Air Transport and Urban Growth:
Evidence from a Quasi-Natural Policy Experiment

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UEA, Ottawa 2012

Introduction

- Cities spend public capital to promote local air service
  - Investments in airport infrastructure
  - Subsidies to deter airlines from terminating strategic routes
- Main justification for these local policy decisions?
  - Strong belief that air transport is crucial for regional economic growth
- Key questions:
  - What is the impact of passenger aviation on urban development?
  - How much does economic activity rely on air service?

Air Transport and Urban Growth

- Little evidence on the relation between air transport and urban growth (Brueckner 2003; Green 2007)
  - establishing causality is difficult !!!
- Empirical challenges come from identification:
  - *Exogeneity:* infrastructure investment decisions are well informed, leaving little room for randomness
  - *Cross-section:* infrastructure highly correlated with level of development
  - *Time-series:* infrastructure changes slowly over time ➔ limited data variation

This Paper

(1). Quasi-natural experiment to get at causality

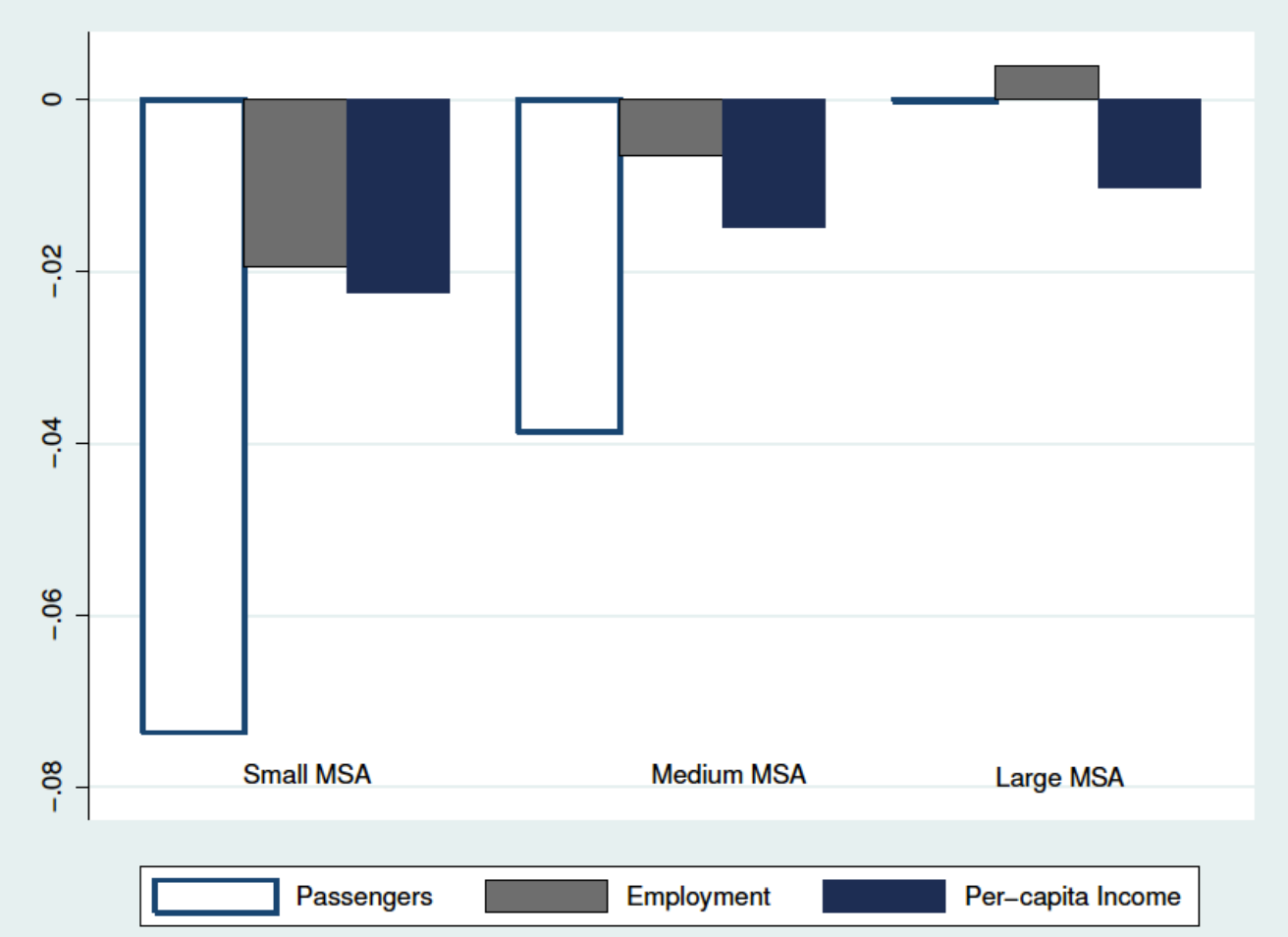
U.S. Airline Deregulation Act (ADA) of 1978:

- Rapid switch from tight government regulation to free market
- Unanticipated yet permanent changes to the aviation network
- Removal of regulatory distortions with different impact across cities

(2). Exploit time variation in air traffic growth rates before/after ADA to examine impact on MSA level growth:

- Population / employment
- Income per-capita
- Sector Composition

Changes in Urban Growth Before/After ADA by MSA size group



Main Findings

- Air services have a significant impact on regional growth
- For the average MSA in the sample, an increase in air traffic growth from the 25th to the 75th percentile level explains:
  - 6.2% of the observed avg. population growth
  - 9.4 % of the observed avg. per-capita income growth
  - 6 % of the observed avg. employment growth
- Across sectors, employment effects are driven primarily by growth in services and retail activities
- Results are not driven by the MSAs hosting the largest hubs

Institutional Background: Airline Deregulation Act (1978)

- **Pre-Deregulation:**

  Developments of the aviation industry closely overseen by the Civil Aeronautic Board (CAB)

  - Certify and approve new carriers
  - Decide route allocation among carriers
  - Regulate entry/exit on every city-pair market (suppress market competition)
  - Pre-determine airfares: cross-route subsidization

  ➔ Systematic distortions to air service supply across MSAs
  Fare structure and route allocation favored small MSAs relative to large ones

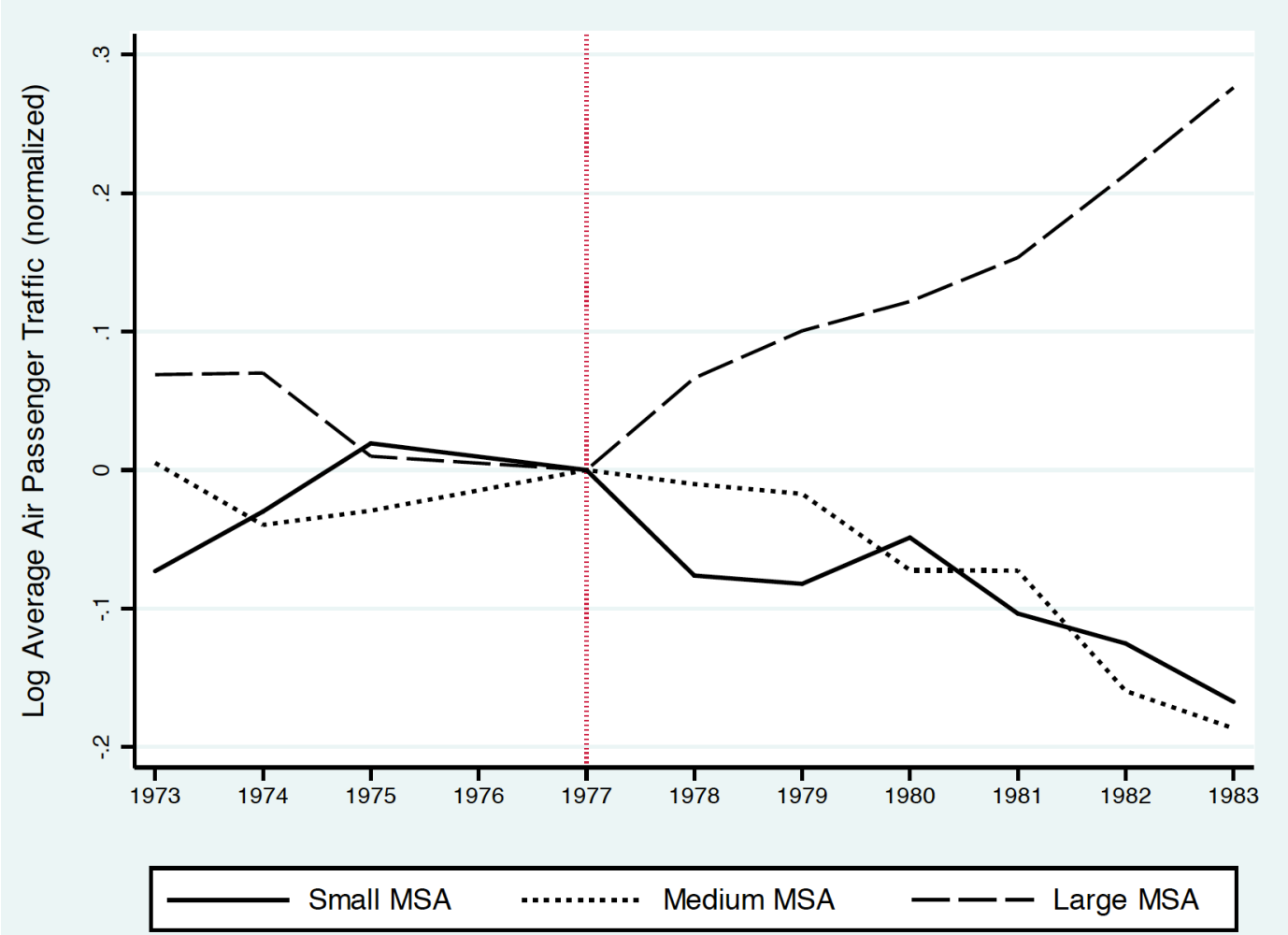
Institutional Background: Airline Deregulation Act (1978)

- **Post-Deregulation:**

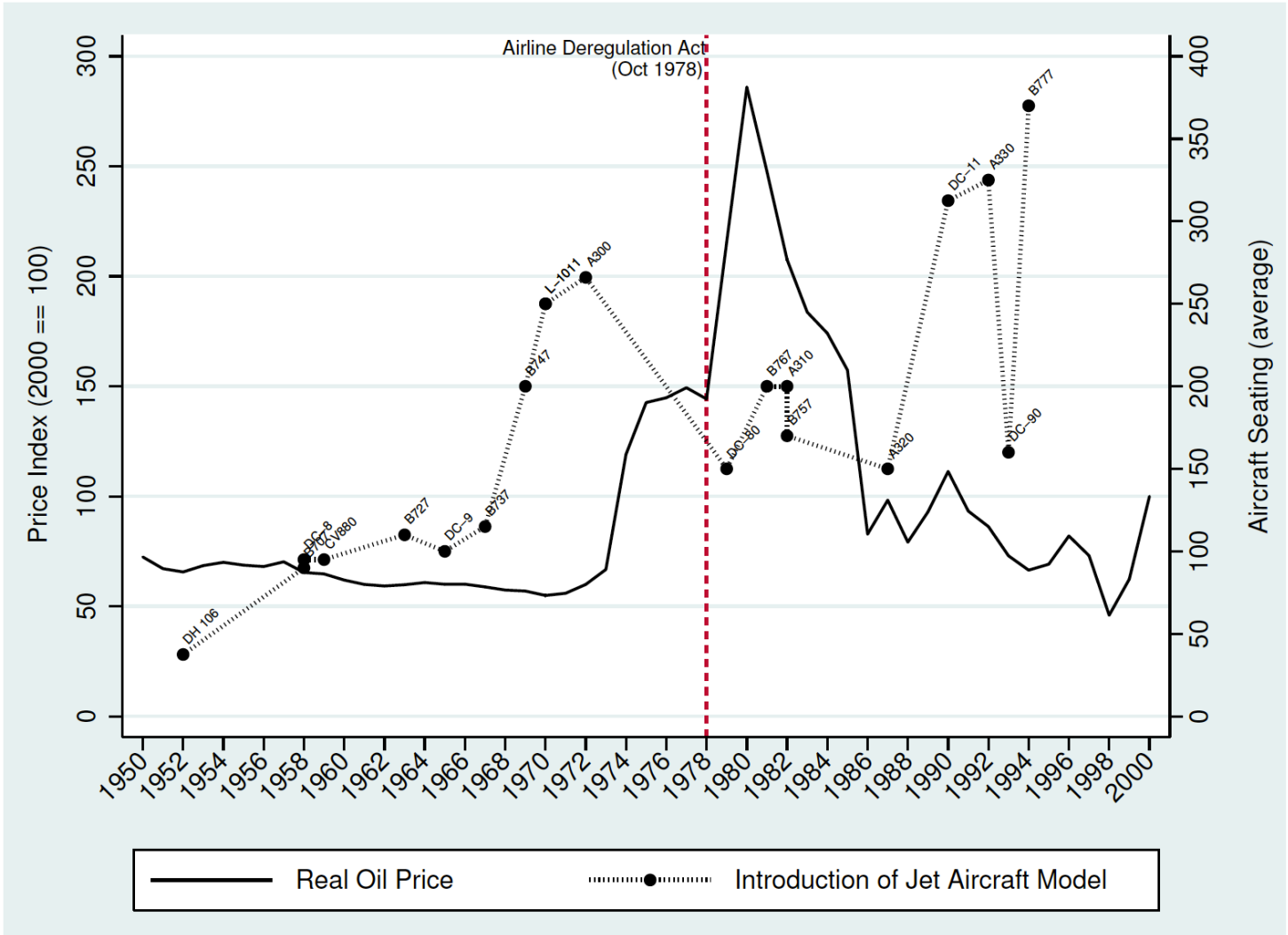
Sweeping industry changes, largely unexpected
("mistaken expectations and unforeseen outcomes", A. Kahn)

- Removal of all regulations (CAB effectively dissolved in 1983)
- Unanticipated, permanent changes in the aviation network:
  - switch from point-to-point air service to hub-and-spoke network
- Reversal to air service levels determined by market forces
  - Small MSAs: increase in prices, reduction in destinations reached
  - Large MSAs: decrease in prices, increase in routes served and in market competition

Trends in Air Traffic Around 1978 Deregulation



Additional exogenous variation: 1979 Oil Price Shock + Jet Aircrafts



Theory Framework

- Simple model of urban growth (Glaeser et al., 1995):
  - Free mobility of factors of production => rates of return equalized across space
  - Factors rooted in local fundamentals are necessary to explain differences in urban growth
- Assume that air service provided at MSA *i* enters as:
  - Productivity shifter
  - Local amenity

Theory Framework

- Total output in city *i*: $Y_{it} = A_{it}(L_{it})^{\alpha}$

- Workers earn the value of their marginal product: $W_{it} = \alpha A_{it}(L_{it})^{\alpha-1}$

- Individuals get utility from earned income (W_{it}) and quality of life (Λ_{it}): $U_{it} = W_{it}\Lambda_{it}$

- Quality of life (Λ_{it}) depends on local amenities (Q_{it}) and congestion: $\Lambda_{it} = Q_{it}(L_{it})^{-\delta}, \quad \delta>0$

- Free mobility of workers implies: $U_{it} = U_t, \quad$ for all *i*

Equilibrium

- Equalizing changes in utility over time across cities implies:

$$\log\left(\frac{L_{it+1}}{L_{it}}\right) = \frac{1}{1-\alpha+\delta}\left[\log\left(\frac{A_{it+1}}{A_{it}}\right) + \log\left(\frac{Q_{it+1}}{Q_{it}}\right)\right] + \kappa_t$$

- Given rate of population growth, income grows as follows:

$$\log\left(\frac{W_{it+1}}{W_{it}}\right) = \frac{1}{1-\alpha+\delta}\left[\delta\log\left(\frac{A_{it+1}}{A_{it}}\right) + (\alpha-1)\log\left(\frac{Q_{it+1}}{Q_{it}}\right)\right] + \omega_t$$

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- Assumptions for productivity and local amenity growth paths:

$$\log\left(\frac{A_{it+1}}{A_{it}}\right) = (X_{it})'\gamma_1 + \beta_1\log\left(\frac{AIR_{it+1}}{AIR_{it}}\right) + \nu_{it}$$

$$\log\left(\frac{Q_{it+1}}{Q_{it}}\right) = (X_{it})'\gamma_2 + \beta_2\log\left(\frac{AIR_{it+1}}{AIR_{it}}\right) + \upsilon_{it}$$

Estimation Strategy

- **Estimating equation** (notation z = lnZ):

$$\Delta y_{it} = \beta \Delta air_{it} + X'_{it}\theta + Post_t + \alpha_i + \epsilon_{it}$$

where i = MSA; y = {population, income per-capita, employment} and X = initial economic conditions

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where i = MSA; y = {population, income per-capita, employment} and X = initial economic conditions

- Persistency in economic variables => long-run annual growth rates

Two time periods:

- Pre-Deregulation (T==0): 1969 – 1977
- Post-Deregulation (T==1): 1977 – 1991

Estimation Issues

$$\Delta y_{it} = \beta \Delta air_{it} + X'_{it}\theta + Post_t + \alpha_i + \epsilon_{it}$$

- **Endogeneity** of air traffic growth:

(1). *Omitted variable bias*

=> MSA fixed effects (α_i)

=> controls for initial period economic conditions (X_{it}): population, income level, sectoral composition

(2). *Simultaneity* in growth trends post-deregulation

=> focus on short run changes in air traffic growth

=> Post-Deregulation period for Δair: 1977 – 1983

More on Endogeneity

- Post-deregulation, airline market entry is determined by prior and anticipated urban growth

$$\Delta air_{it} = \underbrace{\beta_0\left(\frac{air_{it}}{pop_{it}}\right) + \beta_1 \Delta pop_{it-1} + \beta_2 E_t(\Delta pop_{it+1}) + X'_{it}\gamma}_{\text{Deterministic component}} + u_{it}$$

- Exploit the random / unforeseen component in industry's response to the policy change

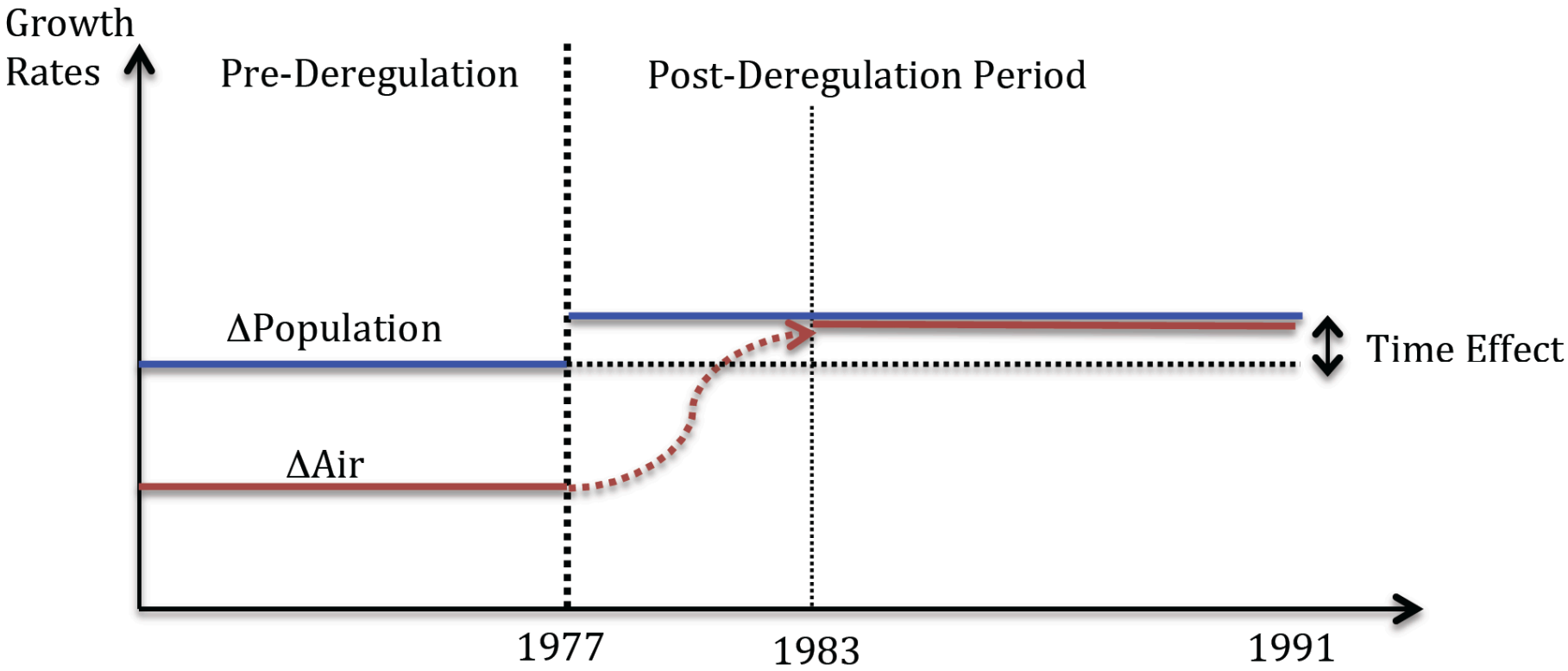
- Assume:

$$u_{it} = f(Dereg_{1978}) + \tilde{u}_{it}$$

$$E_t(\Delta pop_{it+1}) = \sum_{j=0}^{L} \gamma_j pop_{i,t-j}$$

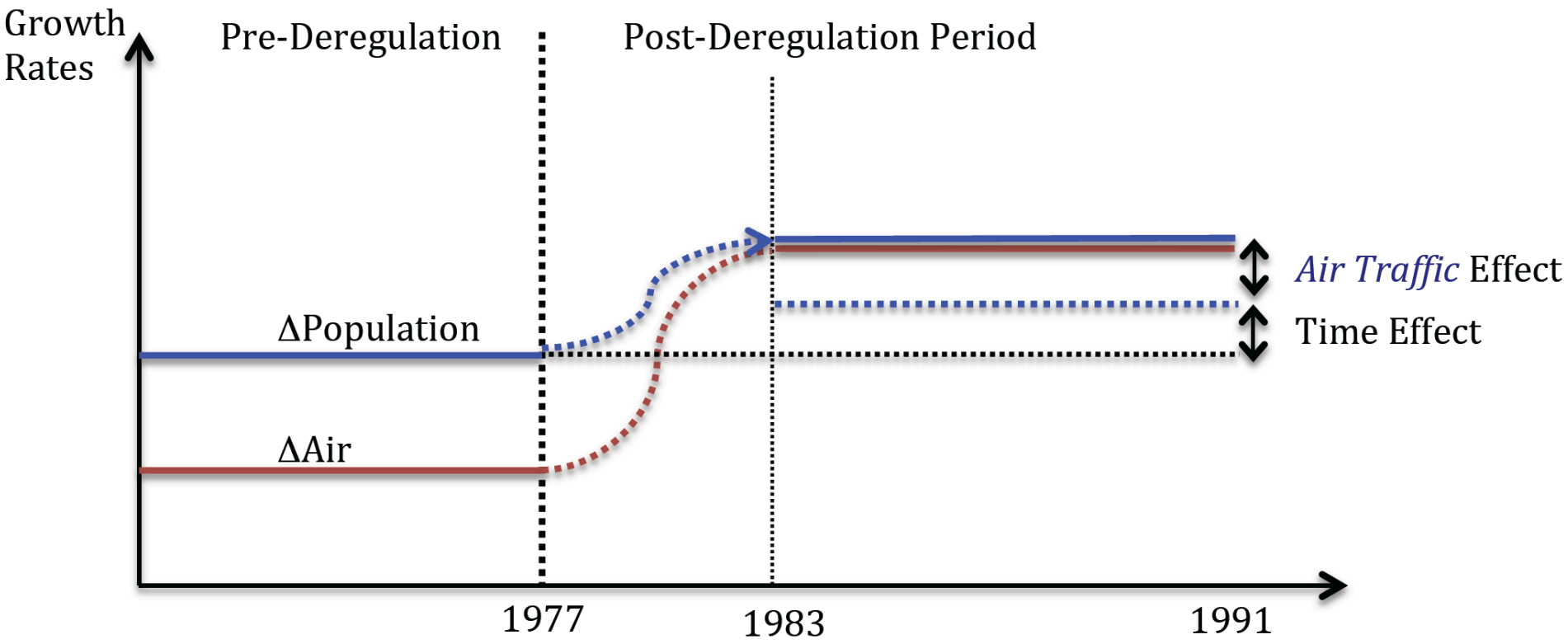
Main Identification Strategy

$\mathbf{H_O}$: *No effect* of air traffic on urban growth



Main Identification Strategy

$\mathbf{H_A}$: *Direct effect* of air traffic on urban growth



Data Sources

- **Air Traffic**: data provided by the *Dept. of Transportation*
  - *Airport Activity Statistics* of Certificated Air Carriers
  - *Schedules T3+T1* – Air Carrier Airport Statistics (online)
  - Match airports to MSAs using county information

- **Urban Economic Indicators**:
  - Population + Income per-capita at MSA level: *BEA*
  - Employment by sector: *County Business Patterns* (CBP)

- Resulting *estimation sample*:
  - 224 statistical areas (metro areas primarily)
  - data collected for years: 1969, 1977, 1983, 1991

Population Growth

	Population Growth Rate $_{t, t+1}$			
	(1)	(2)	(3)	(4)
Passenger Growth Rate $_{t, t+}$	**0.066****	**0.034****	**0.016****	**0.011+**
	[0.011]	**[0.009]**	**[0.006]**	**[0.006]**
Post Period	-0.000	0.000	-0.000	-0.001
	[0.001]	[0.001]	[0.002]	[0.002]
Passenger per-capita $_t$	0.003**	-0.000	0.006**	0.005*
	[0.001]	[0.001]	[0.002]	[0.002]
Population $_t$	-0.002**	0.008	-0.051**	-0.049**
	[0.000]	[0.005]	[0.009]	[0.009]
Observations	448	446	446	394
R-squared	0.233	0.567	0.618	0.637
Control Variabless				
MSA fixed effects	no	no	yes	yes
Population lags $_{(t-1, t-2, t-3)}$	no	yes	yes	yes
Income per-capita $_t$	no	yes	yes	yes
Employment $_t$	no	yes	yes	yes
Sectoral composition $_t$	no	yes	yes	yes
Large Hubs	yes	yes	yes	no

** p<0.01, * p<0.05, + p<0.1. Robust standard errors in brackets

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	[0.001]	[0.001]	[0.002]	[0.002]
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Income Growth

	Per-Capita Income Growth Rate $_{t, t+1}$			
	(1)	(2)	(3)	(4)
Passenger Growth Rate $_{t, t+}$	**0.028****	**0.028****	**0.029****	**0.027****
	[0.004]	**[0.005]**	**[0.004]**	**[0.004]**
Post Period	-0.008**	-0.008**	0.019**	0.018**
	[0.001]	[0.001]	[0.002]	[0.002]
Passenger per-capita $_t$	0.001+	0.001	0.000	0.001
	[0.000]	[0.001]	[0.001]	[0.002]
Income per-capita $_t$	-0.020**	-0.023**	-0.147**	-0.146**
	[0.002]	[0.004]	[0.008]	[0.008]
Observations	448	446	446	394
R-squared	0.592	0.603	0.933	0.936
Control Variabless				
MSA fixed effects	no	no	yes	yes
Population lags $_{(t-1, t-2, t-3)}$	no	yes	yes	yes
Population $_t$	no	yes	yes	yes
Employment $_t$	no	yes	yes	yes
Sectoral composition $_t$	no	yes	yes	yes
Large Hubs	yes	yes	yes	no

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Employment Growth

	Employment Growth Rate $_{t, t+1}$			
	(1)	(2)	(3)	(4)
Passenger Growth Rate $_{t, t+}$	**0.103****	**0.061****	**0.035****	**0.034****
	[0.013]	**[0.011]**	**[0.008]**	**[0.009]**
Post	0.003+	0.003*	0.022**	0.022**
	[0.002]	[0.002]	[0.004]	[0.004]
Passenger per-capita $_t$	0.004**	0.000	0.006*	0.005+
	[0.001]	[0.001]	[0.003]	[0.003]
Employment $_t$	-0.005**	-0.038**	-0.087**	-0.092**
	[0.001]	[0.010]	[0.020]	[0.021]
Population $_t$		0.009**	0.087**	0.092**
		[0.003]	[0.013]	[0.014]
Observations	448	446	446	394
R-squared	0.317	0.561	0.759	0.761
Control Variabless				
MSA fixed effects	no	no	yes	yes
Population lags $_{(t-1, t-2, t-3)}$	no	yes	yes	yes
Income per-capita $_t$	no	yes	yes	yes
Employment $_t$	no	yes	yes	yes
Sectoral composition $_t$	no	yes	yes	yes
Large Hubs	yes	yes	yes	no

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Sector Level Employment

	Sector Employment Growth Rate			
	Manufacturing	**Services**	**Wholesale**	**Retail**
	(1)	(2)	(3)	(4)
Passenger Growth Rate $_{t, t+1}$	**0.023**	**0.037****	**0.015**	**0.021****
	[0.016]	**[0.011]**	**[0.016]**	**[0.006]**
Post Period	0.001	0.047**	0.014*	0.020**
	[0.008]	[0.004]	[0.005]	[0.003]
Passenger per-capita $_t$	0.000	0.003	0.007	0.007*
	[0.005]	[0.004]	[0.006]	[0.003]
Population $_t$	0.066+	0.105**	0.056*	0.103**
	[0.039]	[0.018]	[0.028]	[0.012]
Observations	441	446	445	446
R-squared	0.802	0.716	0.912	0.804
Control Variabless				
MSA fixed effects	yes	yes	yes	yes
Population lags $_{(t-1, t-2, t-3)}$	yes	yes	yes	yes
Income per-capita $_t$	yes	yes	yes	yes
Employment $_t$	yes	yes	yes	yes
Sectoral composition $_t$	yes	yes	yes	yes
Large Hubs	yes	yes	yes	yes

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	Sector Employment Growth Rate			
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Summary of Results

- For the average MSA in the sample, an increase in air traffic growth from the 25th to the 75th percentile level explains:
  - 6.2% of the observed avg. population growth
  - 9.4 % of the observed avg. per-capita income growth
  - 6 % of the observed avg. employment growth

Conclusions

- We examine the contribution of passenger aviation to regional development and urban growth
- To get at causality, we take advantage of a quasi-natural experiment: the 1978 Airline Deregulation Act
- Using panel data for 224 MSAs, we exploit exogenous changes in air traffic growth before/after the policy change to identify the impact on regional growth
- Key findings: Local air services have a positive and significant impact on population, employment and income growth
  - Effects not driven by large hub cities

Thank you!

Remaining Endogeneity Issues?

In progress…

- Instrumental Variables (2SLS) estimation
- Instruments:
  - (Air Passengers / Population) * (Post-Deregulation)
  - (Minimum Distance to Large MSA) * (Post-Deregulation)
  - (MSA size category) * (Post-Deregulation)
- Preliminary results:
  - Same results qualitatively
  - If anything, 2SLS estimates are larger