Economics Letters 168 (2018) 37–41

Contents lists available at ScienceDirect

Economics Letters

journal homepage: www.elsevier.com/locate/ecolet

Persistent shocks to urban density: Evidence from the Berlin air raids☆

Kalle Kappner

Institute of Economic History, School of Economics and Business, Humboldt-Universität zu Berlin, Spandauer Strasse 1, 10178 Berlin, Germany

HIGHLIGHTS

- I examine the effect of World War II air raids on Berlin's population density.
- Controlling for pre-war density, bombed blocks today are less densely populated.
- The effect is due to irreparable damage, while repairable damage is irrelevant.
- Findings are consistent with a vintage effect caused by durable housing.
- Results suggest considerable stickiness in urban adjustment to spatial equilibrium.

ARTICLE INFO

Article history:
Received 22 November 2017
Received in revised form 26 February 2018
Accepted 31 March 2018
Available online 7 April 2018

JEL classification:
J1
N9
R1

Keywords:
Durable housing
Persistent shock
Population density
Vintage effect

ABSTRACT

Temporary shocks can have persistent effects on the distribution of economic activity across urban space, suggesting considerable "stickiness" in adjustment to spatial equilibrium. I examine the long-run effect of World War II air raids on Berlin's contemporary population density profile, exploiting random variation in the extent of damage caused at the scale of street blocks, while controlling for a flexible, secular time trend in the citywide density gradient. 70 years after the end of the war, blocks affected by irreparable damage feature significantly lower population density, while repairable damage had no lasting effect. These findings are consistent with a vintage effect, where large fixed costs associated with the construction of new buildings retard adjustment of the housing supply to growing demand for low-density structures.

1. Introduction

A growing literature in urban and regional economics explores the role of temporary, local shocks in generating persistent patterns in the distribution of economic activity across urban space, leading to significant deviations from spatial equilibrium as described by canonical models. Recent research has postulated several mechanisms capable of explaining such persistent effects, among them neighborhood sorting (Redding and Sturm, 2017) and negative spillovers from an outdated, yet durable building stock (Hornbeck and Keniston, 2017).[1]

I present evidence for the persistence of locally varying shocks to the urban fabric by examining the effects of the World War II bombing of Berlin's inner city on contemporary population density, exploiting random variation in the extent of damage at the scale of street blocks.[2] In particular, I find that irreparable damage to the housing stock is associated with lower contemporary population density, while repairable damage had no lasting effect. While not conclusive as to the underlying mechanism, results are consistent with a vintage effect, where a durable housing stock and large fixed costs associated with reconstruction retard adjustment of the housing supply to growing demand for low-density housing (Duranton and Puga, 2015). Insights into the persistent effects of temporary shocks to the urban density profile are relevant to municipal policy makers as they suggest substantial gains from flexible construction and real estate markets.

☆ Declarations of interest: none.

E-mail address: kalle.kappner@hu-berlin.de.

[1] Other recent contributions include Ambrus et al. (2017), Brooks and Lutz (2016), Siodla (2015) and Redfearn (2009). See Redding and Rossi-Hansberg (2017) for a recent survey of canonical urban economics models.

[2] Air raid damage has been used as a source of exogenous variation on the city or regional level in a number of studies, including Davis and Weinstein (2002), Bosker et al. (2007) and Wolf and Caruana Galizia (2016). Dericks and Koster (2017) and Redding and Sturm (2017) use London's intraurban differences in World War II bombing damage as source of variation.

https://doi.org/10.1016/j.econlet.2018.03.038
0165-1765/

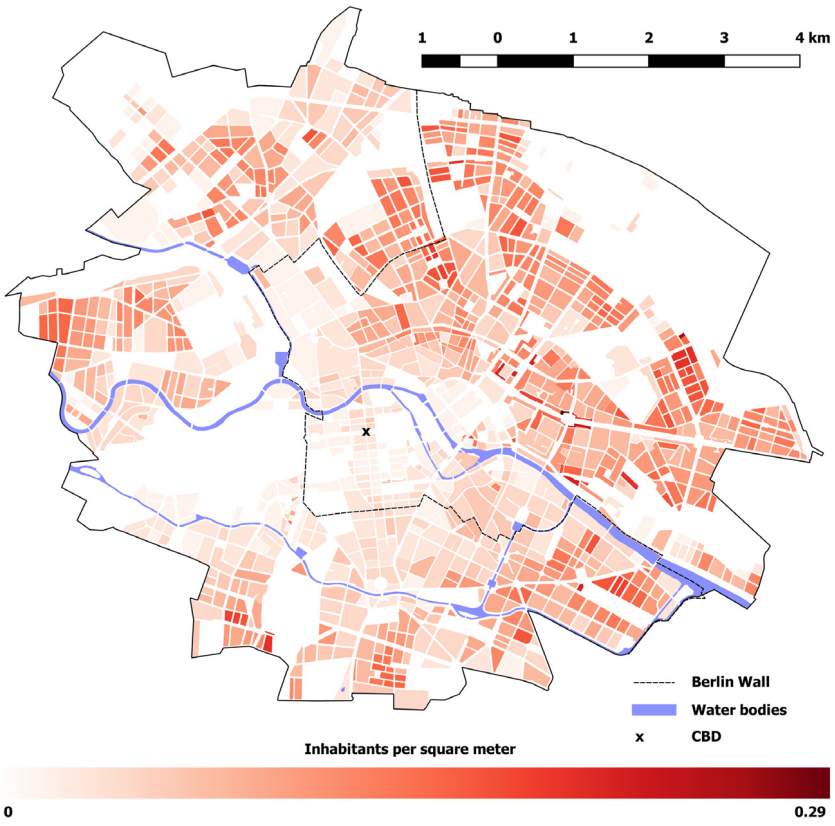

Fig. 1. Population density in central Berlin, 1910.

2. The bombing of Berlin

During World War II, Berlin was a main target for air raids by the Allied forces. Throughout the war, about 45,500 tons of bombs fell on Berlin in 235 air raids (Demps, 2012, 41). Allied forces targeted not only military and administrative facilities, but also industrial and residential areas, to which they felt especially justified with reference to the German air raids on London in 1940 and 1941 (Metzger, 2013, 49–57). Including damage caused by Soviet ground forces, Berlin's first postwar census concluded that the war damaged 27,679 buildings containing 501,795 flats beyond repair, amounting to 11.3% of all buildings and 32% of all flats. Another 20,127 (8.2%) buildings were severely damaged but repairable (Statistisches Amt der Stadt Berlin, 1947, 186). Regarding casualties, estimates range from 29,000 to 30,000 deaths caused by the air raids (Demps, 2012, 98; 106).

While air raids specifically targeted Berlin's central business district (CBD) and the Western districts *Charlottenburg* and *Schöneberg*, the extent of damage was arguably random at the scale of street blocks within the targeted area, thus providing a spatially varying exogenous shock that is unrelated to any citywide secular trend in population density. Up until 1944, Berlin still had a strong antiaircraft defense, forcing enemy bombers to strike from great heights and mostly at night, when 85.1% of all strikes occurred (Demps, 2012). Technology was still unequipped for high precision bombing during World War II. Furthermore, many British pilots experienced only superficial training and British air raid experts estimated that, given optimal weather conditions and undisturbed by antiaircraft defense, only about 50% of the bomb strikes would be able to precisely hit a target within a perimeter of 8 km (Groehler, 1990, 18–20). The next section provides formal evidence for the random allocation of bombing damage across street blocks.

3. Data sources and preparation

I conduct my analysis at the level of street blocks located inside Berlin's inner city, i.e. its pre-1920 borders. Using GIS techniques, I construct block-level data on residential population in 1910 and 2014, as well as the area share that sustained irreparable and repairable damage, respectively. Blocks are georeferenced using a shapefile provided by Berlin–Brandenburg's statistical office. I cut blocks located only partially inside Berlin's pre-1920 borders and adjusted their population in proportion to area.

Berlin's registry office provides block-level data on residential population in 2014. To obtain population estimates in 1910, I disaggregate data from the level of 463 city districts in Berlin's 1910 census (Statistisches Amt der Stadt Berlin, 1914) to the block level using a dasymetric interpolation approach (Mennis, 2009). In particular, I spatially distribute each city district's population to the built-up residential area contained in that district, where ancillary information comes from official maps (Straube, 1910, 1915). Next, I intersect the 1910 residential areas with the contemporary block structure and assign population estimates to the resulting polygon set in proportion to their area. In a final step, I reaggregate the population estimates to the contemporary block structure.[3] Figs. 1 and 2 show block-level density estimates for 1910 and 2014.

[3] As Berlin's inner city street grid experienced only minor changes between 1910 and 2014, only few 1910 residential areas lay outside contemporary street blocks, i.e. on streets, parks or open space, in which case I assigned the population estimates to the nearest contemporary block. Several studies have shown that dasymetric interpolation methods using land cover data provide reasonable small-area estimates and clearly improve upon simple areal weighting methods (Buttenfield et al., 2015). While it is not possible to evaluate the validity of the estimation outcomes for 1910 density levels, a test using 2014 population data is possible. In particular, I aggregate observed block-level population data to the 463 pre-war districts and then redistribute the district-level data back to the street blocks using modern land-cover data from the Urban Atlas 2012 (European Environment Agency, Directorate-General Enterprise and Industry (DG-ENTR), Directorate-General for Regional Policy, 2012).