Is terrorism eroding agglomeration economies in Central Business Districts?

Lessons from the office real estate market in downtown Chicago

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Journal of Urban Economics, 2008

presented by

Federico Curci

September 30, 2014

Introduction

Research question

- Has the increased in perception terrorist risk after 9/11 any effect on the office real estate market in downtown Chicago?
- Can economic activity in CBD be influenced by changes in perceived level of terrorism?

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Motivation

- Terrorism more prevalent in cities than rural areas (Savitch and Ardashev, 2001)
  - Target-rich environments
  - High density
  - Communication nodes
  - Presence antagonistic groups

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  - Data sources expansive and difficult to access
  - True magnitude can be observed after prolonged adjustment period

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- Limited amount evidence effect terrorism on cities
  - Data sources expansive and difficult to access
  - True magnitude can be observed after prolonged adjustment period
- Ambiguous effect increase perception of terrorist risk on agglomeration and location decision
  - Negative effect might be compensated through prices without any effect on vacancies (Abadie and Dermisi, 2006)
  - Long-run effects through reduction construction new tall buildings or reduction density in CBD (not considered)

- Effect of terrorism/conflict on economic activity
  - Negative effect on GDP (10 %) of Basque Terrorism in Euskadi (Abadie and Gardeazabal, 2003)
  - Possible channel: destruction productive capital, level of fear and uncertainty

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- Effect of warfare on urban form (Glaeser and Shapiro, 2002)
  - Four influence channels: safe harbors, target effect, cost of transportation, actual destruction of buildings
  - No effect on population growth of Jerusalem (compared with Tel Aviv) of Palestinian conflict and in London because of IRA
  - Positive effect on population growth of Paris, London, Berlin of WWI and negative of WWII
  - Small effect 1968-1977 terrorism on urbanization and not on height tall buildings

Effect of 9/11

- Effect on NY of 9/11: 44% of Manhattan's Downtown Class A space destroyed, 83 billion lost in output, wages, business closing, spending reductions (Eisinger, 2004)
- Increase in security costs from 49 cents per square foot in 2001 to 55 cents in 2003 (Chapman, 2004), lower security costs for firms outside urban centers
- Qualitative prediction: increase insurance costs tall buildings, possible deter construction new buildings, lower rents, dispersal and sprawl (Mills, 2002)
- No direct evidence effect terrorism on cities, CDB and agglomeration, and no identification of perceived risk of terrorism after 9/11

Contribution

- Estimation of effect of increase perceived risk on agglomeration using panel-data techniques

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- Estimation of effect of increase perceived risk on agglomeration using panel-data techniques
- Database: disaggregated at building level (242 buildings) on quarterly basis (1996-2006)
  - Variables: X-Y coordinates, building height, rentable building area, submarket, vacancy rates, gross rates
  - Usually not accessible data
  - Possible to have enough time to see adjustment period

Empirical strategy

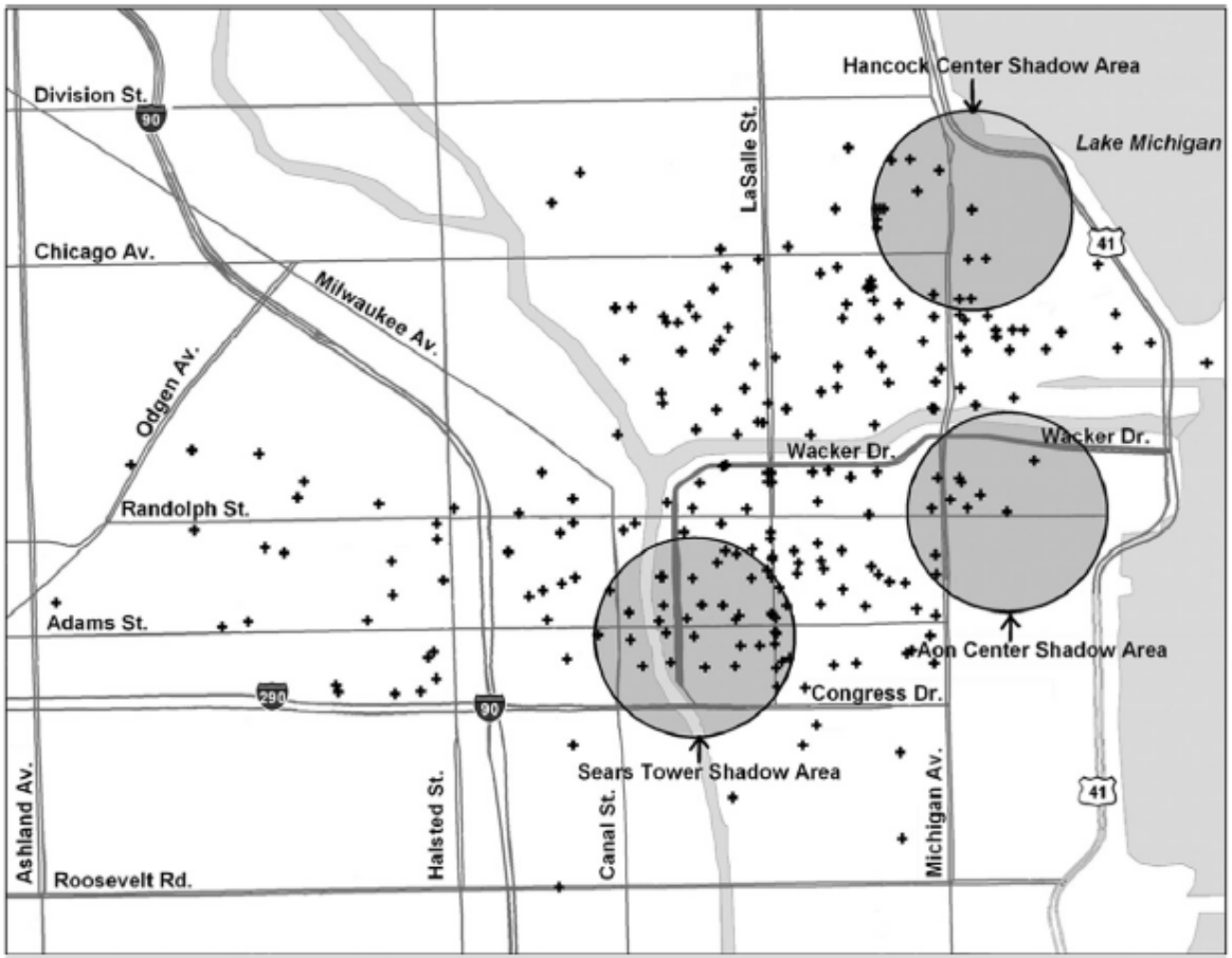
Sample

Focus on Chicago

- Possible distinguish between actual destruction and perception risk effect
- Willis (Sears) tower has become tallest skyscraper in U.S. after 9/11
- Three "‘anchor"’ buildings: Sears Tower (527 m), Aon Center (362 m), Hancock Center (456 m)

Empirical strategy

Sample



Crosses represent Class A and Class B office buildings in Chicago's Central Business District. Shaded circles represent 0.3-mile radius "shadow areas" surrounding the three main Chicago landmark buildings: the Aon Center, the Hancock Center, and the Sears Tower.

Fig. 1. Chicago's Central Business District office buildings and shadow areas.

Empirical strategy

Compare evolution vacancy rates at three main landmark buildings and nearby offices ("'shadow area"') with offices located in other areas ("'non-shadow area"')

- Shadow area: buildings located at <0.3 miles from landmark building
- Focus on vacancy rate as informative of degree of spatial agglomeration instead of rents
  - Scarce and subjective information on rents
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Use panel data fixed-effects: control unmeasured characteristics of each individual buildings

Empirical strategy

Specifications

Basic regression: fixed effect estimator

- $\text{vacancy rate}_{it} = \alpha(\text{shadow}_i \, x \, \text{post-9/11}_t) + f_t + \eta_i + \varepsilon_{it}$
- Identification assumption: in absence of 9/11 shadow and non-shadow areas would have experienced similar office real estate market trends
- Possible bias: if office tenants moved from shadow areas in Chicago to non-shadow areas in Chicago
  - Bias would enhance statistical power of test for hypothesis of no effect ($\alpha = 0$)
  - Two possible effects of terrorism (negative in shadow areas and positive outside) + possible attenuation bias (if little substitution and negative impact in non-shadow areas because of overall economic conditions)

Empirical strategy

Specifications

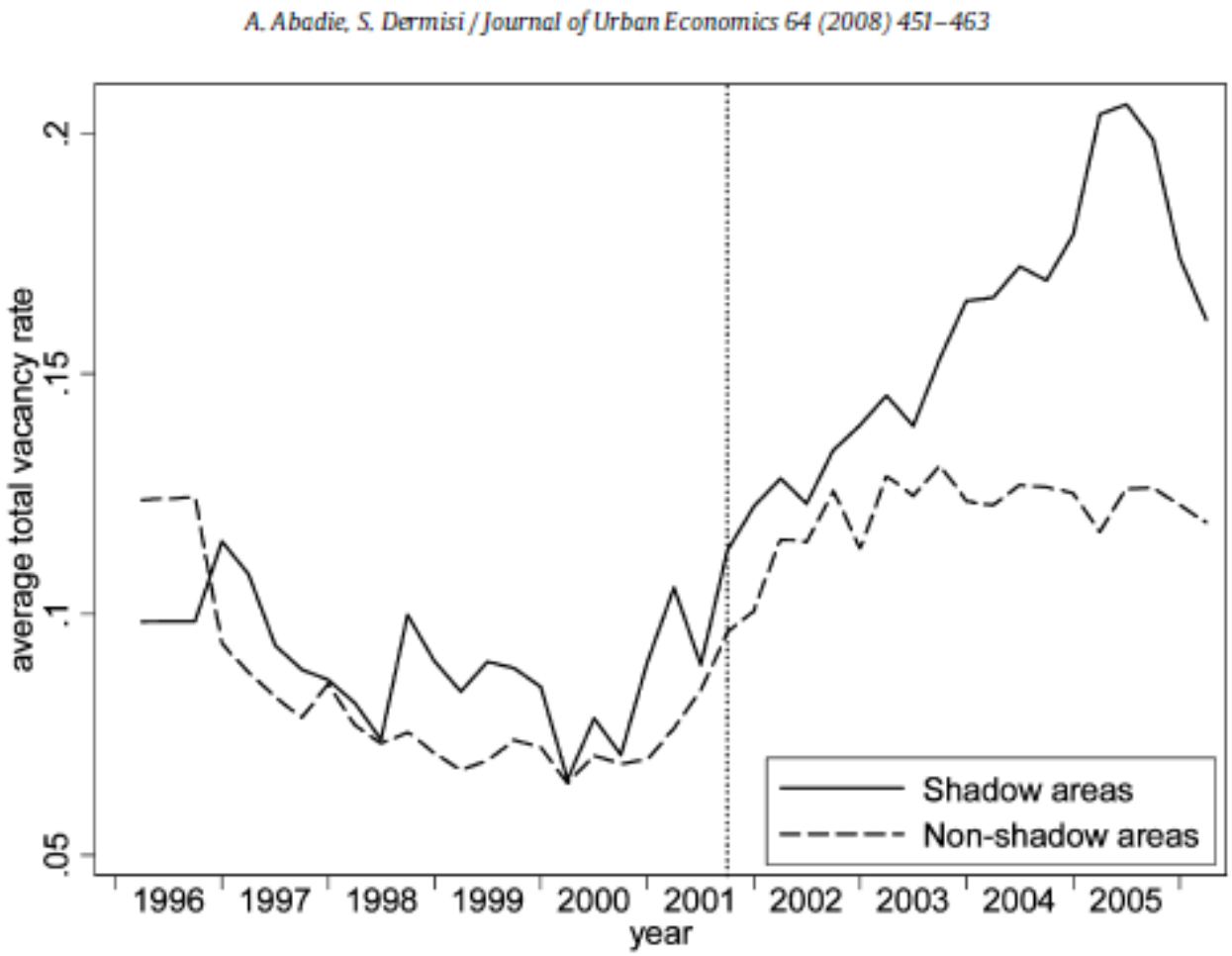
Dose-response design

- $\text{vacancy rate}_{it} = \alpha(\text{distance to anchor}_i \; x \, \text{post-9/11}_t) + f_t + \eta_i + \varepsilon_{it}$
- $\text{vacancy rate}_{it} =$
  $\alpha(\text{distance to non-shadow area}_i \; x \, \text{post-9/11}_t) + f_t + \eta_i + \varepsilon_{it}$
- $\text{vacancy rate}_{it} = \alpha(\text{height}_i \; x \, \text{post-9/11}_t) + f_t + \eta_i + \varepsilon_{it}$

Results

Descriptive statistics

Vacancy rates in shadow and non-shadow areas evolved very similar before 9/11 and take different behaviours after 9/11 attacks



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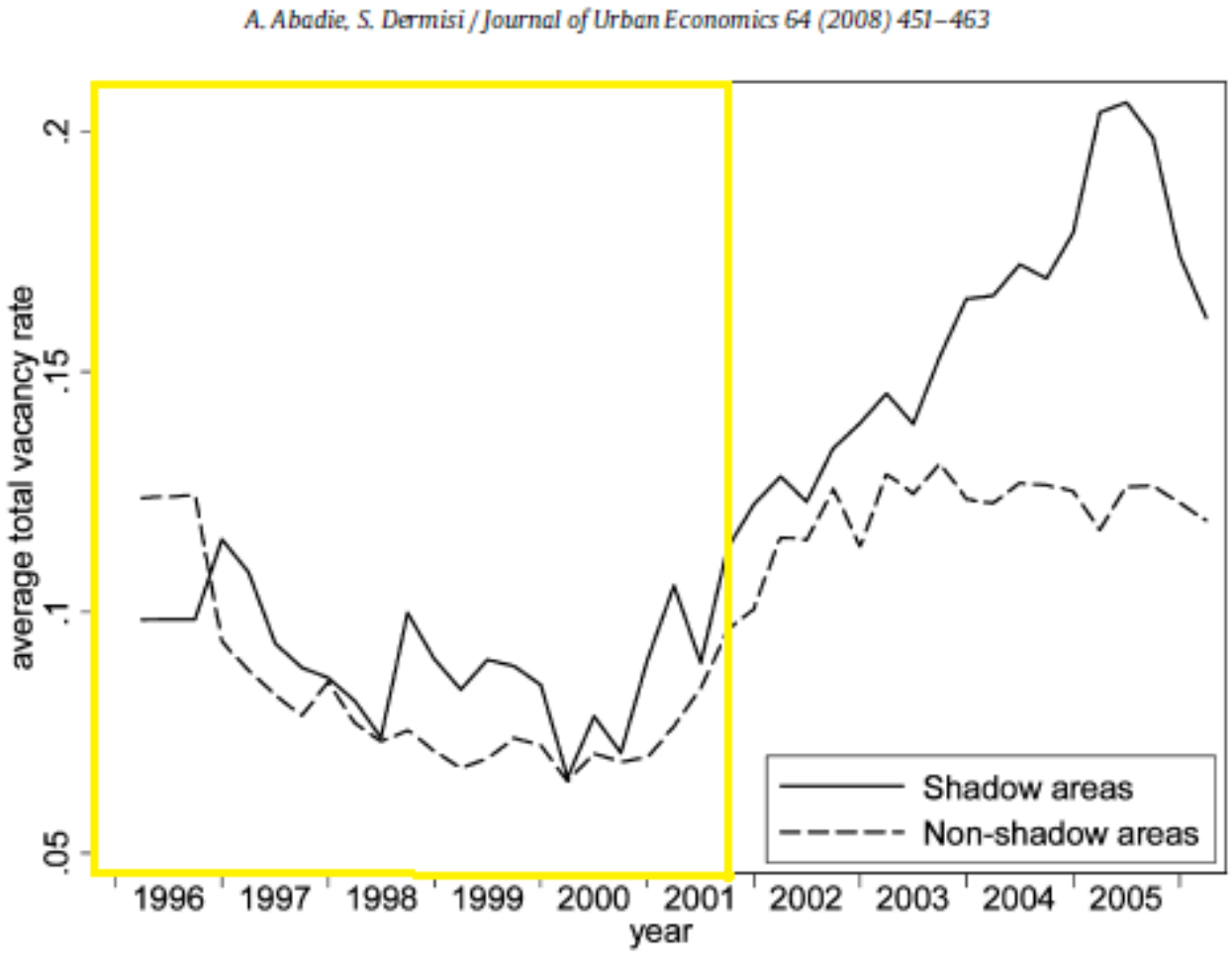

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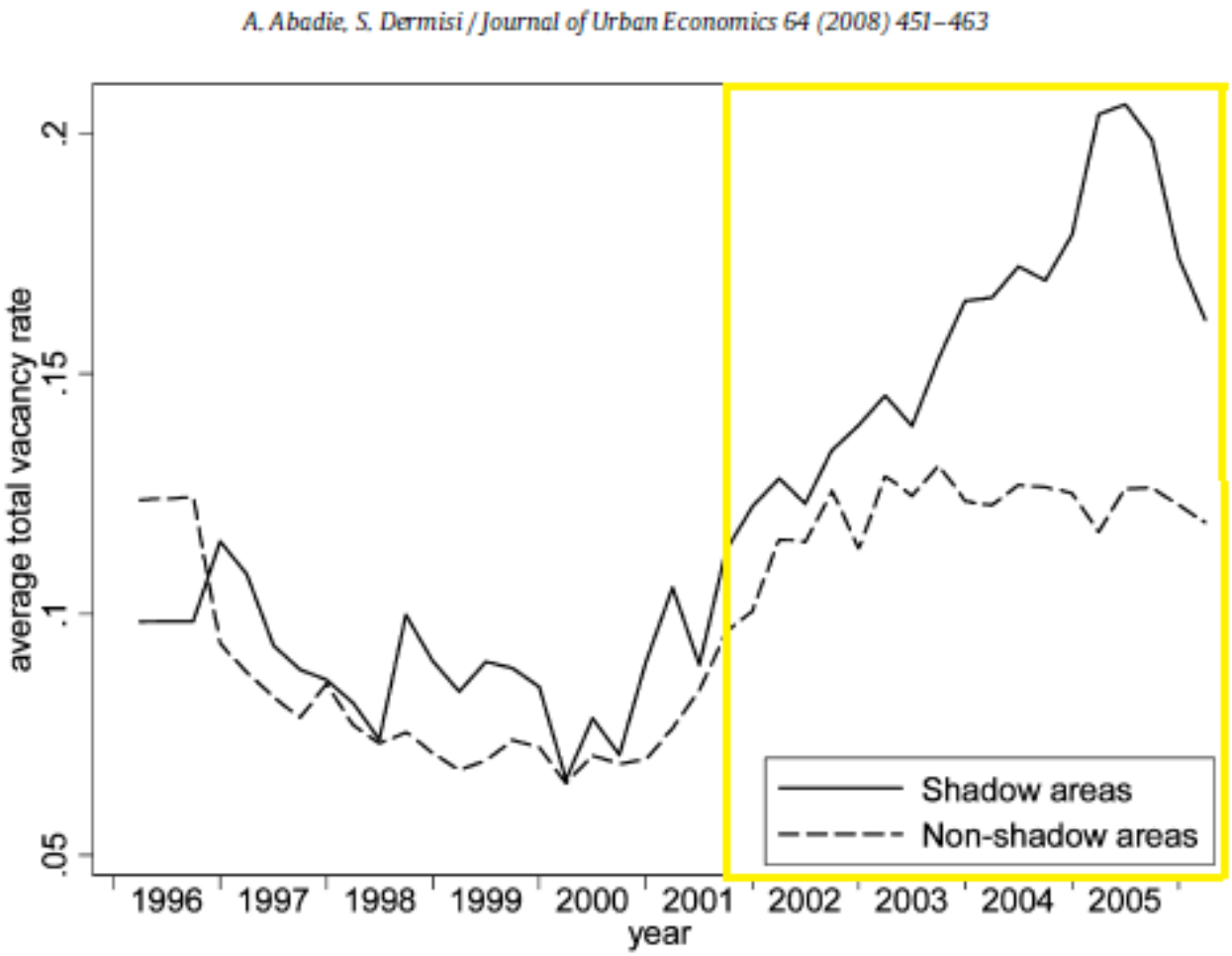

Results

Descriptive statistics

Decrease in average rent difference between shadow and non-shadow areas

Table 1
Descriptive statistics—means and standard deviations (Class A and B office buildings in downtown Chicago)

	(1) Entire sample	(2) Inside shadow areas	(3) Outside shadow areas	(4) Diff. (2)–(3) (s.e.)
Characteristics of the buildings:				
shadow (=1 if in shadow area, =0 otherwise)	.27			
	[.45]			
Class A (=1 if Class A building, =0 if Class B building)	.21	.44	.13	.31**
	[.41]	[.50]	[.34]	(.07)
distance to anchor (miles)	.46	.19	.56	−.38**
	[.26]	[.08]	[.24]	(.02)
height (hundred feet)	2.76	4.43	2.14	2.29**
	[2.46]	[2.90]	[1.94]	(.39)
number of stories	19.77	32.59	14.96	17.63**
	[18.80]	[21.67]	[15.08]	(2.90)
rentable building area (sq. feet)	353,683	665,705	236,675	429,031**
	[499,847]	[604,842]	[397,123]	(80,243)
Vacancy rates (fraction):				
First quarter of 2001	.0803	.0901	.0699	.0202
	[.0949]	[.0903]	[.0989]	(.0174)
First quarter of 2006	.1491	.1740	.1228	.0512**
	[.1306]	[.1302]	[.1266]	(.0248)
Rent per square foot (current USD):				
First quarter of 2001	30.40	32.22	28.08	4.14**
	[5.43]	[5.59]	[4.25]	(1.23)
First quarter of 2006	28.08	29.09	26.78	2.31*
	[5.97]	[5.30]	[6.54]	(1.28)
Number of buildings in the sample	242	66	176	

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Table 2
9/11 and vacancy rates in downtown Chicago Office Buildings (fixed-effects estimates with clustered standard errors, 1996–2006)

Dependent variable: Building vacancy rate				
	(1)	(2)	(3)	(4)
shadow area×post-9/11	.0303*			
	(.0166)			
distance to anchor×post-9/11		−.0617*		
		(.0362)		
distance to non-shadow area×post-9/11			.2302**	
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height×post-9/11				.0052**
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R-squared	.39	.39	.39	.39
Number of observations	9922	9922	9922	9922

Note: The sample is a quarterly panel of Class A and Class B office buildings in the extended Chicago Central Business District between the second quarter of 1996 and the second quarter of 2006. See text of the article for the exact limits of the area of the City of Chicago included in our sample. Observations are weighted by the rentable area of the buildings. All specifications include building fixed effects and a full set of year×quarter dummies. Standard errors (in parentheses) are clustered at the building level.

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Vacancy rate increase in shadow areas is 3 percentage points higher than buildings outside shadow area

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Additional mile to closest anchor building leads to 6.17 percentage point lower change in vacancy rate after 9/11

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Additional 0.1-mile to closest anchor building lead to a 2.3 percentage point lower increase in vacancy rate

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Increase of 1000 feet in building height is associated to a 5.2 percentage point higher change in vacancy rate

Robustness checks

- Effect not instantaneous but cumulative in time Table
  - Introduction interaction shadow*quarters since 9/11
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- Control for possible increase in supply of office space in shadow areas Figure
  - Post-9/11 non-shadow areas experience a higher increase in total rentable building area

Robustness checks

Effect of recessionary period of 2001

- Bias if 2001 recession has a more pronounced effect on tall buildings (which are more present in shadow-areas)
- Gap in vacancy rates open rapidly between 2003 and 2005 (output growth periods)
- Exclude class B buildings
- Consider sub-sample high-rise buildings (at least 115 feet or 12 floor high)
- Consider submarket-specific trends

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- Results obtained using panel-data techniques and a database at building-level
- Results are robust to a battery of robustness analysis
- Terrorism can provide an exogeneous variation that affect urban economy and form
- Policy implication: perceived risk of terrorism (and not just actual terrorism) can be detrimental to urban agglomeration and agglomeration economies

Cumulative effect terrorism

Table 3
Time since 9/11 and vacancy rates in downtown Chicago Office Buildings (fixed-effects estimates with clustered standard errors, 1996–2006)

Dependent variable: Building vacancy rate				
	(1)	(2)	(3)	(4)
shadow area×post-9/11	−.0046			
	(.0173)			
shadow area×quarters since 9/11	.0037**			
	(.0017)			
distance to anchor×post-9/11		.0156		
		(.0379)		
distance to anchor×quarters since 9/11		−.0081**		
		(.0039)		
distance to non-shadow area×post-9/11			.0614	
			(.0639)	
distance to non-shadow area×quarters since 9/11			.0178**	
			(.0060)	
height×post-9/11				−.0003
				(.0022)
height×quarters since 9/11				.0006**
				(.0002)
R-squared	.39	.39	.39	.39
Number of observations	9922	9922	9922	9922

Note: The sample is a quarterly panel of Class A and Class B office buildings in the extended Chicago Central Business District between the second quarter of 1996 and the second quarter of 2006. See text of the article for the exact limits of the area of the City of Chicago included in our sample. Observations are weighted by the rentable area of the buildings. All specifications include building fixed effects and a full set of year×quarter dummies. Standard errors (in parentheses) are clustered at the building level.
** Statistical significance at the 5% level.

Back to Robustness.

Evolution vacancy rates

Table 4
Post-9/11 years and vacancy rates in downtown Chicago Office Buildings (fixed-effects estimates with clustered standard errors, 1996–2006)

Dependent variable: Building vacancy rate

	Post-9/11 exposure to terrorism			
	shadow area	distance to anchor	distance to non-shadow area	height
	(1)	(2)	(3)	(4)
exposure×year 2002	.0048	−.0125	.0966*	.0025
	(.0143)	(.0287)	(.0579)	(.0016)
exposure×year 2003	.0118	−.0153	.1602**	.0030
	(.0175)	(.0428)	(.0688)	(.0026)
exposure×year 2004	.0354*	−.0677	.2570**	.0033
	(.0208)	(.0463)	(.0799)	(.0030)
exposure×year 2005	.0652**	−.1360**	.3791**	.0091**
	(.0251)	(.0542)	(.0910)	(.0032)
exposure×year 2006	.0387	−.0924*	.2858**	.0114**
	(.0246)	(.0560)	(.1027)	(.0036)
R-squared	.39	.39	.39	.39
Number of observations	9922	9922	9922	9922

Note: The sample is a quarterly panel of Class A and Class B office buildings in the extended Chicago Central Business District between the second quarter of 1996 and the second quarter of 2006. See text of the article for the exact limits of the area of the City of Chicago included in our sample. Observations are weighted by the rentable area of the buildings. All specifications include building fixed effects and a full set of year×quarter dummies. Standard errors (in parentheses) are clustered at the building level.

* Statistical significance at the 10% level.

** Idem, 5%.

Back to Robustness.

Trends vacancy rates do not depend on proxy variables

Table 5
Regressions using pre-9/11 data only (fixed-effects estimates with clustered standard errors, 1996–2001)

Dependent variable: Building vacancy rate				
	(1)	(2)	(3)	(4)
shadow area×after 1998	.0120			
	(.0165)			
distance to anchor×after 1998		−.0313		
		(.0370)		
distance to non-shadow area×after 1998			.1017	
			(.0839)	
height×after 1998				.0026
				(.0025)
R-squared	.48	.48	.48	.48
Number of observations	5324	5324	5324	5324

Note: The sample is a quarterly panel of Class A and Class B office buildings in the extended Chicago Central Business District between the second quarter of 1996 and the third quarter of 2001. See text of the article for the exact limits of the area of the City of Chicago included in our sample. Observations are weighted by the rentable area of the buildings. All specifications include building fixed effects and a full set of year×quarter dummies. Standard errors (in parentheses) are clustered at the building level.

Back to Robustness.

Permutation distributions

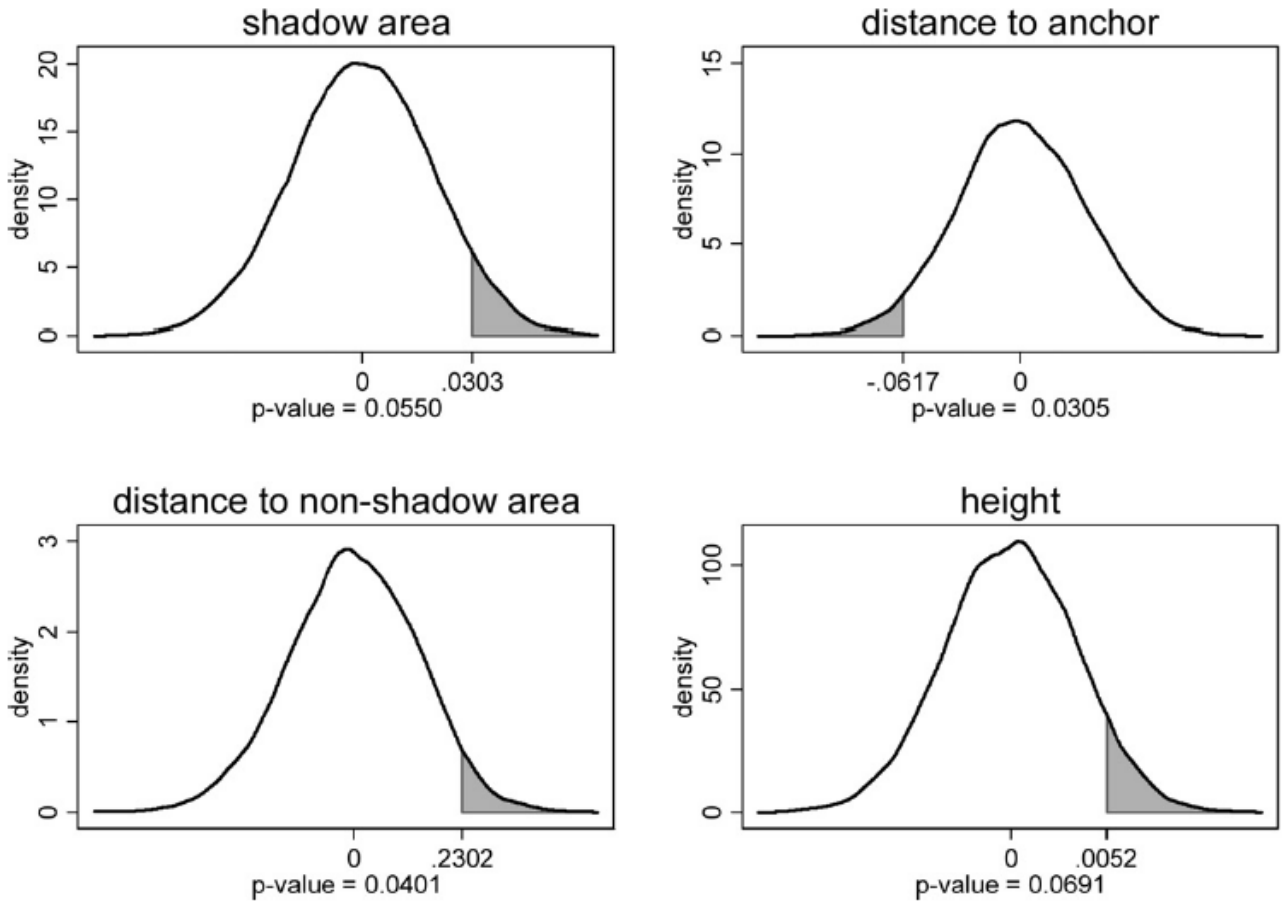

Fig. 3. Permutation distributions and *p*-values.

Back to Robustness.

Evolution rentable areas

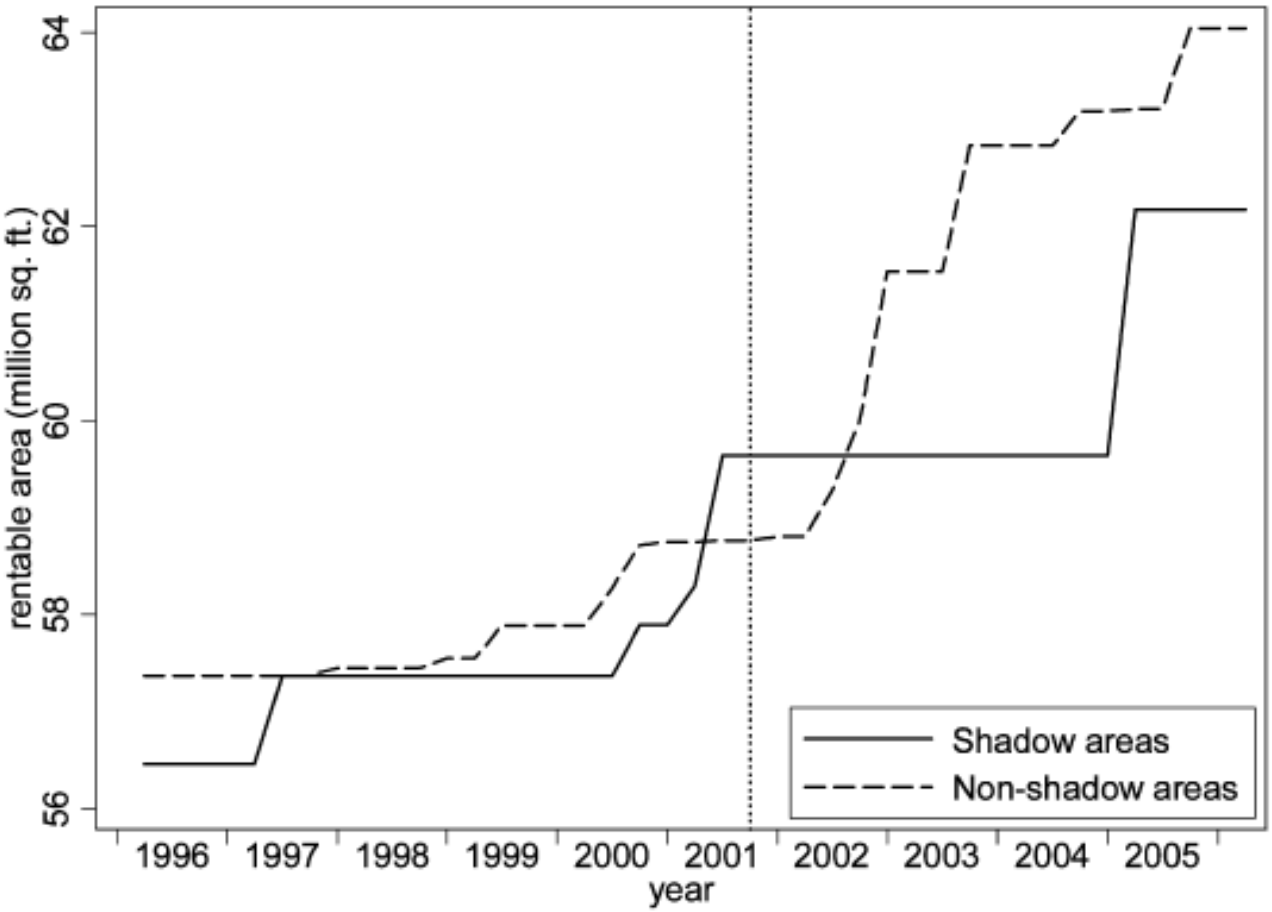

Fig. 4. Total rentable areas in shadow and non-shadow areas.

Back to Robustness.