  - Infrastructure
    - Cohen and Paul (2003) – airport infrastructure and mfg costs

Methodology

- MSAs with one commercial (OEP) airport
- Airport short run operating costs
- Runways are quasi-fixed factor of production
- Cost minimizing behavior
- Focus on airport rather than social costs

$$C_{it} = C(q_{it}, p_{itj} ; k_{it}, \tau)$$

- Estimate cost function and relate costs to MSA economic development

Model Outputs

- Economies of capital utilization
- Input demand elasticities
- Input substitution elasticities
- Average cost of output
- Marginal cost of output

Data

- Sources
  - Passengers – BTS*
  - Operating Costs – CATS*
  - Prices – QCEW*, BLS*
  - Runways – NFDC*

* BTS – Bureau of Transportation Statistics; CASTS – FAA's Compliance Activity Tracking System; NFDC – National Flight Data Center; QCEW – Quarterly Census of Earnings and Wages; BLS – Bureau of Labor Statistics

Data

MSA Airport Output and Operating Costs ($)
Panel of 35 Airports, 1996 - 2007

Group	Variable	# Obs	Mean	Std Dev
Full Sample	Contractual, Repair/Maintenance Costs $	420	27,802,392	23,466,241
	General Airport Operations Costs	420	16,302,538	15,590,252
	Operating Costs, Personnel compensation and benefits ($)	420	27,481,877	18,878,676
	Operating Expenses, Total ($)	420	71,586,808	49,350,531
	Passengers	420	9,069,000	6,567,000
Over Airports	Contractual, Repair/Maintenance Costs $	12	27,802,392	51,661,244
	General Airport Operations Costs	12	16,302,538	9,722,917
	Operating Expenses, Personnel compensation and benefits ($)	12	27,481,877	38,780,191
	Operating Expenses, Total ($)	12	71,586,808	95,975,873
	Passengers	12	9,069,000	4,198,000
Over Years	Contractual, Repair/Maintenance Costs $	35	27,802,392	70,547,339
	General Airport Operations Costs	35	16,302,538	45,826,112
	Operating Expenses, Personnel compensation and benefits ($)	35	27,481,877	60,614,206
	Operating Expenses, Total ($)	35	71,586,808	155,802,680
	Passengers	35	9,069,000	22,531,000

Variation greater over years than over airports

Data

Input Price Indices (1996 = 100)

Panel of 35 Airports, 1996 - 2007

Group	Variable	# Obs	Mean	Std Dev
Full Sample	Price Index, Contractual, Repair/Maintenance	420	128.905	25.321
	Price Index, Airport Operations	420	139.745	27.975
	Price Index, Personnel	420	126.787	16.881
Over Airports	Price Index, Contractual, Repair/Maintenance	12	128.905	155.898
	Price Index, Airport Operations	12	139.745	172.248
	Price Index, Personnel	12	126.787	98.017
Over Years	Price Index, Contractual, Repair/Maintenance	35	128.905	4.841
	Price Index, Airport Operations	35	139.745	5.329
	Price Index, Personnel	35	126.787	12.920

Variation greater over airports than over years

Results

1. Cost Elasticity 0.37

2. Economies of Runway Utilization 2.48

3. Input Demand Elasticities

η_{ll}	-0.825				
η_{le}	0.956	η_{ee}	-3.722		
η_{lm}	-0.131	η_{em}	1.977	η_{mm}	-1.027

4. Morishima Elasticities of Substitution

σ_{ll}	-	σ_{el}	2.570	σ_{ml}	0.683
σ_{le}	4.678	σ_{ee}	-	σ_{me}	4.891
σ_{lm}	0.897	σ_{em}	3.004	σ_{mm}	-

Author's Calculations. l – Personnel; e – General Airport Operations; m – Contractual and Repair/Maintenance.

η_{ij} – Elasticity of input l with respect to a change in the price of input j.

σ_{ij} – Elasticity of substitution between inputs i and j due to a change in the factor price ratio..

Results

- MC < AC

Average and Marginal Cost

$ Million per million passengers

	Average Cost	Marginal Cost
Full Sample	8.634	3.166
Large Hubs	9.695	3.557
Medium Hubs	7.740	2.834

Results

- AC and MC by Airport

Large hubs more efficient than small hubs

Airport	Average Cost (per million)	Average Cost (per pax)		PAX (millions)	Marginal Cost (per million)	Marginal Cost (per pax)		Per Runway Marginal Cost (per pax)	
Large Hubs									
Pittsburgh International, PIT	9.47	1.46	**	7.43	3.48	0.54		0.13	#
San Diego International, SAN	4.08	0.53		7.73	1.50	0.19	*	0.19	#
Tampa International, TPA	7.47	0.97		7.75	2.74	0.36		0.12	
Honolulu International, HNL	8.33	1.06		7.89	3.06	0.39		0.06	
Cincinnati/Northern Kentucky, CVG	6.77	0.80		8.69	2.47	0.29		0.09	
Baltimore-Washington International, BWI	6.56	0.75		8.96	2.41	0.28		0.07	
Salt Lake City International, SLC	7.23	0.77		9.41	2.65	0.28		0.07	
General Edward Lawrence Logan, BOS	17.01	1.63	**	10.47	6.24	0.60		0.12	
Philadelphia International, PHL	8.30	0.77		10.96	3.04	0.28		0.08	
Charlotte/Douglas International, CLT	2.34	0.21	*	11.45	0.86	0.08	*	0.03	
Lambert-St. Louis International, STL	8.19	0.89		11.63	2.99	0.32		0.06	
Seattle-Tacoma International, SEA	11.48	0.89		12.79	4.21	0.33		0.16	
Orlando International, MCO	7.12	0.53		13.38	2.61	0.20	*	0.06	
Detroit Metro Wayne, DTW	7.94	0.54		14.68	2.91	0.20	*	0.06	
Minneapolis-St.Paul International, MSP	8.78	0.60		14.68	3.22	0.22	*	0.03	
McCarran International, LAS	7.62	0.45		17.15	2.79	0.17	*	0.04	
Phoenix Sky Harbor International, PHX	4.90	0.27		18.18	1.80	0.10	*	0.04	
Denver International, DEN	10.60	0.58		18.37	3.89	0.21		0.04	
Hartsfield-Jackson Atlanta International, ATL	2.85	0.08	*	35.56	1.05	0.03	*	0.01	
Medium Hubs									
Jacksonville International, JAX	1.76	4.79	**	2.57	4.44	1.76	**	0.88	#
Southwest Florida International, RSW	2.10	5.72	**	2.76	5.52	2.10	**	2.10	#
General Mitchell International, MKE	1.24	3.37	**	2.95	3.59	1.24	**	0.25	
Port Columbus International, CMH	1.61	4.38	**	3.25	5.18	1.61	**	0.80	#
Albuquerque International, ABQ	0.91	2.48	**	3.44	3.12	0.91		0.23	
Austin-Bergstrom International, AUS	0.93	2.53	**	3.60	3.34	0.93		0.46	#
Indianapolis International, IND	1.47	4.01	**	3.75	5.52	1.47	**	0.49	#
Raleigh-Durham International, RDU	0.61	1.67	**	4.09	2.46	0.61		0.20	
Sacramento Metro, SMF	0.95	2.60	**	4.30	4.05	0.95		0.48	#
New Orleans International, MSY	0.49	1.34	**	4.58	2.13	0.49		0.16	
Nashville International, BNA	0.67	1.82	**	4.62	3.09	0.67		0.17	
Memphis International, MEM	0.60	1.63	**	4.88	2.91	0.60		0.15	
Cleveland-Hopkins International, CLE	0.59	1.62	**	5.46	3.21	0.59		0.13	
Kansas City, International, MCI	0.51	1.40	**	5.87	2.99	0.51		0.17	
Portland International, PDX	0.49	1.34	**	6.39	3.15	0.49		0.16	
San Antonio International, SAT	0.29	0.78		7.73	2.22	0.29		0.10	

Results

- How does ATL compare with other large hub airports?

	Atlanta	Other Large Hubs
Cost Function Related		
Cost Elasticity	0.367	0.367
Additional Runway	**-1.04%**	**0.12%**
Average Cost per Passenger	**0.080**	**0.762**
Marginal Cost per Passenger	**0.029**	**0.279**
September 11, 2001 Attack	**23%**	**5%**

Results

- Marginal Airport Cost and MSA Economic Development

Explanatory Variable	*Metropolitan Employment*	*Number of Establishments*	*Real Gross Metropolitan Product*	*Real Gross State Product*	*Real Per Capita Income*
Real Marginal Cost	-0.275	-0.241	-0.261	-0.167	-0.004
(p-value)	(< 0.0001)	(< 0.0001)	(< 0.0001)	(< 0.0001)	(0.863)
911 × Atlanta	0.066	0.087	na	0.023	-0.058
(p-value)	(0.008)	(< 0.0001)	-	(0.382)	(0.017)

Author's Calculations. * All results except Real Gross Metropolitan Product (Real GMP) are based on a panel of 35 large and medium hubs, 1996 – 2007. Real GMP data are only available for 2001 – 2007. All models contain 34 fixed effects (Tampa International Airport is the reference airport) and 11 (6 for the Real GMP model) time effects (2007 is the reference year).

Conclusions

- Airport production technology
  - Homothetic and homogeneous
  - Increasing returns to capital utilization (i.e. runways)
  - Inelastic (elastic, unit elastic) demand for labor (general operations and maintenance/repair)
  - General operations substitutable for labor and maintenance/repair

Conclusions

- Airport costs
  - MC < AC over the sample
  - AC and MC per passenger smaller for large hubs
  - 911 terrorist attacks – ↑ airport operating costs 5% for the sample, 23% for ATL
  - Scale matters – ATL dominates the sample in terms of throughput, implying
    - Significantly lower AC and MC
    - Reduction in operating costs from additional runway in comparison with sample

Conclusions

- **Economic Development**
  - Analysis establishes a link between airport costs and economic development
  - 1% reduction in real airport costs
    - ↑ metropolitan employment 0.25%
    - ↑ # of metropolitan establishments 0.25%
    - ↑ gross state product 0.16%
    - Negative but insignificant impact on per capita income

Consistent with Brueckner

Next Steps

- Include multi-airport MSAs and small hubs
- Explore economies of scope with freight shipments
- Improve measures of runway capacity
- Incorporate airport heterogeneity (e.g. retail activities, car rental facilities)
- Model demand and cost together

Questions?