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The Neighborhood Impact of Industrial Blight: A Path Analysis

GEOSCAPE

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Abstract

Historically, industry shaped the space-economy of the American city, a major source of employment opportunity for residents that selected housing nearby or within a convenient or affordable commuting distance. However, the contemporary American city is structurally characterized by abandoned, blighted, vacant industrial properties due to urban expansion, deindustrialization and the suburbanization of both jobs and population. The urban studies literature rarely documents the neighborhood impact of industrial blight akin to studies of residential blight. We determine the proximity-effect of industrial blight on the neighborhood thought of not as an isolated and closed entity, but as a connected and open entity within the city and the region. Unlike studies confined to the property value impact, we determine Pearson correlations of industrial blight and vacancy expansively with the socio-economic and physical characteristics of neighborhoods. We use path analysis to determine direct, indirect, and total neighborhood impact of industrial blight and vacancy. The census block group and parcel-level geographic information system (GIS) provide our principal sources of data. The block group geography contains the neighborhood as a fundamental spatial unit. We determine how the neighborhood impact varies with distance from the blighted, vacant industrial property.

Keywords

Industrial Blight and Vacancy,
Neighborhood Impact,
Block Group Median Income,
Pearson Correlations,
Path Analysis,
GIS

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Highlights for public administration, management and planning:

- The neighborhood, a fundamental spatial unit of the block-group geography of the metropolitan region, is highlighted in various proximities to the industrial blight and vacant sites.
- We show how neighborhood viability, measured by block group median income, is impacted by industrial blight in proximity.
- We determine correlations with socio-economic characteristics of the neighborhood in various distances to the blighted and vacant properties.
- Planning and policy alternatives to address industrial blight and vacancy are suggested.

1 Introduction

The urban studies literature provides a preponderance of evidence that amenities like light-rail transit stations, walking and biking trails are public goods with beneficial impacts on nearby residential properties (e.g., Cervero and Duncan 2002; Parent and Hofe 2013). The impacts of "public bads" are also recorded in the literature, particularly in blighted residential properties that negatively impact neighborhoods (e.g., Farber 1998; Ross and Leigh 2000; Han 2014; vom Hofe et al. 2019). Rarely, do existing studies address the impact of industrial blight, which is a "public bad", or a dis-amenity akin to those like noxious or landfill sites, on neighborhoods.

Our research fills this literature gap. This paper focuses on the impact of industrial blight and vacant properties in proximity to neighborhoods. Unlike studies confined to mainly property value impact, we determine the impact of industrial blight expansively and show how industrial blight correlates with the socio-economic and physical characteristics of neighborhoods (e.g., vom Hofe et al. 2019; Blackmond and Downey 2019; Al-Attar 2011). Specific areas of impact include housing tenure and va-

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cancy, African-Americans percent of the population, appraised median home value, household income, poverty rate, food desert, and crime (rate and number). The census block group and parcel-level geographic information system (GIS) in the public domain provide our principal sources of data. We use the block group since it constitutes a fundamental spatial unit that contains neighborhoods. Furthermore, studies of neighborhood blight generally focus on factors causing blight from within the neighborhood (e.g., Mui et al. 2017; vom Hofe et al. 2019; LaVoice 2019). However, the neighborhood is not a closed system; it is an open socio-spatial unit of the city and the region as a whole. Historically, the American city provided industry as a major source of employment opportunity for residents that selected housing nearby or within a convenient or affordable commuting distance. The jobs-housing-access-services nexus is immediately implied. We examine the interconnections statistically later in the paper. Commentators stress the connected metropolitan region-wide feature as a whole in addressing the growth or decline (including blight) of the urban economy together with its suburban counterpart (e.g., see Downs 1973; Calthorpe and Fulton 2001). We determine the proximity-effect of industrial blight on the neighborhood thought of not as an isolated but connected entity within the city and the region. Thus, our approach contrasts studies of neighborhood blight, noted below, confined to factors from within, as though a neighborhood could feasibly be considered as an isolated part of a city and region.

In the section that follows we draw on a vast urban studies literature to briefly review how blight correlates with the socio-economics of the inner city and the suburban neighborhood. However, the sub-regional impacts of industrial blight are too aggregate to reveal the site-specific, proximity effects on neighborhoods. To fill this void, we disaggregate the socio-economic correlations by mapping the block group's industrial blighted and vacant properties by various proximities, at distances from ¼ to ½ and ¾ miles. Pearson correlations are presented in subsection 3.2. Mindful that correlations are not necessarily indicators of causation, in subsection 3.3. we set out a path analysis to determine the direct, indirect, and total block-group impact of blighted and vacant properties. We distinguish between blight and vacant properties in correlations and path analysis to determine if any differential impacts exist. Finally, we conclude with some directions for further investigation.

2 A brief review of the literature

From the literature on urban sprawl and its corollary blight (for a discussion of the vicious, blight-sprawl circle, see Antipova et al. 2022b), we excerpt the interrelationship of industrial blight and the socio-economic characteristics in cities. This literature is inclusive of the metropolitan region's spatial units of observation of the variables and their interrelationships, from downtown, the inner city, the suburb, or the metropolitan area as a whole. However, after a brief review, we focus our attention on industrial rather than residential or commercial blight, given our purpose to determine the impact of industrial blight on the neighborhood that has received only scant attention in urban studies literature particularly in deference to the proximity effects of the blighted property. Our focus on industrial land is deliberate. Historically, industry determined the morphology of the American city-region. Thus, industrial land provides clues for understanding metropolitan region's growth and decline. Niedercorn and Hearle (1964) provide a historical perspective on the growth and suburbanization of the American city particularly post World War II with a focus on land use changes that includes industrial as well as residential, commercial, and vacant land, and road, highway and public uses (see also Wainright 2020). As the brief review of the literature also indicates industrial property is a vital component of the interrelated socio-economics of the city-region. Thus, we fill the void that exists in the correlations of the industrial blight with socio-economic features of cities at the block-group level that contains the all-important neighborhood. We begin with housing.

2.1 Housing

Suburban growth coupled with deindustrialization did not just result in the inner city's blighted industrial properties. The shrinking inter city is coupled with both residential and non-residential blight. Neumann et al. (1973) find a shortage of low to moderate-income housing in Metropolitan Toronto's blighted areas that include residential, commercial, and industrial use. Sailer-Fliege (1999) observes the impact of industrial blight on the condition and affordability, and segregation of housing in post-socialist, Central European countries akin to the Neo-Liberal Angelo-American pattern. The remnants of the socialist period are manifest in "the decay of old housing stock, large scale derelict industrial areas and the extent and deficiencies of high-rise housing estates".

2.2 Racial Segregation

Blackmond and Downey (2019) study does not mention industrial blight but determines the higher impact of tax increment financing (TIF) in non-white districts of Chicago compared to other districts. Blighted and toxic industrial properties characterized as brownfield sites have differential impacts on class and race. Ard and Smiley (2021) observe the concentration of poverty and the reduction of manufacturing employment in proximity to hazardous industrial sites. Broadway (1995) highlights the socio-economic disparity that exists within and between the Canadian cities as a consequence of post-industrialization, for example comparing the prospering Vancouver and Victoria with declining and impoverishing Oshawa and Sudbury, with "weak industrial and mining economies".

2.3 Segregated Poverty and Suburban Competition

Ard and Smiley (2021) remind the declining population of the White and African-American middle-class in industrial areas of the city combined with the declining manufacturing employment intensified the poverty of the minority in proximity to industrial sites. Lewis (2020) points out that the suburban business and residential development competed with the economic and planning policy that targeted (declining) heavy industry and middle-class and upper-class amenities in Chicago's downtown. Thomas (2013) observes, despite comprehensive, city wide- and project-planning to stop the physical and economic deterioration in the post-war decades, Detroit epitomizes urban decay. The contributing factors to the physical and economic decline are similar to those of other cities: Industrial activity declining steadily and the white residents decentralizing (Thomas 2013). The highway is a major driver of the suburbanization of jobs and the consequent decline of inner-city manufacturing. An earlier study observes the relationship between blighted industrial sites and the highway, elevated and depressed– on residential development (Thiel 1962). The spread of urban blight is linked directly or indirectly to large-scale urban transportation (Schmitt 1977).
(Howland 2007) observes the location of brownfield sites in "distressed neighborhoods" and "weak land markets". Redevelopment and employment creation even after remediation or cleanup are not possible without public investment. However, the recognition of the jobs-residents nexus preempts dislocation after remediation.

2.4 Property Value

Al-Attar (2011) reminds us that industrial blight is correlated with de-industrializing inner city and functional and spatial restructuring of industrial activity. Al-Attar (2011) notes blighted sites have wide-ranging impacts – physical, socio-economic, and environmental - not just contained within the blighted site but also in surrounding properties. Property value is but one of the economic impacts of industrial blight. Blackmond and Downey (2019) examine the blight-race-property value nexus in Chicago's TIF districts. Interestingly, the observation that tax increment financing districts with a majority of non-white residents register property value growth rates better than other (non-TIF) districts counters expectations. For a review of the property value impact of "undesirable" land uses, see (Farber 1998). Hazardous, noxious industrial sites or brownfields are generally regarded as undesirable -justification for remediation, cleaning up and removal of hazardous materials as a precondition to property redevelopment with federal, state, and local government funding incentives, with the United States Environmental Protection Agency (EPA) Superfund and National Priority List (see also Ross and Leigh 2000). [These EPA programs provide funding for removal of toxic materials from brownfields or formerly industrial but later abandoned or blighted industrial sites.] Han (2014) finds protracted abandonment not only impacts the value of the "nearby" but also distant property.

2.5 Food Desert and Swamp

The decline in inner-city employment and population results in the loss of services, most importantly food stores. Inner city neighborhoods with inadequate food stores are called food deserts. The gap in food services is provided by convenience stores with less nutritious and unhealthy "junk foods." These are called food swamps. Concomitantly, inner-city neighborhoods with blighted, vacant properties and lack of accessible green characterize park deserts.
Mui et al. (2017) observe an association between neighborhood crime, foreclosure, vacancy rates, and food swamps. The neighborhood foreclosure and vacancy rates have a statistically significant relationship with food swamp scores. Further-

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more, Branas et al. (2016) determine an association between crime and vacant properties, observed at the block-group level. Solomon et al. (2016) include food deserts, inferior housing quality, and park and open space deserts in low-income communities near "former industrial sites, major roadways, and agricultural operations".

The deindustrialization of the inner city and the suburbanization of population and jobs did not just create blight limited to industrial and manufacturing land use but also contributed to the decline of neighborhoods with an increasing vacancy and declining property values of the housing in proximity to the industrial sites that historically provided employment for workers nearby. Although the neighborhood impact of industrial blight is given limited attention, empirical studies observe wide-ranging correlations of industrial blight with housing (property values), racial composition, the concentration of poverty, and income. It is not surprising that the blighted inner city is also the location of food deserts or food swamps and declining retail markets (see Mui et al. 2017) (see path analysis).

3 Methodology

3.1 Study Area, Data, and Data Preparation

Shelby County with a population of 929,744 in 2020 and a geographic extent of 785 sq. miles (≈763 sq. miles of land and 22 sq. miles of water bodies) is located in southeast Tennessee. The population in the City of Memphis, the largest city in the county, dropped by almost 8% from 1990 to 2010. However, the population in the suburban areas of Shelby County increased by more than 124% in the same period Momeni and Antipova (2020, 2022); Momeni (2022). This rapid growth of the suburban area caused the decentralization of population and migration from the central area to the peripheral suburbs (known as urban sprawl, when it occurs haphazardly). Sprawl, which is a global phenomenon, is commonly addressed for its wide-ranging negative impacts on the sustainability of urban areas (Fig. 1). Blight and sprawl are among the key indicators that plague this metropolitan region (Antipova et al. 2022a,b). Therefore, numerous properties were left vacant and some turned to blight. Properties zoned as industrial are among the vacant and blighted. Blight has become a major issue in Shelby County, and the City of Memphis, since 2015. Therefore, the city and the county officials developed various anti-blight programs mostly on an individual basis by demolishing or improving individual houses (Antipova et al. 2022b). Fig. 1 shows the distribution of industrial blight and vacant properties in Shelby County. Also, neighborhoods in 0.25 (ring 1), 0.50 (ring 2) and 0.75 miles (ring 3) distance to a blight property are highlighted.

While blight and vacancy are different concepts, they are sometimes used interchangeably. The term blight was initially used in the early 1900s to refer to substandard slum housing (Banai et al. 2021) and later was used to justify the urban renewal of predominately African-American neighborhoods. While in the past blight had a complex racial history, nowadays it refers to a wide category of vacant, abandoned, foreclosed, contaminated, and disrepair properties (Banai et al. 2021) . Code of the District of Colombia defined blighted vacant buildings as "vacant building that is determined by the mayor to be unsafe, unsanitary, or which is otherwise determined to threaten the health, safety, or general welfare of the community" (Code of the District of Columbia 2021).

In contrast, vacant properties are properties with active ownership which are not legally occupied (Bieretz & Schilling 2019; Farmington & Michigan, Code of Ordinances 2010). For instance, the code of the District of Colombia defined a vacant building as "real property improved by a building which, on or after April 27, 2001, has not been occupied continuously" (Code of the District of Columbia 2021). In some ordinances, a specific number of days are required for an empty property to be classified as a vacant property. For instance, the code of ordinances in Harper Woods, MI, defines vacant property as "an improved lot or parcel of real property with at least one building or structure that is not currently used or occupied for a period in excess of 30 days" (Harper Woods & Michigan, Code of Ordinances 2014). Therefore, some properties can be considered vacant through a normal market turnover when the property is waiting to be sold or rented. Vacant properties become an issue when the property loses active ownership or stewardship and makes a public nuisance (Bieretz & Schilling 2019). Short-term vacancy is a normal and healthy part of the real estate cycle providing opportunities for residents and business owners to find units whose net utility gain is greater than their current unit. Whether a property is vacant or blighted is consequential to future actions on the property. For instance, owners of vacant properties (defined as properties that are simply empty) in Washington D. C. must pay five times more tax than what the average Washington D. C. homeowner pays, while owners of blighted proper-

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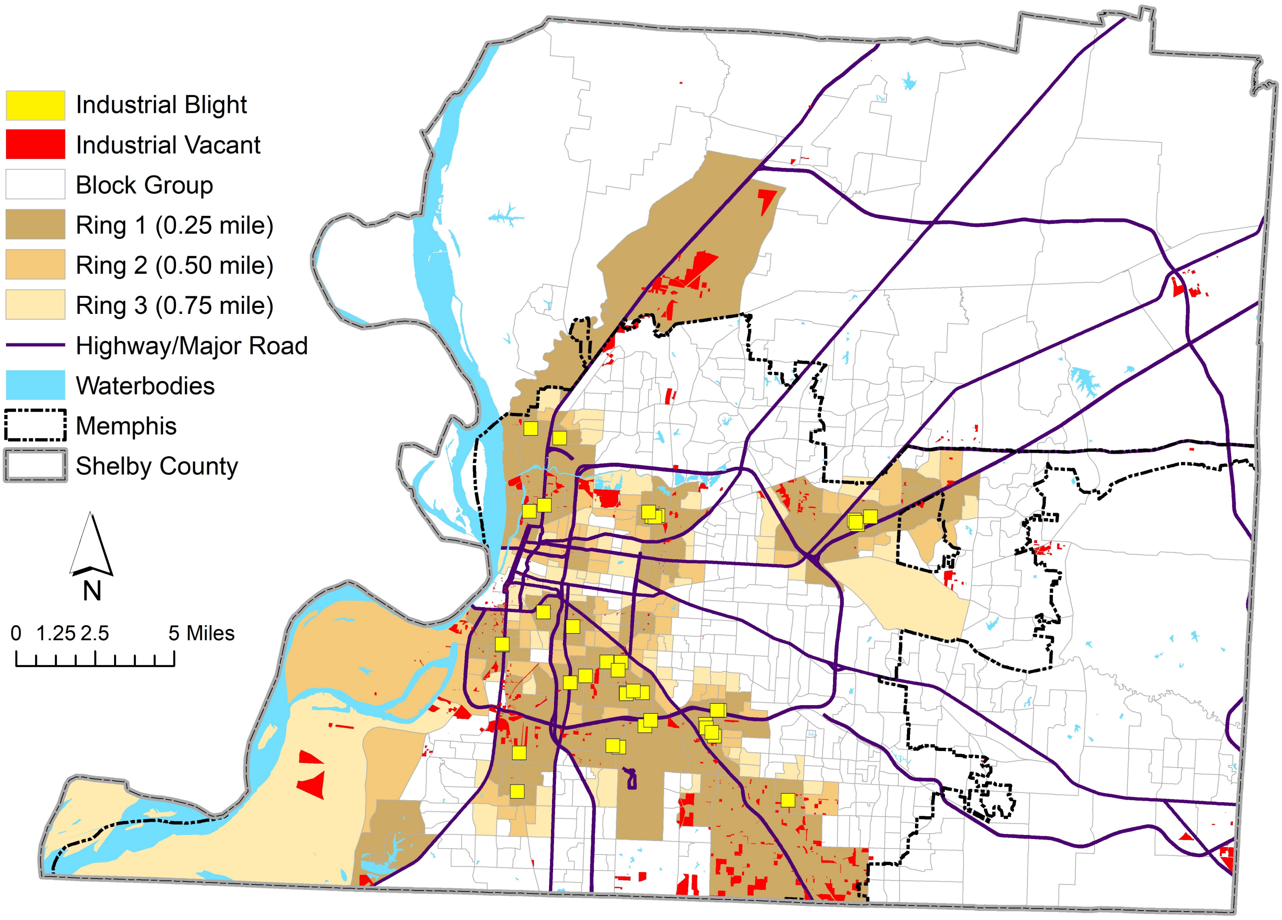

Fig. 1 The geography of industrial blight and vacant properties in Memphis and Shelby County. The neighborhood is a spatial unit of the geography of the block group, highlighted with various proximities to the industrial blight and vacant sites.

ties (defined as properties that are in a deteriorated state, or "falling apart") must pay ten times the tax most average homeowners pay (Baca 2021).

Our study uses data from three main sources: a) Block group boundaries in 2019, household income in the past 12 months in 2018 inflation-adjusted dollars, the poverty status of individuals in the past 12 months in 2013, and house values in 2017 which were downloaded from the National Historical Geographic Information System (NHGIS), https://nhgis.org/, that provides GIS data for the U.S. censuses and other nationwide surveys since 1790 at different geographic levels such as Nation, State, County, Tract, Block Groups, etc; b) Limited Supermarket Access (LSA) data in 2016 were downloaded from the PolicyMap, at https://www.policymap.com/ which provides an online mapping of data on demographics, jobs, and more in communities across the United States. LSA is a measure to identify areas with inadequate or inequitable access to healthy food. LSA was first used to support Reinvestment Fund's Pennsylvania Fresh Food Financing Initiative (FFFI) in 2011 (Norton & Reeves 2018). Access to a supermarket is a relative term. While in rural areas many communities are miles away from the closest supermarket, and supermarkets are usually farther apart, supermarkets are closer together in urban areas. Limited access to a supermarket in an urban area occurs when the nearest supermarket is a mile or two away from a community. To consider these variations, population density and car ownership are embedded in the calculation of LSA scores (Norton & Reeves 2018). Blight and vacancy data in 2018 were downloaded from the Shelby County Assessor of Property, at https://www.assessormelvinburgess.com/welcome, which provides spatial data of all taxable properties in the State of Tennessee (Banai & Ploderer 2018).

In the data preparation step, all data were imported to ArcMap 10.8 and converted to a numeric format, as some data were offered in the text format. NHGIS provides data for household income in detailed intervals. For example, for each block group, data for income in the past 12 months are in 16 different intervals (Fig. 2) such as income less than $10k, $10k to $15k, $15k to $20k, etc. As Fig. 2 illustrates, the first column in the raw data for income indicates GEO_ID which is the unique ID for each block group. The second column indicates NAME which is the geographic name of the block group and its Census Tract, County, and State. The third and fourth columns (B19001_001E and B19001_001M) are the estimated number of families within the block group and the margin of error for that estimation, respectively. The fifth and sixth columns (B19001_002E and B19001_002M) indicate the estimated number of families with income less than $10,000 and the margin of error for that estimation, respectively. The seventh and eighth columns (B19001_003E and B19001_003M) indicate the estimated number of families with income of more than $10,000 and less than $14,999, and the margin of errors for that estimation, respectively; and so on. In Fig. 2, each row indicates a unique block group (in total 628 block groups). Further details on supporting documentation on code lists, subject definitions, raw data accuracy, and statistical testing can be found on the American Community Survey website at https://www.census.gov/programs-surveys/acs/technical-documentation/code-lists.html. To calculate the median household income in each block group, we applied an approximation method (Wonnacott & Wonnacott 1990) (Fig. 3), programmed in MATLAB (R2020b) (Fig. 4); script is available at GitHub repository, https://github.com/Ehsan-Momeni/Stats/blob/main/Approximation-of-Median-from-Grouped-Data.

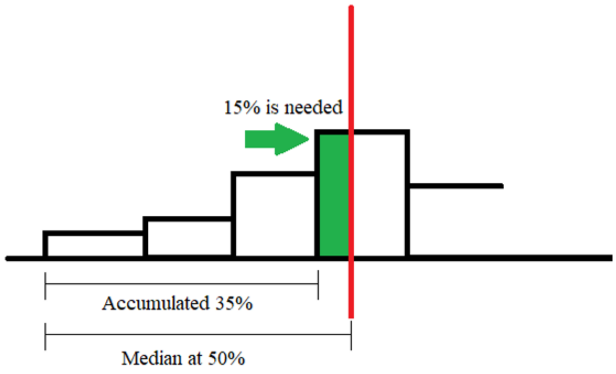

Fig. 3 Example of an approximation of the median for grouped data (adapted from Wonnacott and Wonnacott 1990).

In addition, data for blight and vacancy were provided for different land uses. To extract only industrial, vacant parcels, an attribute query was made in ArcMap using the Select by Attributes tool. Moreover, counts and total areas of industrial vacant and industrial blight parcels within each block group were calculated using the Spatial Join tool in ArcMap.
In the next step, the centroid of each block group was estimated, and the distance between the centroid of each block group and industrial blights was calculated using the Proximity Analysis in ArcMap, and block groups were categorized into three different rings:

1. Ring 1: block groups within 0.25 miles of an industrial blight;
2. Ring 2: block groups within 0.50 miles of an industrial blight including Ring 1;
3. Ring 3: block groups within 0.75 miles of an industrial blight including Ring 1 and Ring 2.

There are some limitations to using County Assessor of Property data. These include inconsistencies between zoning and land use classifications, e.g., current use of the rezoned parcels is not updated in the dataset. Classification of GIS field mismatch problem, e.g., classified vacant and zoned industrial. Parcels classified as vacant but are not actually vacant – overcounting; and parcels that are not classified as vacant, but are vacant – undercounting. Blight-adjacent mismatch problem, e.g. parcels that are adjacent to blighted properties (classified vacant, zoned industrial) – overcounting properties; and finally, ambiguous zoning. SPSS V26 is used for the statistical analysis of pre-processed data.

	A	B	C	D	E	F	G	H	I	J	K	L
1	GEO_ID	NAME	B19001_001E	B19001_001M	B19001_002E	B19001_002M	B19001_003E	B19001_003M	B19001_004E	B19001_004M	B19001_005E	B19001_005M
2	471570221111	Block Group 1, Census Tract 221.11, Shelby County, Tennessee	866	191	233	109	129	114	41	39	40	51
3	471570039001	Block Group 1, Census Tract 39, Shelby County, Tennessee	1011	58	375	67	123	53	58	36	35	26
4	471570042001	Block Group 1, Census Tract 42, Shelby County, Tennessee	793	139	85	68	38	59	17	18	18	20
5	471570053001	Block Group 1, Census Tract 53, Shelby County, Tennessee	490	108	70	50	120	66	82	60	52	51
6	471570024001	Block Group 1, Census Tract 24, Shelby County, Tennessee	347	63	76	47	47	36	54	41	20	23
7	471570024003	Block Group 3, Census Tract 24, Shelby County, Tennessee	222	81	5	9	42	33	15	23	0	12
8	471570024002	Block Group 2, Census Tract 24, Shelby County, Tennessee	353	66	59	35	20	24	91	53	44	34
9	471570025001	Block Group 1, Census Tract 25, Shelby County, Tennessee	441	118	36	32	98	79	39	54	29	33
10	471570025002	Block Group 2, Census Tract 25, Shelby County, Tennessee	673	121	42	33	55	48	44	42	59	62
11	471570030002	Block Group 2, Census Tract 30, Shelby County, Tennessee	401	88	80	59	46	49	27	24	48	45
12	471570030001	Block Group 1, Census Tract 30, Shelby County, Tennessee	297	79	36	41	36	42	22	25	122	66
13	471570030003	Block Group 3, Census Tract 30, Shelby County, Tennessee	689	103	38	36	71	49	59	64	81	58
14	471570033002	Block Group 2, Census Tract 33, Shelby County, Tennessee	434	81	24	27	23	36	13	15	0	12
15	471570033001	Block Group 1, Census Tract 33, Shelby County, Tennessee	703	95	22	24	0	12	12	18	50	49
16	471570211361	Block Group 1, Census Tract 211.36, Shelby County, Tennessee	827	104	29	27	0	12	12	18	10	15
17	471570222103	Block Group 3, Census Tract 222.10, Shelby County, Tennessee	332	92	48	43	52	51	8	13	52	44
18	471570222102	Block Group 2, Census Tract 222.10, Shelby County, Tennessee	283	79	35	28	29	36	41	46	28	34
19	471570215401	Block Group 1, Census Tract 215.40, Shelby County, Tennessee	1424	130	0	12	19	30	0	12	19	32
20	471570216201	Block Group 1, Census Tract 216.20, Shelby County, Tennessee	313	71	0	12	18	27	0	12	30	28
21	471570216202	Block Group 2, Census Tract 216.20, Shelby County, Tennessee	800	87	39	34	61	51	20	19	82	57
22	471570217451	Block Group 1, Census Tract 217.45, Shelby County, Tennessee	921	172	32	53	10	17	0	12	0	12
23	471570003002	Block Group 2, Census Tract 3, Shelby County, Tennessee	125	50	28	28	10	16	0	12	44	36
24	471570217452	Block Group 2, Census Tract 217.45, Shelby County, Tennessee	1384	169	77	91	7	13	0	12	0	12
25	471570002001	Block Group 1, Census Tract 2, Shelby County, Tennessee	389	54	115	49	96	43	10	10	32	25
26	471570003001	Block Group 1, Census Tract 3, Shelby County, Tennessee	218	40	36	28	46	33	45	34	10	12
27	471570037001	Block Group 1, Census Tract 37, Shelby County, Tennessee	818	62	272	58	130	48	74	38	53	43
28	471570009003	Block Group 3, Census Tract 9, Shelby County, Tennessee	476	94	61	36	65	53	49	45	28	21
29	471570009002	Block Group 2, Census Tract 9, Shelby County, Tennessee	284	75	85	61	36	33	8	19	62	67

Fig. 2 Example of raw income data.

```
% Approximation of Median from Grouped Data

format long
clc

BinLowerLimit = [0,10000,15000,20000,25000,30000,35000,40000,50000, ...
                 60000,70000,80000,90000,100000,125000,150000,175000, ...
                 200000,250000,300000,400000,500000,750000,1000000,1500000,2000000];


Sum=sum(Data,1);
Percentage=Sum/sum(Sum,2)*100;

TempCumPercentage=0;
for i=1:size(Percentage,2)
    TempCumPercentage=TempCumPercentage+Percentage(1,i);
    CumPercentage(1,i)=TempCumPercentage;
    if TempCumPercentage<50
        index = i;
    end

end

Median =((50-CumPercentage(1,index))/Percentage(1,index+1))* ...
        (BinLowerLimit(index+2)-BinLowerLimit(index+1))+BinLowerLimit(index+1)
```

Fig. 4 Screenshot of MATLAB script for approximation of the median.

3.2 Socio-Economic Correlations

Our GIS-aided spatial data facilitate the calculation of the socio-economic variables with various distances to industrial blight and vacant sites, from the immediate ¼ mile to distances beyond up to ¾ miles. For comparison, we also include Shelby County. Pearson correlations indicate the degrees of the relationship among the block group's socio-economic, blighted, and vacant properties as variables. The correlation coefficient r is bounded 0 ≤ r ≤ 1. The value of r =1 indicates a strong correlation (Nettleton 2014). The Pearson correlations are shown in Table 1 and Table 2 and were calculated as follows:

$$r = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2}\sqrt{\sum_{i=1}^{n}(y_i - \bar{y})^2} \quad (1)$$

where $x_x i$ values of x variable in a sample, $\overline{x}$ mean of the values of the x variable, $y_y i$ values of y variable in a sample, $\overline{y}$ mean of the values of the y variable.
Industrial vacant measured as the percent of block group area is directly related to the number of residential vacancies, at various distances from the blighted site as expected (Table 1). Correlations that indirectly relate to the area of the industrial vacant are not statistically discernible. Thus, we ignore the implications, as the more plausible results are given by the industrial vacant percent rather than site area. The findings are similar to Marlow et al. (2020) for Rhode Island.
Median income correlations are also statistically discernible with the expected sign for various rings and Shelby County. Median income declines with the number of industrial vacancies. Similar results are obtained for the number of industrial blighted properties. For Shelby County, the correlations are statistically discernible whether measured by the number or percent blighted area. Findings are in agreement with LaVoice (2019) across 28 U.S. cities.
As well, the median house value also correlates indirectly with the number of industrial vacancies, statistically discernible at various rings and Shelby County, with a p-value of 0.07 and higher (see Table 1). Homeownership declines with vacancies. Statistically discernible correlations are found for Shelby County's industrial blight whether measured by the number or percent of blight, or percent of the block group blighted area. This finding is in agreement with the findings of the National Vacant Properties Campaign (2005) in the USA.
Population below poverty (percent) increases with industrial vacancies. This result is in agreement with the findings of Silverman et al. (2013) in Buffalo, NY. The highest correlation is for Shelby County. Statistically discernible correlations are at ½ mile and ¾ mile and Shelby County, rather than ¼ mile distance. Population in poverty also increases with industrial blight with statistically significant correlations for Ring 3, ¾ distance, and Shelby County (see Table 2; Fig. 6) for results with different measures of blight). The findings are in agreement with Silverman et al. (2013) in Buffalo, NY.
The association between the inner city and crime is commonly noted in urban studies literature. Our focus is on the nexus of crime and industrial blight. We use two indicators, total crime, and arguably the more descriptive, per capita crime. Total crime has a positive correlation with the area of industrial vacancies. Total crime has the highest correlation at ¼ mile distance of the vacant industrial area, decreasing in value with increasing distance in Ring 2, Ring 3, and Shelby County. Furthermore, all the correlations are at a high level of significance. We get an even higher correlation value when per capita crime is used, also with statistical discernibility. The correlation between per capita crime and the area of industrial vacancies has the highest positive or direct correlation at ½ mile distance (r = 0.672; p-value = 0). The weakest correlation is in Shelby County (Table 1). We find similar results for industrial blight, with positive values of total crime from ¼ to ¾ mile distance and in Shelby County. Statistically significant results are when the area of industrial blight is measured (see Table 2). It turns out that per capita crime has the highest correlation at ¼ mile distance whether blight is measured in number or percent of property blight. Thus, the realization of lower crime as a desirable feature of the county compared to the city is more than a mere matter of perception (see also Ross and Leigh 2000). These findings are in agreement with Branas et al. (2016) in Philadelphia, PA, and the results of a research by the Center on Urban Poverty and Community Development (2017) in Cleveland, OH.
In summary, methodologically by measuring industrial blight and vacancies by both the number and the area allowed us to sift through statistically discernible associations which would likely be missed if measured as either/or. Furthermore, data on the number and the area of industrial blight and vacancy are facilitated by a GIS-enabled spatial analysis of the correlations of the socio-economic variables at various distances from the blight source. This finer-grain investigation of the impact of industrial blight complements studies com-

Table 1 Pearson correlations of the socio-economic variables with various distances to industrial vacant sites.

		Industrial Vacant				Industrial Vacant			
Variable	Distance	Count Correlation	p-value	Percent Correlation	p-value	Area Correlation	p-value	Percent Correlation	p-value
Residential Vacant Count	Ring 1	0.629***	0	0.073	0.491	-0.058	0.585	0.033	0.759
	Ring 2	0.654***	0	0.021	0.794	-0.078	0.331	0.042	0.598
	Ring 3	0.677***	0	0.086	0.201	-0.055	0.414	0.131	0.051
	SC	0.626***	0	0.138***	0.001	0.08*	0.046	0.174***	0
Pct. Residential Vacant Count	Ring 1	0.501***	0	-0.058	0.587	-0.032	0.761	-0.04	0.707
	Ring 2	0.529***	0	-0.078	0.327	-0.072	0.366	0	0.997
	Ring 3	0.564***	0	0.019	0.776	-0.033	0.626	0.068	0.312
	SC	0.502***	0	0.122**	0.002	-0.005	0.909	0.162***	0
Residential Vacant Area	Ring 1	0.065	0.538	0.088	0.408	0.04	0.704	0.059	0.58
	Ring 2	0.134	0.092	0.036	0.654	0.028	0.731	0.026	0.749
	Ring 3	0.048	0.476	0.36***	0	0.943***	0	0.017	0.805
	SC	0.192***	0	0.223***	0	0.682***	0	0.011	0.786
Pct. Residential Vacant Area	Ring 1	0.189	0.074	-0.257*	0.014	-0.095	0.372	-0.153	0.149
	Ring 2	0.189*	0.017	-0.235**	0.003	-0.099	0.214	-0.153	0.054
	Ring 3	0.196**	0.003	-0.121	0.07	0.079	0.238	-0.109	0.106
	SC	0.176***	0	-0.043	0.277	0.053	0.185	-0.005	0.906
LSA Score	Ring 1	0.442***	0	-0.091	0.389	-0.12	0.256	0.047	0.659
	Ring 2	0.369***	0	-0.103	0.197	-0.128	0.107	-0.005	0.95
	Ring 3	0.362***	0	-0.062	0.358	-0.077	0.249	0	0.994
	SC	0.362***	0	0.029	0.473	-0.001	0.972	0.049	0.216
Med. Income	Ring 1	-0.237*	0.024	0.012	0.912	-0.049	0.646	-0.042	0.695
	Ring 2	-0.285***	0	-0.059	0.46	-0.09	0.259	-0.062	0.436
	Ring 3	-0.29***	0	-0.114	0.09	-0.108	0.108	-0.083	0.217
	SC	-0.18***	0	-0.145***	0	0.041	0.306	-0.124**	0.002
Med. House Value	Ring 1	-0.19	0.072	-0.129	0.222	-0.122	0.248	-0.128	0.227
	Ring 2	-0.208**	0.009	-0.139	0.08	-0.111	0.162	-0.124	0.121
	Ring 3	-0.199**	0.003	-0.158*	0.018	-0.084	0.212	-0.126	0.059
	SC	-0.102*	0.011	-0.158***	0	0.057	0.152	-0.144***	0
Pct. Blacks or AA	Ring 1	0.231*	0.028	0.007	0.945	-0.136	0.198	0.072	0.5
	Ring 2	0.286***	0	0.03	0.708	-0.024	0.766	0.057	0.478
	Ring 3	0.302***	0	0.004	0.955	-0.16*	0.017	0.08	0.232
	SC	0.217***	0	0.093*	0.02	-0.14***	0	0.143***	0
Pct. Pop. Below Poverty	Ring 1	0.143	0.178	-0.045	0.67	0.352***	0.001	0.054	0.613
	Ring 2	0.186*	0.019	-0.092	0.249	0.138	0.082	0.022	0.779
	Ring 3	0.214***	0.001	-0.056	0.408	-0.093	0.165	0.036	0.588
	SC	0.241***	0	0.064	0.107	-0.113**	0.005	0.138***	0.001
Pct. Home Owner	Ring 1	-0.091	0.391	-0.253*	0.015	-0.095	0.371	-0.17	0.107
	Ring 2	-0.143	0.072	-0.27***	0.001	-0.207**	0.009	-0.107	0.18
	Ring 3	-0.112	0.097	-0.269***	0	-0.159*	0.017	-0.069	0.303
	SC	-0.093*	0.02	-0.236***	0	-0.01	0.804	-0.095*	0.017
Total Crime	Ring 1	-0.116	0.275	.597**	0	-0.012	0.908	.222*	0.034
	Ring 2	0.004	0.963	.511**	0	-0.021	0.788	.214**	0.007
	Ring 3	0.025	0.713	.410**	0	-0.072	0.285	.202**	0.002
	SC	0.042	0.299	.329**	0	-.107**	0.007	.157**	0
Per Capita Crime	Ring 1	-0.015	0.886	.269*	0.01	.538**	0	0.029	0.786
	Ring 2	-0.027	0.733	.442**	0	.672**	0	-0.012	0.883
	Ring 3	-0.009	0.896	.381**	0	0.109	0.103	-0.004	0.95
	SC	0.016	0.689	.381**	0	.079*	0.048	0.014	0.731

Significance level (2-tailed): * at 0.05; ** at 0.01; *** at 0.001.
Distance in miles from blight: Ring 1 ≤ 0.25; Ring 2 ≤ 0.5; Ring 3 ≤ 0.75.

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Table 2 Pearson correlations of the socio-economic variables with various distances to industrial blight sites.

		Industrial Blight				Industrial Blight			
Variable	Distance	Count Correlation	p-value	Percent Correlation	p-value	Area Correlation	p-value	Percent Correlation	p-value
Residential Vacant Count	Ring 1	-0.001	0.989	-0.146	0.169	-0.113	0.288	-0.11	0.301
	Ring 2	-0.005	0.953	-0.103	0.194	-0.081	0.311	-0.078	0.326
	Ring 3	0.039	0.559	-0.061	0.363	-0.044	0.511	-0.032	0.632
	SC	0.075	0.06	-0.006	0.877	0.002	0.966	0.021	0.607
Pct. Residential Vacant Count	Ring 1	-0.05	0.638	-0.152	0.15	-0.138	0.192	-0.09	0.396
	Ring 2	-0.044	0.585	-0.112	0.16	-0.102	0.201	-0.07	0.379
	Ring 3	-0.002	0.971	-0.071	0.288	-0.066	0.33	-0.03	0.659
	SC	0.074	0.062	0.007	0.862	0.005	0.901	0.047	0.24
Residential Vacant Area	Ring 1	-0.04	0.707	-0.055	0.608	0.012	0.912	-0.051	0.632
	Ring 2	-0.019	0.808	-0.03	0.708	0.01	0.899	-0.027	0.738
	Ring 3	-0.018	0.79	-0.018	0.793	-0.006	0.933	-0.019	0.783
	SC	-0.027	0.494	-0.024	0.554	-0.014	0.721	-0.026	0.512
Pct. Residential Vacant Area	Ring 1	-0.13	0.218	-0.144	0.174	-0.086	0.418	-0.047	0.656
	Ring 2	-0.119	0.134	-0.121	0.128	-0.08	0.314	-0.062	0.439
	Ring 3	-0.077	0.25	-0.085	0.205	-0.053	0.433	-0.032	0.636
	SC	-0.033	0.414	-0.038	0.342	-0.023	0.572	-0.011	0.779
LSA Score	Ring 1	0.013	0.899	-0.01	0.926	-0.078	0.463	0.009	0.931
	Ring 2	-0.01	0.904	-0.022	0.784	-0.071	0.372	-0.01	0.896
	Ring 3	-0.015	0.821	-0.024	0.725	-0.064	0.34	-0.015	0.823
	SC	0.035	0.384	0.018	0.66	-0.015	0.701	0.03	0.454
Med. Income	Ring 1	-0.182	0.084	-0.132	0.214	-0.047	0.661	-0.153	0.147
	Ring 2	-0.133	0.095	-0.098	0.218	-0.041	0.604	-0.114	0.153
	Ring 3	-0.122	0.068	-0.091	0.175	-0.043	0.521	-0.106	0.116
	SC	-0.131***	0.001	-0.099*	0.013	-0.07	0.081	-0.116**	0.004
Med. House Value	Ring 1	-0.171	0.105	-0.204	0.052	-0.13	0.221	-0.15	0.156
	Ring 2	-0.127	0.111	-0.133	0.095	-0.093	0.241	-0.112	0.158
	Ring 3	-0.118	0.079	-0.122	0.07	-0.087	0.196	-0.105	0.118
	SC	-0.119**	0.003	-0.109**	0.006	-0.085*	0.033	-0.106**	0.008
Pct. Blacks or AA	Ring 1	0.108	0.306	0.027	0.797	0.023	0.827	0.165	0.119
	Ring 2	0.068	0.398	0.013	0.875	0.01	0.896	0.11	0.168
	Ring 3	0.077	0.251	0.028	0.682	0.024	0.721	0.109	0.105
	SC	0.107**	0.008	0.066	0.099	0.059	0.142	0.115**	0.004
Pct. Pop. Below Poverty	Ring 1	0.13	0.221	0.178	0.091	0.059	0.576	0.175	0.096
	Ring 2	0.108	0.175	0.141	0.077	0.054	0.499	0.14	0.079
	Ring 3	0.112	0.094	0.134*	0.046	0.061	0.366	0.136*	0.043
	SC	0.129***	0.001	0.125**	0.002	0.079*	0.047	0.135***	0.001
Pct. Home Owner	Ring 1	-0.127	0.23	-0.25*	0.017	-0.023	0.829	-0.053	0.615
	Ring 2	-0.132	0.097	-0.215**	0.006	-0.044	0.586	-0.074	0.352
	Ring 3	-0.098	0.143	-0.17*	0.011	-0.03	0.66	-0.053	0.435
	SC	-0.12**	0.003	-0.139***	0	-0.063	0.115	-0.089*	0.025
Total Crime	Ring 1	.233*	0.026	0.155	0.143	.314**	0.002	0.059	0.58
	Ring 2	.254**	0.001	.176*	0.027	.312**	0	0.099	0.216
	Ring 3	.251**	0	.176**	0.008	.301**	0	0.107	0.112
	SC	.213**	0	.154**	0	.231**	0	.116**	0.004
Per Capita Crime	Ring 1	.365**	0	.304**	0.003	0.149	0.158	0.005	0.963
	Ring 2	0.041	0.608	0.037	0.646	0.012	0.877	-0.016	0.838
	Ring 3	0.049	0.47	0.043	0.526	0.018	0.79	-0.009	0.898
	SC	0.068	0.087	0.058	0.148	0.032	0.424	0.01	0.794

Significance level (2-tailed): * at 0.05; ** at 0.01; *** at 0.001.
Distance in miles from blight: Ring 1 ≤ 0.25; Ring 2 ≤ 0.5; Ring 3 ≤ 0.75.

monly done at a coarser grain of the inner city of the metropolitan region.

3.3 Path Analysis

The inner-city neighborhood blight literature commonly identifies the drivers of decline endogenously, as if the neighborhood is a closed socio-spatial unit. However, the historic urban form that located housing near industry for employed residents' convenient and affordable access, and industrial sites near major roads for optimum regional access provides clues to look for the neighborhood and industrial jobs as elements of an open urban system or connected network of housing-jobs-access. The manifestation and spatial distribution of blight are different in different urban areas, due to the city-specific contexts and empirical analyses (Antipova et al. 2022b). Fig. 1 shows the distribution of industrial blight in Shelby County, TN, and block groups in 0.25 miles (Ring 1), 0.50 miles (Ring 2), and 0.75 miles (Ring3) distance to blight site (see also Banai and Ploderer 2018).
A previous study by Antipova et al. (2022a) indicates that blight decays with distance from the city center. In the current study, we have set out to focus on the neighborhood impact of industrial blight within an urban system that is characterized by the scale of block groups. Besides the operational facility of the U.S. Census with socio-spatial data, and aided with a GIS, the block group approximates the neighborhood. Previous studies conducted at various spatial scales of the metropolitan region, for example, the neighborhood, downtown, inner-city, outer ring, or the metropolitan region shed light on the urban blight dimension but also pose the ambiguity of both the variable relation and the relative importance of blight determinants which are site- or context-specific (analogously to the well-known modifiable areal unit problem – MAUP – in spatial science).
We determine the direct and indirect impact of the industrial site on the neighborhood with a path analysis by using block-group data (Fig. 5 and Fig. 6). A brief review of the literature informed what socio-economic variables are plausibly applied in our site-specific urban system.
We have conceptualized industrial vacant and blight as a kind of filter in the block group. The viability of the block group as a whole is indicated by income. We use block group median income (BMI) analogously to the commonly used area median income (AMI), which is metropolitan region-wide. We use it as a dependent variable in path analysis. The socio-economic variables of interest have a direct and indirect relationship to the median block income through industrial blight and industrial vacancy as a "filter". For simplicity, the direct impacts of explanatory variables on area median income (AMI) are not shown in Fig. 6.
The socio-economic correlations of industrial blight noted above do not connote causation. Thus, we use path analysis to determine how the well-being of the block group as measured by median block group income (analogously to metropolitan median area income noted above) is determined directly and indirectly by socio-economic variables and by industrial blight. Path analysis results for ¼ mile distance of indusial blight and for Shelby County are shown in Table 3 and Table 4, respectively. The path analysis in Fig. 6 is expressed by regression equations as:

$$Y = e_0 + e_1 \cdot factor_1 + e_2 \cdot factor_2 \cdots + e_n \cdot factor_n \quad (2)$$

Where e_0 is the constant, e_i is the coefficient and $factor_i$ indicates a socio-economic variable. For instance, the path analysis for variables shown in Fig. 5 can be expressed as:

$$Number\ of\ industrial\ vacants = e_0 + e_1 \cdot LS \quad (3)$$
$$BMI = e_0' + e_1 \cdot LSA + e_3 \cdot (Num.\ of\ industrial\ vacants) \quad (4)$$

The vitality of the neighborhood is reflected by the supply and condition of housing. Housing vacancy, food deserts (low LSA score), crime, and proximity to industrial blight are among the contributors to neighborhood decline. We have already observed associations. However, our path analyses confirm causation. Our hypothesis that neighborhood well-being as measured by the block group median income is affected by the presence of industrial vacancy and bight is reflected in the path analysis (Fig. 6). We highlight the impact when industrial vacancy and blight are in proximity, block group land use within ¼ mile distance, Ring 1 (Table 3). The influence of the African-American population (percent), poverty, food desert, residential area vacancy (percent), residential vacancy, and crime (per capita) is as expected - the increasing variable values result in declining median block group income. The increase in the percent of block group area industrial vacancy decreases the median block group income (MBI). A similar impact is found for the number of industrial blight sites. Not expected are the impacts of alternative measures of industrial vacancy and blight which indicate MBI increasing.
For Shelby County, the median block group income declines with an increasing percent area of industrial blight as well as the number of industrial blight sites. However, industrial vacancies do not have

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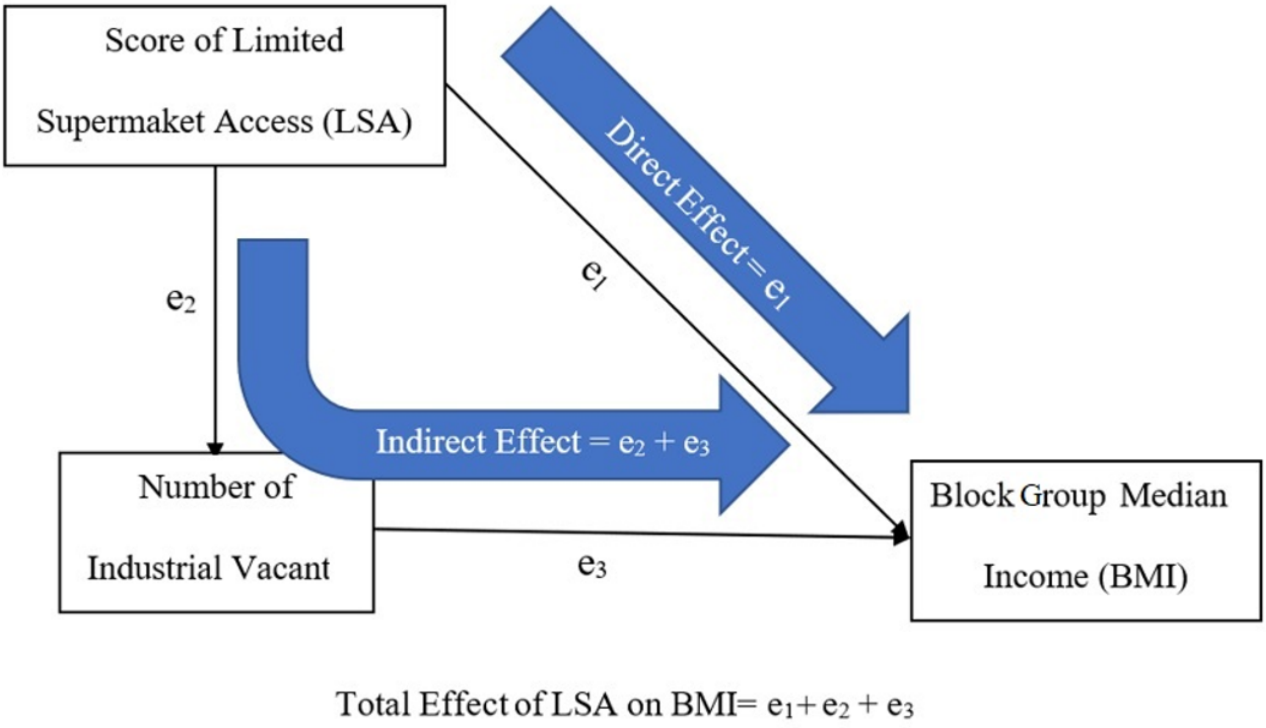

Fig. 5 A path analysis depicting direct and indirect (number of industrial vacant) impacts of limited supermarket access (LSA) on block group median income (BMI).

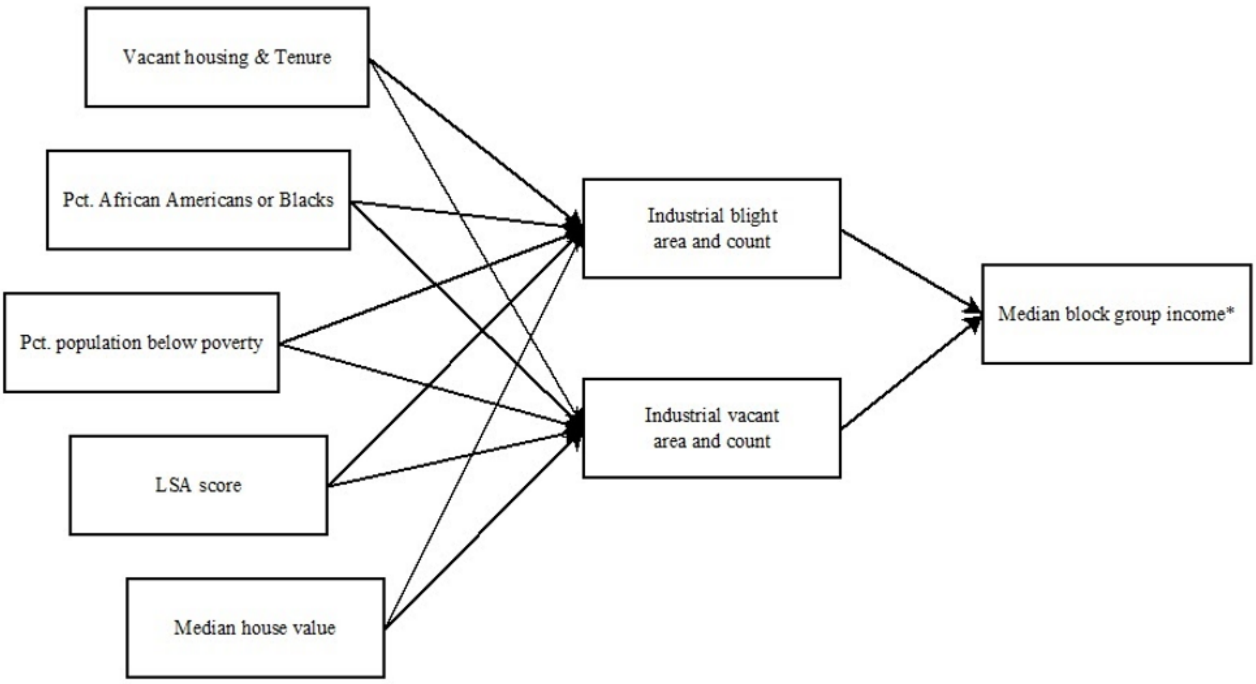

Fig. 6 Causal path diagram for block group neighborhood impact of industrial blight. * Housing Tenure is measured by % owner-occupied. ** Block group median income (BMI) is analogous to the commonly used Area Median Income (AMI), which is metropolitan region-wide. We use it as a dependent variable in path analysis. *** Variables have direct and indirect (through industrial blight and industrial vacant) relationships to the median block income.

Table 3 Direct, indirect, and total effect of socio-economic variables and industrial blights and vacant for Ring 1 (¼ mile distance of indusial blight).

Vairable	Direct effect	Indirect effect	Total effect
Per capita crime rate	−4930.649	2122.413	−2808.236
Count of crimes	6.411	2.374	8.785
Pct. people below poverty level	−305.711	58.472	−247.24
Pct. Blacks or African-Americans	−276.846	−26.867	−303.713
Median house value	0.169	−0.005	0.164
Score of limited supermarket access	−19.592	−22.247	−41.839
Pct. owner occupied houses	149.302	−17.402	131.9
Area of residential vacants	−55.482	−141951	−197.433
Pct. area of residential vacants	0	0	0
Count of residential vacants	337.254	78.625	415.879
Pct. count of residential vacants	−24.875	−4.931	−29.806
Area of industrial vacants	−19.153	0	−19.153
Pct. area of industrial vacants	0	0	0
Count of industrial vacants	821.173	0	821.173
Pct. count of industrial vacants	1.748	0	1.748
Area of industrial blight	21.131	0	21.131
Pct. area of industrial blight	0.003	0	0.003
Count of industrial blight	5223.231	0	5223.231
Pct. count of industrial blight	−3046.774	0	−3046.774

Table 4 Direct, indirect, and total effect of socio-economic variables and industrial blight and vacant for Shelby County.

Vairable	Direct effect	Indirect effect	Total effect
Per capita crime rate	−1115.058	123.759	−991.299
Count of crimes	−6.231	3.002	−3.229
Pct. people below poverty level	−412.804	4.291	−408.514
Pct. Blacks or African-Americans	−113.797	−2.717	−116.513
Median house value	0.174	−0.001	0.173
Score of limited supermarket access	−73.908	1.646	−72.263
Pct. owner occupied houses	78.572	0.844	79.416
Area of residential vacants	−2.738	−1.08	−3.817
Pct. area of residential vacants	0	0	0
Count of residential vacants	−76.925	−8.002	−84.927
Pct. count of residential vacants	13.355	12.639	25.994
Area of industrial vacants	70.887	0	70.887
Pct. area of industrial vacants	0	0	0
Count of industrial vacants	537.97	0	537.97
Pct. count of industrial vacants	8.836	0	8.836
Area of industrial blight	−118.3	0	−118.3
Pct. area of industrial blight	0.008	0	0.008
Count of industrial blight	7108.752	0	7108.752
Pct. count of industrial blight	−3285.342	0	−3285.342

the same impact as an industrial blight on MBI. This finding is the same whether the industrial vacancy is measured by the percent of block group area, the number, or percent of properties (Table 1 and Table 4). Residential vacancies measured in percent impact Shelby County negatively with decreasing BMI, whereas increasing if measured by the number of vacancies. Median housing value positively impacts Shelby County's BMI. Similarly, ownership increases BMI (see percent value in Table 2).

The variables expected to have a negative impact in Shelby County are similar to those observed in the inner city, particularly within a ¼ mile distance of the industrial blighted or vacant properties. Crime, measured by the number of per capita, poverty, percent black residents, and limited supermarket area (LSA) or food desert decreases Shelby County's BMI (Table 3 and Table 4).

4 Conclusion and Extensions

We have compared our empirical findings with those in the literature on urban blight. However, blighted and vacant properties are rarely an integral part of empirical studies. We have filled this void by including both in a two-part analysis – Pearson correlation and path analysis.

A GIS enabled classification of data by various proximities, from ¼ to ¾ mile distance of the blighted and vacant site. For comparison, we include results from Shelby County. The mapping of both blighted and vacant properties was also facilitated by using GIS with the calculation of the block group's industrial blight and vacancy determined in both numbers as well as proportion. Within the immediate vicinity of the vacant and blighted property, ¼ mile-distance, and for Shelby County, we highlight the socio-economics of the block group with the differential effect of blight and vacant property with a path analysis.

It turns out, certain socio-economic correlations are similar whether measured for blight or vacant property. Among them, is the proportion of population below poverty which increases with blight and vacant property. Similarly, that symbol of the American dream, homeownership, declines with both blight and vacancies. However, the (inverse) correlation values decline with increasing distance from ¼ to ¾ mile. There are also differences in the results from blight vs. vacancy, particularly for the county. For example, the (county) median block group income (BMI) is impacted similarly whether blight is measured in percent of industrial area or the number of sites. This result is in contradistinction to the effect of industrial vacancies on BMI, whether vacancy is measured by the percent of block group industrial area, the number, or percent of properties.

The distinction made between blight and vacant industrial properties provides further implications for public policy that aims at blight remediation vs. reduction of vacancies. For example, the finding that home ownership declines with vacancies suggests policy attention to both home ownership and vacant property – notwithstanding the challenges that each poses independently (see also Nassauer and Raskin 2014). The socio-economic variables measured directly and indirectly for block group impact in path analysis provide further clues for targeted policy intervention. The observation that vitality of the block group (as determined by median income) is affected similarly by both industrial blighted and vacant property also suggests targeted policy interventions – e.g., vacancy may be given a greater priority than the more formidable blight reduction, particularly in brownfield sites. The distinction made between "structural abandonment" and "vacant" sheds light on policy and planning intervention strategically (Newman et al. 2018). Brownfield sites characterize structural abandonment, a manifestation of urban economic decline whereas the latter is related to expansion of "political boundaries". Comprehensive planning and (re)zoning of industrial land is an intervention option which aims to address the strengths and weaknesses of the local and regional economy (Howland 2010).

Furthermore, our measures of the block group's blighted and vacant properties include crime statistics in the correlations of the socio-economic variables at various distances from the blighted and vacant properties. Although the aggregate statistic does not reveal characteristics of the persons with crime, the inclusion of structural features of the block groups, including poverty suggests future, in-depth investigation of a persistent place vs. place prosperity in urban studies (see also Stark 1987; Crossley 2017).

We have presented path analysis and Pearson correlation results of the blighted and vacant properties parsimoniously. Comparisons of the impact of blighted and vacant properties in various rings similar to the differentiation of proximity in Pearson correlations from ¼ to ¾ mile noted above await further observation. Estimation of the degree as well as significance of the relationship beyond an association at various distances to blighted and vacant sites, similar to Banai and Antipova (2016) micro analysis of the variability of retail suggests a plausible extension.

To determine the impact of industrial blight and vacancy on the block group, we used readily available block group median income (BMI) analogously to commonly used metropolitan area median income (AMI), as a dependent variable in the path analysis (https://www.huduser.org). Further research plausibly explores alternative indicators of block group and neighborhood vitality.

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