Neighborhood Effects: Evidence from Wartime Destruction in London

Stephen J. Redding
Princeton University, NBER and CEPR

Daniel M. Sturm
London School of Economics and CEPR

Motivation

- What explains the large observed differences in house prices and socioeconomic outcomes across neighborhoods?
  - Fundamentals:
    - Green areas and scenic views in a location $\Rightarrow$ house prices are bid up until only the rich can afford to live there
  - Neighborhood effects:
    - Individual behavior influenced by the surrounding characteristics of the neighborhood (people or other neighborhood characteristics)

Motivation

- What explains the large observed differences in house prices and socioeconomic outcomes across neighborhoods?
  - Fundamentals:
    - Green areas and scenic views in a location $\Rightarrow$ house prices are bid up until only the rich can afford to live there
  - Neighborhood effects:
    - Individual behavior influenced by the surrounding characteristics of the neighborhood (people or other neighborhood characteristics)
- We use the German bombing of London during WWII as a natural experiment to provide evidence on these explanations
  1. Exogenous shock: uncorrelated with pre-war location characteristics within 1 km geographical grid cells
  2. Long-lasting direct effect: on economic outcomes, because reconstruction mainly occurred through council (social) housing
  3. Long-lasting spillover effect: on surrounding unbombed locations
  4. Quantitative urban model: heterogeneous groups of individuals endogenously sort across locations in response to differences in natural advantages, wartime destruction and neighborhood effects

This Paper

- Reduced-form evidence that wartime destruction has statistically significant and economically-relevant long-run effects
  - Complete destruction in a Census 2001 Output Area $\Rightarrow$ share of high-income residents falls by 4 % points, share of low-income residents rises by 6 % points, property values decline by 11-18 %
- Develop our quantitative urban model to estimate the direct and spillover effects of wartime destruction on residential amenities
  - Wartime destruction changes relative amenities through the construction of council housing in bombed locations
  - In the presence of neighborhood effects, this change in relative amenities spills over to surrounding unbombed locations
  - Quantify using a general specification of neighborhood effects and a parameterization as preferences over socioeconomic composition
- Use our estimated model to undertake counterfactuals to evaluate the general equilibrium implications of neighborhood effects
  - Substantially magnify the impact of wartime destruction
  - Make a major contribution to observed differences in socioeconomic outcomes in counterfactual scenarios without war destruction

Related Literature

- Economic Geography and Urban Economics
  - Fujita et al. (1999), Redding & Sturm (2008), Allen & Arkolakis (2014), Desmet & Rossi-Hansberg (2014), Ahlfeldt et al. (2015), Redding & Rossi-Hansberg (2017), Caliendo et al. (2018), Gaubert (2018), Monte et al. (2018), Davis & Dingel (2019), Fajgelbaum et al. (2019), Fajgelbaum & Gaubert (2020), Heblich et al. (2020), Owens et al. (2020), Dingel & Tintelnot (2021), Eckert & Kleineberg (2021), Allen & Donaldson (2022), Allen et al. (2022), Tsivanidis (2022), Gechter & Tsivanidis (2023), Almagro et al. (2023), Monte et al. (2023)
- Neighborhood Effects and Spillovers
  - Wilson (1990), Benabou (1993), Overman (2002), Fernandez (2003), Duranton & Puga (2004), Moretti (2004), Rosenthal & Strange (2004), Ellison et al. (2010), Glaeser (2010), Rossi-Hansberg et al. (2010), Autor et. al (2012), Ioannides (2012), Sampson (2013), Kline & Moretti (2014), Field (2015), Galiani et al. (2015), Bayer et al. (2016), Chetty & Hendry (2018), Davis et al. (2019), Diamond & McQuade (2019), Fogli & Guerrieri (2019), Ambrus et al. (2020), Chetty et al. (2020), Blanco (2021), Chyn & Katz (2021), Bayer et al. (2022), Guennewig-Moenert (2023), Almagro et al. (2024), Bergman et al. (2023), Couture et al. (2023)
- Natural Experiments and the Location of Economic Activity
  - Davis & Weinstein (2002, 2008), Brakman et al. (2004), Bosker et al. (2008), Redding & Sturm (2008), Dell (2010), Redding et al. (2010), Miguel & Roland (2011), Bleakley & Lin (2012), Hornbeck (2012), Koster et al. (2012), Siodla (2015), Kline & Moretti (2014), Villarreal (2015), Dericks & Koster (2017), Hornbeck & Keniston (2017), Lowes et al. (2017), Dell & Querubin (2018), Kappner (2018), Lee & Lin (2018), Harada et al. (2022), Michaels & Rauch (2018), Takeda & Yamagishi (2022), Fetzer (2023)

Outline

- Historical Background
- Data
- Reduced-form Evidence
- Theoretical Model
- Quantitative Analysis
- Conclusions

Historical Background

- Rich spatially-disaggregated data on socioeconomic status in London
  - Hubert Llewellyn-Smith, *New Survey of London Life and Labor*, 1928-31
  - Classify streets by socioeconomic status of residents (by income)

Historical Background

- Rich spatially-disaggregated data on socioeconomic status in London
  - Hubert Llewellyn-Smith, *New Survey of London Life and Labor*, 1928-31
  - Classify streets by socioeconomic status of residents (by income)
- London experienced heavy bombing during WWII
  - Initial German attacks on Royal Air Force ("Battle of Britain")
  - Switch to strategic bombing of London ("Blitz" from Sept 1940-May 1941)
  - Heavy daylight losses led to largely night bombing from Oct 1940
  - Bombing sharply reduced after German invasion of USSR in June 1941
  - From June 1944-May 1945, London targeted by long-range missiles: V1 (cruise missile) and V2 (ballistic missile)

Historical Background

- Rich spatially-disaggregated data on socioeconomic status in London
  - Hubert Llewellyn-Smith, *New Survey of London Life and Labor*, 1928-31
  - Classify streets by socioeconomic status of residents (by income)
- London experienced heavy bombing during WWII
  - Initial German attacks on Royal Air Force ("Battle of Britain")
  - Switch to strategic bombing of London ("Blitz" from Sept 1940-May 1941)
  - Heavy daylight losses led to largely night bombing from Oct 1940
  - Bombing sharply reduced after German invasion of USSR in June 1941
  - From June 1944-May 1945, London targeted by long-range missiles: V1 (cruise missile) and V2 (ballistic missile)
- London County Council (LCC) recorded wartime damage to individual buildings using 1:2,500 OS maps
  - Monitor destruction and manage public services in response
  - Wartime redevelopment plans, but financial burden of war debt, shortages and urgent need for housing meant that most not implemented
  - Over 80 percent of all new housing units constructed in the LCC area from 1945-1980 were council housing

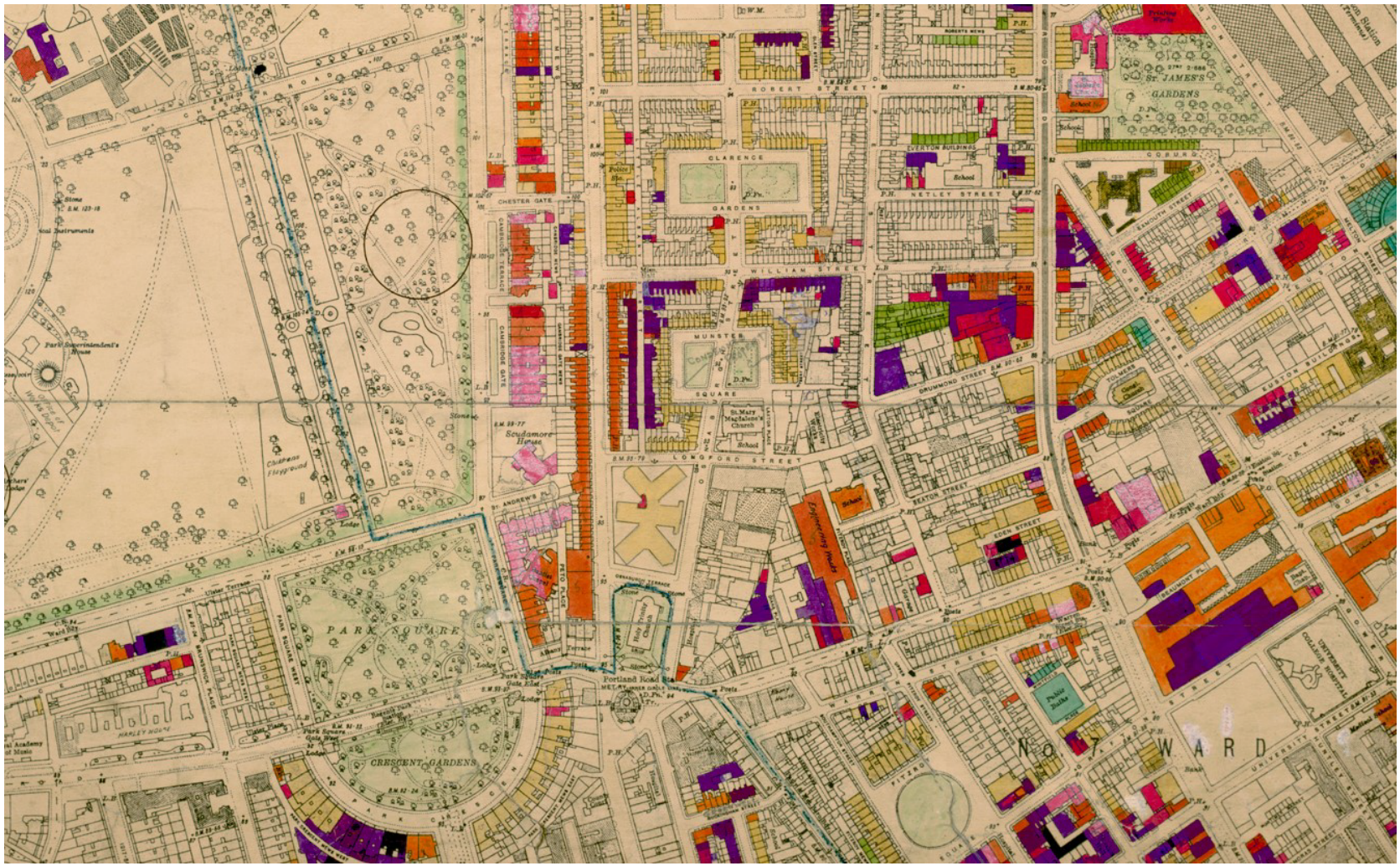
Outline

- Historical Background
- Data
- Reduced-form Evidence
- Theoretical Model
- Quantitative Analysis
- Conclusions

Data

- New spatially-disaggregated dataset for pre and post-war periods
  - LCC administrative area, $300 km^2$, 4.4 million in 1931
  - Spatial units: 9,041 Output Areas, target size 125 households
  - Long-run impact: 1930s and 2001 (first post-war population census to report socioeconomic composition by Output Area)
- LCC Bomb Damage Maps
  - Building footprints and pre-war built-up area
  - Damage to buildings (from minor blast damage to total destruction)
- Property values
  - LCC valuation list 1936, 50,000 pages, >1 million properties, digitized, geolocated and matched to individual building footprints
  - Property transactions data 1995-2020
- Population from 1931, 2001 and 2011 Censuses
- Socioeconomic composition
  - NSOL 1930 socioeconomic status by street, matched to buildings
  - Socioeconomic composition 2001 and 2011
  - Residents of social housing 1980, 2001 and 2011
- Transport network: Over and underground rail, buses, and trams

LCC Bomb Damage Maps

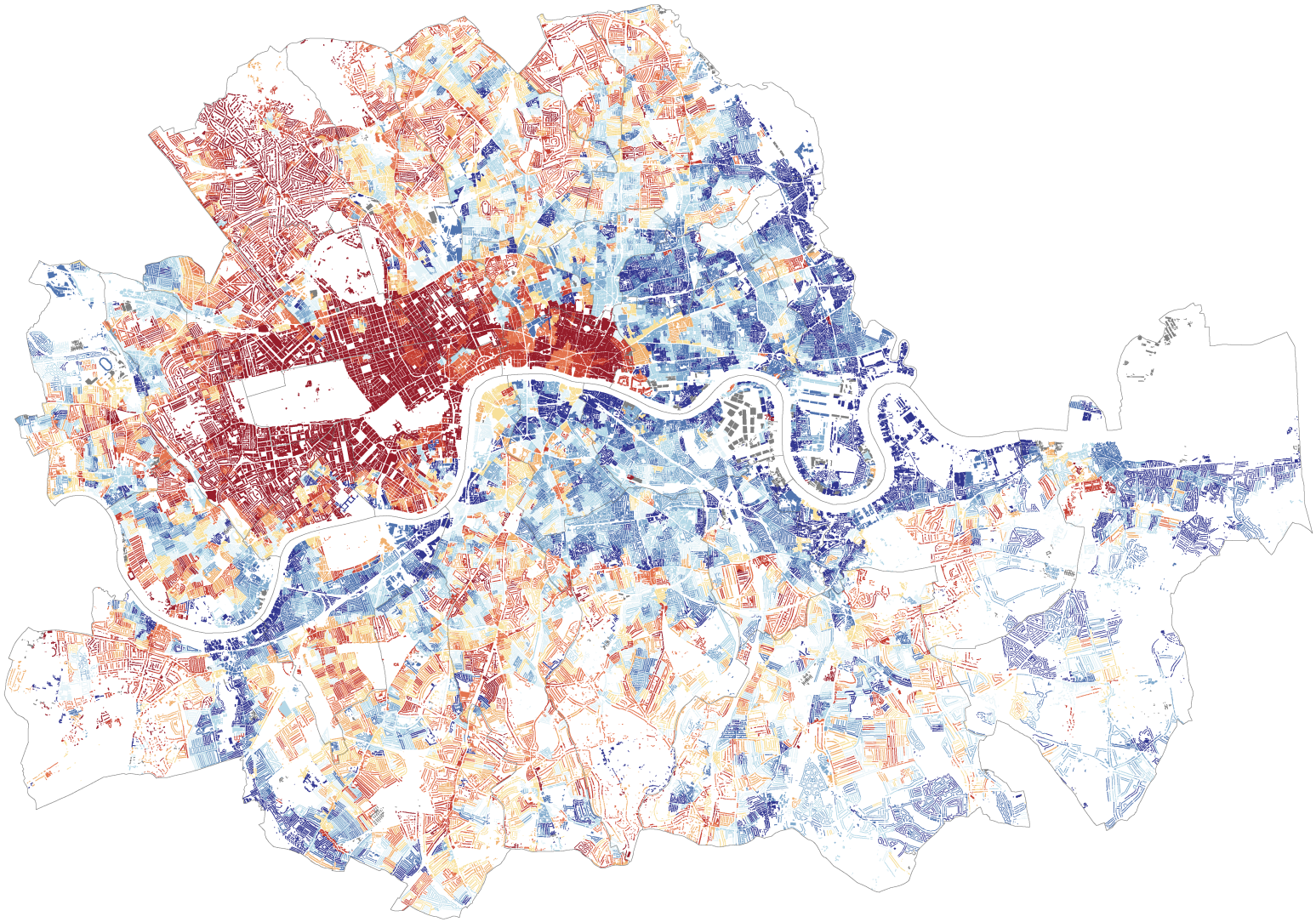


Notes: minor blast damage (yellow); general blast damage (orange); seriously damaged but repairable at cost (light red); seriously damaged and doubtful if repairable (dark red); damaged beyond repair (purple); and total destruction (black); large black circle in Regent's Park shows a V-1 missile impact; 40 percent pre-war built-up area some damage (yellow above); 20 percent serious damage (red above)

Wartime Destruction in LCC Area

Notes: minor blast damage (yellow); general blast damage (orange); seriously damaged but repairable at cost (light red); seriously damaged and doubtful if repairable (dark red); damaged beyond repair (purple); total destruction (black); 40 percent some damage (yellow above); 20 percent serious damage (red above)

Pre-War Property Values by Output Area



Notes: Property values in 1936 based on the market rental value for tax purposes. The property values are the Output Area fixed effects from a hedonic regression of the logarithm of rateable values on observed property characteristics. Red denotes high values; blue denotes low values.

Outline

- Historical Background
- Data
- Reduced-form Evidence
- Theoretical Model
- Quantitative Analysis
- Conclusions

Bombing Regressions

- Randomization Check

$$Y_{i,\text{Pre-War}} = \beta D_{i,\text{War}} + \varrho_k + u_i$$

- Causal Impact of Bombing

$$Y_{i,\text{Post-War}} = \beta D_{i,\text{War}} + \varrho_k + u_i$$

- Spillover Impact of Bombing

$$Y_{i,\text{Post-War}} = \beta D_{i,\text{War}} + \sum_{g=1}^{G} \gamma_g D_{ig,\text{War}} + \varrho_k + u_i$$

- i are Output Areas and ϱ_k are fixed effects for hexagonal grid cells
- g are grid cells for 100 meter buffers and u_i is stochastic error
- Standard errors clustered by hexagonal grid cells
- Robustness using Conley (HAC) standard errors

Pre-war Randomization Check

Fixed Effects	(1) Fraction High Status	(2) Fraction Middle Status	(3) Fraction Low Status	(4) Socio-Economic Index	(5) Log of Property Value	(6) Log of Property Value
None	-0.235^{***}	0.039^{*}	0.196^{***}	-0.215^{***}	-0.473^{***}	-0.481^{***}
	(0.031)	(0.023)	(0.025)	(0.026)	(0.057)	(0.066)
4 km Hexagons	-0.061^{***}	0.020	0.042^{**}	-0.051^{***}	-0.094^{**}	-0.094^{**}
	(0.020)	(0.018)	(0.017)	(0.016)	(0.041)	(0.044)
1 km Hexagons	−0.007	−0.004	0.011	−0.009	−0.017	−0.024
	(0.014)	(0.013)	(0.012)	(0.012)	(0.033)	(0.033)

Post-war Direct Effect of Bombing

	(1) Fraction High Status	(2) Fraction Middle Status	(3) Fraction Low Status	(4) Socio-Economic Index	(5) Log of Property Value	(6) Log of Property Value
All Damage	−0.039***	−0.023***	0.062***	−0.051***	−0.175***	−0.113***
	(0.006)	(0.005)	(0.009)	(0.007)	(0.022)	(0.018)
Hexagon Fixed Effects	1 km	1 km	1 km	1 km	1 km	1 km
Observations	8912	8912	8912	8912	8112	8112
R-squared	0.505	0.280	0.439	0.483	0.658	0.799

- Wartime destruction negative causal impact on post-war economic outcomes within 1km hexagons

Post-war Spillover Effects of Bombing

	Socio-Economic Index		Log of Property Value		Log of Property Value	
	(1)	(2)	(3)	(4)	(5)	(6)
Destruction in own area	−0.051***	−0.042***	−0.175***	−0.157***	−0.113***	−0.097***
	(0.007)	(0.007)	(0.022)	(0.022)	(0.018)	(0.017)
Destruction in 100m buffer		−0.030**		−0.080*		−0.070*
		(0.013)		(0.045)		(0.038)
Destruction in 200m buffer		−0.026		−0.130**		−0.110**
		(0.018)		(0.059)		(0.047)
Destruction in 300m buffer		−0.026		−0.094		−0.100*
		(0.019)		(0.064)		(0.054)
Destruction in 400m buffer		0.004		−0.085		−0.063
		(0.023)		(0.076)		(0.061)
Destruction in 500m buffer		0.001		−0.011		−0.024
		(0.023)		(0.077)		(0.070)
Hexagon Fixed Effects	1 km	1 km	1 km	1 km	1 km	1 km
Observations	8912	8909	8112	8109	8112	8109
R-squared	0.483	0.485	0.658	0.659	0.799	0.800

- Negative and localized impacts of neighbors' wartime destruction on post-war outcomes within 1km hexagons

Mechanisms

	(1) Fraction Buildings Surviving	(2) Log of Height of Buildings	(3) Fraction Land Area Built-Up	(4) Fraction Council in 2001	(5) Fraction Council in 1981	(6) Log of Empl. Density
Destruction in Own Area	−0.301***	0.079***	−0.041***	0.135***	0.246***	−0.209***
	(0.023)	(0.019)	(0.005)	(0.017)	(0.030)	(0.064)
Destruction in 100m Buffer	0.018	−0.017	0.005	0.028	0.035	−0.004
	(0.043)	(0.039)	(0.012)	(0.034)	(0.059)	(0.129)
Destruction in 200m Buffer	0.052	0.037	0.007	0.031	0.072	0.156
	(0.053)	(0.053)	(0.015)	(0.047)	(0.077)	(0.160)
Destruction in 300m Buffer	−0.044	−0.070	0.020	−0.016	0.035	0.098
	(0.059)	(0.052)	(0.017)	(0.045)	(0.080)	(0.172)
Destruction in 400m Buffer	0.163**	−0.164**	0.015	−0.075	−0.204**	0.032
	(0.065)	(0.066)	(0.018)	(0.050)	(0.088)	(0.202)
Destruction in 500m Buffer	−0.077	0.082	0.017	0.014	0.003	0.236
	(0.068)	(0.071)	(0.020)	(0.057)	(0.101)	(0.210)
Hexagon Fixed Effects	1 km	1 km	1 km	1 km	1 km	1 km
Observations	8909	8909	8909	8909	6697	8909
R-squared	0.407	0.473	0.464	0.396	0.444	0.479

- Own, but not neighbors' destruction, affects building structures and share of households in social housing
  - Suggests spillover effects not driven by correlated rebuilding
  - Consistent with spillovers from neighborhood effects
- Own destruction if anything shifts economic activity away from commercial use

Outline

- Historical Background
- Data
- Reduced-form Evidence
- Theoretical Model
- Quantitative Analysis
- Conclusions

Model Setup

- We consider a city (London) in a wider economy (Britain)
- City consists of a discrete set of locations $n, i \in \mathbb{N}$
- Two types of agents: workers and landlords
- Workers belong to one of three types (occupations) that are imperfect substitutes in production: $o \in \{Low, Mid, High\}$
- Utility depends on amenities, consumption of the final good and floor space, commuting costs and idiosyncratic preference shocks
- Amenities depend on own and neighboring location characteristics (location fundamentals and wartime destruction)
- Firms use labor and floor space to produce a freely-traded final good
- Productivity depends on own and neighboring location characteristics (location fundamentals and wartime destruction)
- Wartime destruction changes relative amenities through the construction of social housing in bombed locations
- In the presence of neighborhood effects, this change in relative amenities spills over to unbombed locations

Spatial Sorting

- Probabilistic sorting across residence-workplace pairs

$$\lambda_{nit}^{o} = \frac{E_{nit}^{o}}{\overline{E}_{t}^{o}} = \frac{\left(B_{nt}^{o} w_{it}^{o}\right)^{\epsilon^{o}} \left(\kappa_{nit}^{o} P_{nt}^{\alpha^{o}} Q_{nt}^{1-\alpha^{o}}\right)^{-\epsilon^{o}}}{\sum_{k \in \mathbb{N}} \sum_{\ell \in \mathbb{N}} \left(B_{kt}^{o} w_{\ell t}^{o}\right)^{\epsilon^{o}} \left(\kappa_{k\ell t}^{o} P_{kt}^{\alpha^{o}} Q_{kt}^{1-\alpha^{o}}\right)^{-\epsilon^{o}}}$$

- Amenities (B_{nt}^{o}) depend on own and neighboring location characteristics

$$B_{nt}^{o} = B^{o}\left(b_{nt}, D_{nt}, \{b_{-nt}\}, \{D_{-nt}\}\right)$$

- Residents (R_{nt}^{o}) and employment (E_{it}^{o})

$$\lambda_{nt}^{Ro} = \frac{R_{nt}^{o}}{\overline{E}_{t}^{o}} = \sum_{i \in \mathbb{N}} \lambda_{nit}^{o}, \qquad \lambda_{it}^{Eo} = \frac{E_{it}^{o}}{\overline{E}_{t}^{o}} = \sum_{n \in \mathbb{N}} \lambda_{nit}^{o}$$

- Occupation utility equalized across residence-workplace pairs

$$U_{t}^{o} = \vartheta^{o} \left[\sum_{k \in \mathbb{N}} \sum_{\ell \in \mathbb{N}} \left(B_{kt}^{o} w_{\ell t}^{o}\right)^{\epsilon^{o}} \left(\kappa_{k\ell t}^{o} P_{kt}^{\alpha^{o}} Q_{kt}^{1-\alpha^{o}}\right)^{-\epsilon^{o}}\right]^{\frac{1}{\epsilon^{o}}}, \quad \vartheta^{o} \equiv \Gamma\left(\frac{\epsilon^{o}-1}{\epsilon^{o}}\right)$$

Production

- Single final good produced using labor and floor space under conditions of perfect competition the costlessly tradeable final good

$$1 = \frac{1}{A_{it}} \mathbb{W}_{it}^{\beta} q_{it}^{1-\beta}$$

- where q_{it} is the price of commercial floor space
- Labor cost index ($\mathbb{W}_{it}$) is a constant elasticity of substitution (CES) function of the wage for each occupation (w_{it}^{o})

$$\mathbb{W}_{it} = \left[\left(\frac{w_{it}^{L}}{\gamma^{L}} \right)^{1-\sigma} + \left(\frac{w_{it}^{M}}{\gamma^{M}} \right)^{1-\sigma} + \left(\frac{w_{it}^{H}}{\gamma^{H}} \right)^{1-\sigma} \right]^{\frac{1}{1-\sigma}},$$

- Productivity (A_{it}) depend on own and neighboring location characteristics

$$A_{it} = A\left(a_{it}, D_{it}, \{a_{-it}\}, \{D_{-it}\}\right),$$

Floor Space Clearing

- Given supplies of residential and commercial floor space (H_{it}^R, H_{it}^E), prices of floor space (Q_{it}, q_{it}) floor space are determined as:

$$Q_{it} = \frac{\sum_{o \in \mathbb{O}} \left(1 - \alpha^o\right) v_{it}^o R_{it}^o}{H_{it}^R}$$

$$q_{it} = \frac{1 - \beta}{\beta} \frac{\left[\sum_{o \in \mathbb{O}} w_{it}^o E_{it}^o\right]}{H_{it}^E}$$

- For estimation, not required to specify determinants of supplies of residential and commercial floor space (H_{it}^R, H_{it}^E)
- For counterfactuals, baseline specification holds these supplies fixed, motivated by our empirical setting (Town and Country Planning 1942)
- In robustness checks, undertake counterfactuals allowing for endogenous responses in the supply of floor space

Outline

- Historical Background
- Data
- Reduced-form Evidence
- Theoretical Model
- Quantitative Analysis
- Conclusions

Parameterization

- Calibrate and estimate the model's parameters using historical data for our empirical setting and other related evidence

Parameter	Low	Mid	High	Source
Preferences				
$(1-\alpha^o)$	0.26	0.22	0.16	Housing Expenditure Survey 1937-8
Commuting				
$\phi^o = \kappa\epsilon^o$	2.92	2.41	1.87	Gravity Estimation
ϵ^o	6.36	5.25	4.07	Gravity & Heblich et al. (2020)
Production				
β		0.55		Antràs and Voth (2003)
σ		1.41		Katz and Murphy (1992)
γ^o	0.17	0.38	0.46	Residential Property Values

- Solve for pre-war wages, employment and commuting using the model's commuter market clearing condition and observed pre-war residents, commercial property values and travel times

Pre-war Wages and Commuting

- Recover unobserved endogenous variables in initial equilibrium
- Wages (w_i^o) by worker type from commuter market clearing

$$\frac{\beta}{1-\beta}\frac{\left(\frac{w_{it}^o}{\gamma^o}\right)^{1-\sigma}}{\sum_{\ell\in\mathbb{O}}\left(\frac{w_{it}^\ell}{\gamma^\ell}\right)^{1-\sigma}}\mathbb{V}_i^E = \sum_{n\in\mathbb{N}}\frac{\left(w_i^o\right)^{\epsilon^o}\tau_{ni}^{-\phi^o}}{\sum_{\ell\in N}\left(w_\ell^o\right)^{\epsilon^o}\tau_{n\ell}^{-\phi^o}}w_i^o R_n$$

- Expected income (v_n) from conditional commuting probabilities

$$v_n^o = \sum_{i\in\mathbb{N}}\lambda_{ni|n}^o w_i^o = \sum_{i\in\mathbb{N}}\frac{\left(w_i^o\right)^{\epsilon^o}\tau_{ni}^{-\phi^o}}{\sum_{\ell\in\mathbb{N}}\left(w_\ell^o\right)^{\epsilon^o}\tau_{n\ell}^{-\phi^o}}w_i^o$$

- Given wages (w_i^o), commuting costs ($\tau_{ni}^{-\phi^o}$), and residents (R_{nt}^o), recover commuting and employment ($\lambda_{ni|n}^{Ro}$, λ_{ni}^o, E_n^o)

Neighborhood Effects Estimation

- Recover amenities from residential choice probabilities

$$\ln B_n^o = \ln\left(\overline{U}^o/\delta^o\right) + \frac{1}{\epsilon^o}\ln\left(\lambda_n^{Ro}\right) + \left(1-\alpha^o\right)\ln Q_n - \ln RMA_n^o$$

- General specification of neighborhood effects
  - Amenities depend on the characteristics of surrounding locations without taking a stand on the underlying mechanisms

$$\ln B_{nt}^o = \beta^o D_{nt} + \sum_{g=1}^{G}\gamma_g^o D_{ngt} + \varrho_{kt}^o + d_{nt}^o$$

- Parameterization of neighborhood effects
  - Preferences over surrounding socioeconomic composition

$$\ln B_{nt}^o = \eta_D^o D_{nt} + \eta_R^o \ln \mathbb{B}_{nt} + \varrho_{kt}^o + d_{nt}^o$$

  - where neighborhood effects ($\mathbb{B}_{nt}$) modelled as distance-weighted average of socioeconomic status in the own location and 100-500 meter buffers
  - Instrument with neighboring destruction in the 100-500 meter buffers, excluding the own location

$$\ln \mathbb{B}_{nt} = \varkappa_D D_{nt} + \varkappa_N D_{nt}^{\text{Neigh}} + \varpi_{kt} + u_{nt}$$

High-Income Neighborhood Effects (Parameterization)

	(1)	(2)	(3)	(4)	(5)	(6)
(A) High-income	$\ln B_n^H$	$\ln B_n^H$	$\ln B_n^H$	$\ln B_n^H$	$\ln B_n^H$	$\ln B_n^H$
Destruction in own area	-0.102***	-0.020**	-0.043***	-0.054***	-0.055***	-0.085***
	(0.014)	(0.008)	(0.011)	(0.010)	(0.010)	(0.010)
Post-war neighborhood effects		1.347***	0.970***	0.892***	0.861***	0.776***
		(0.020)	(0.169)	(0.149)	(0.158)	(0.179)
Pre-war neighborhood effects					0.070***	0.092***
					(0.024)	(0.028)
Observations	8779	8773	8771	8587	8587	8587
R-squared	0.556	0.845	–	–	–	–
First-stage F-statistic	–	–	11.56	19.19	18.72	28.08

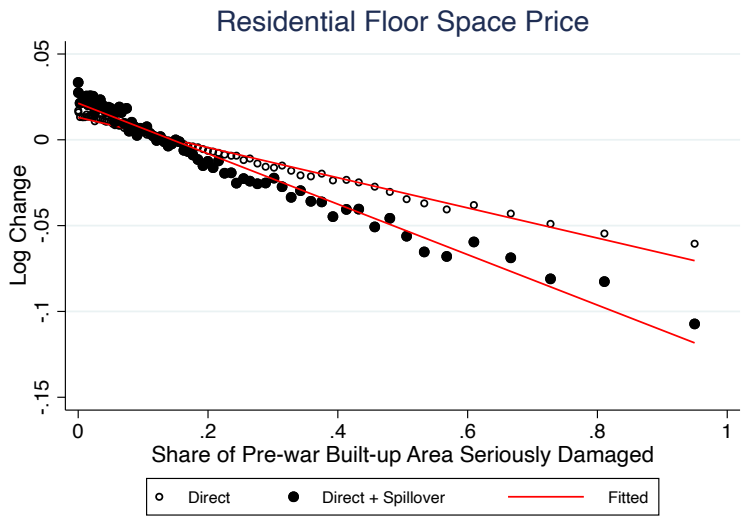
Counterfactuals

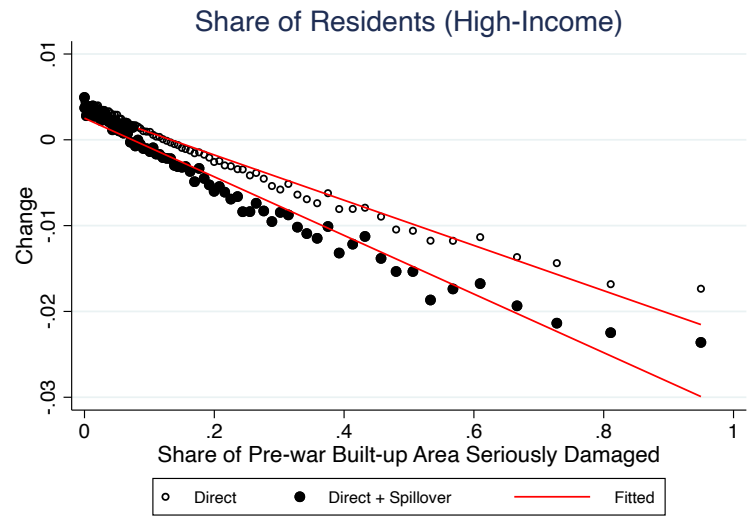
- Use our estimates to undertake counterfactuals to assess the general equilibrium implications of neighborhood effects.
  1. Impact of wartime destruction
  2. Observed differences in socioeconomic outcomes even in counterfactual scenarios without wartime destruction

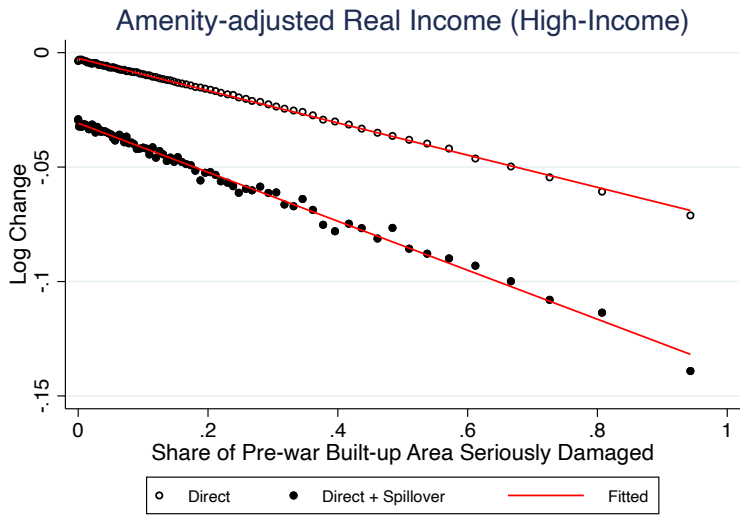
1. Wartime destruction
   (i) General Specification
   (ii) Parameterization in terms of preferences over socioeconomic status
2. Neighborhood effects
   (i) Remove preferences over socioeconomic composition

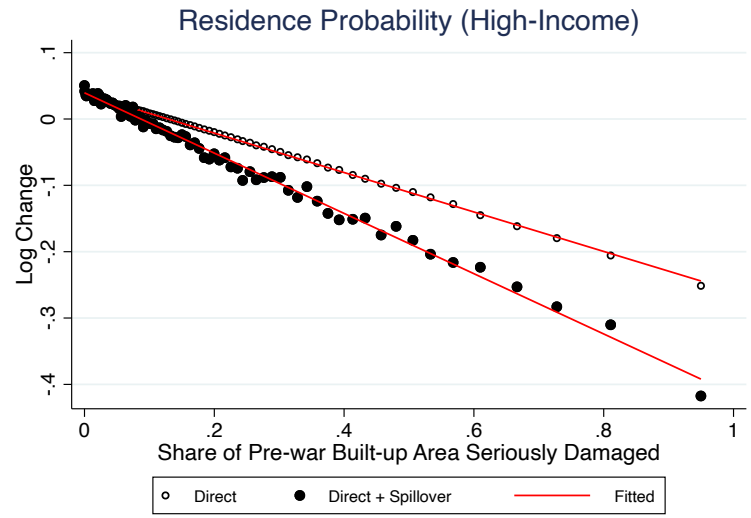
- Baseline specification
  - Closed-city, exogenous productivity and inelastic supplies of commercial and residential floor space, start from pre-war equilibrium
- Robustness specifications
  - Open-city, agglomeration forces, and imperfectly elastic supplies of commercial and residential floor space, start from post-war equilibrium

Wartime Destruction Counterfactual

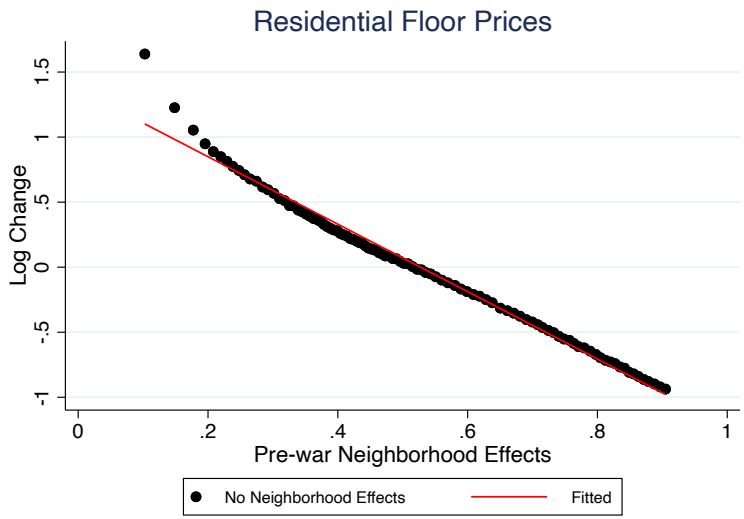


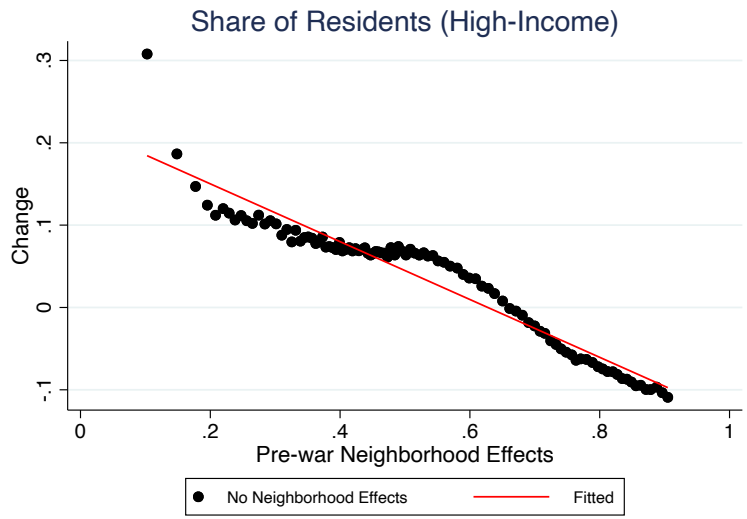


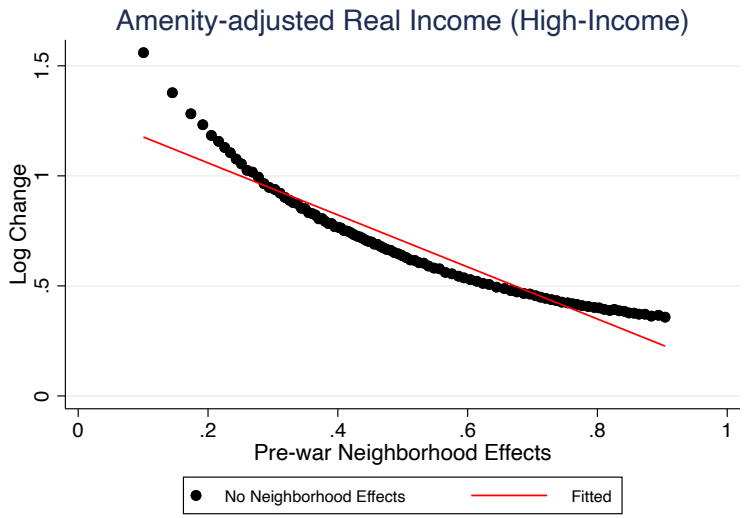


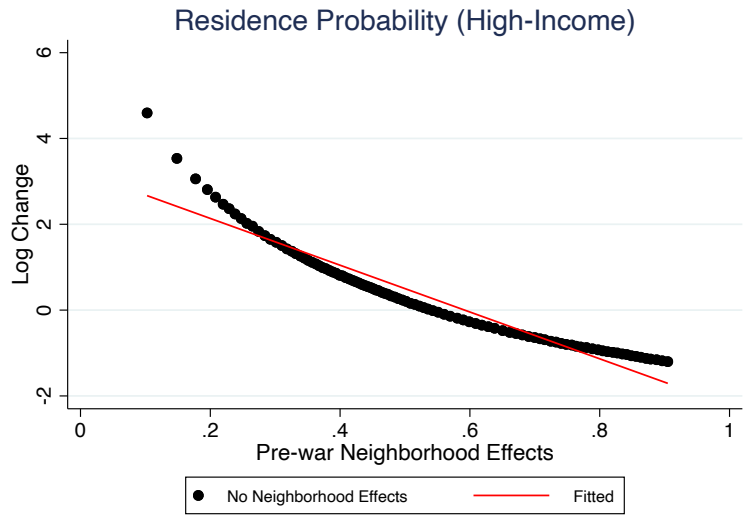


Neighborhood Effects Counterfactual









Outline

- Historical Background
- Data
- Reduced-form Evidence
- Theoretical Model
- Quantitative Analysis
- Conclusions

Conclusion

- We use German bombing of London during WWII as a natural experiment to provide evidence on neighborhood effects
  - Exogenous shock: uncorrelated with pre-war location characteristics within geographical grid cells
  - Long-lasting effect: reconstruction occurred during rationing, financial constraints, and expansion social housing
- Provide reduced-form evidence on wartime bombing
  - Direct negative effects on post-war economic outcomes
  - Negative spillover effects on post-war economic outcomes
- Develop a quantitative urban model to rationalize these findings
  - Heterogeneous workers from different occupations sort across locations
  - Construction of council housing in bombed locations reduces relative amenities for higher-income workers
  - In the presence of neighborhood effects, this reduction in relative amenities for higher-income workers spills over to surrounding locations
- Counterfactuals for wartime destruction and neighborhood effects
  - Neighborhood effects magnify the impact of wartime destruction
  - Neighborhood effects account for much of the observed differences in socioeconomic composition across locations

Thank You