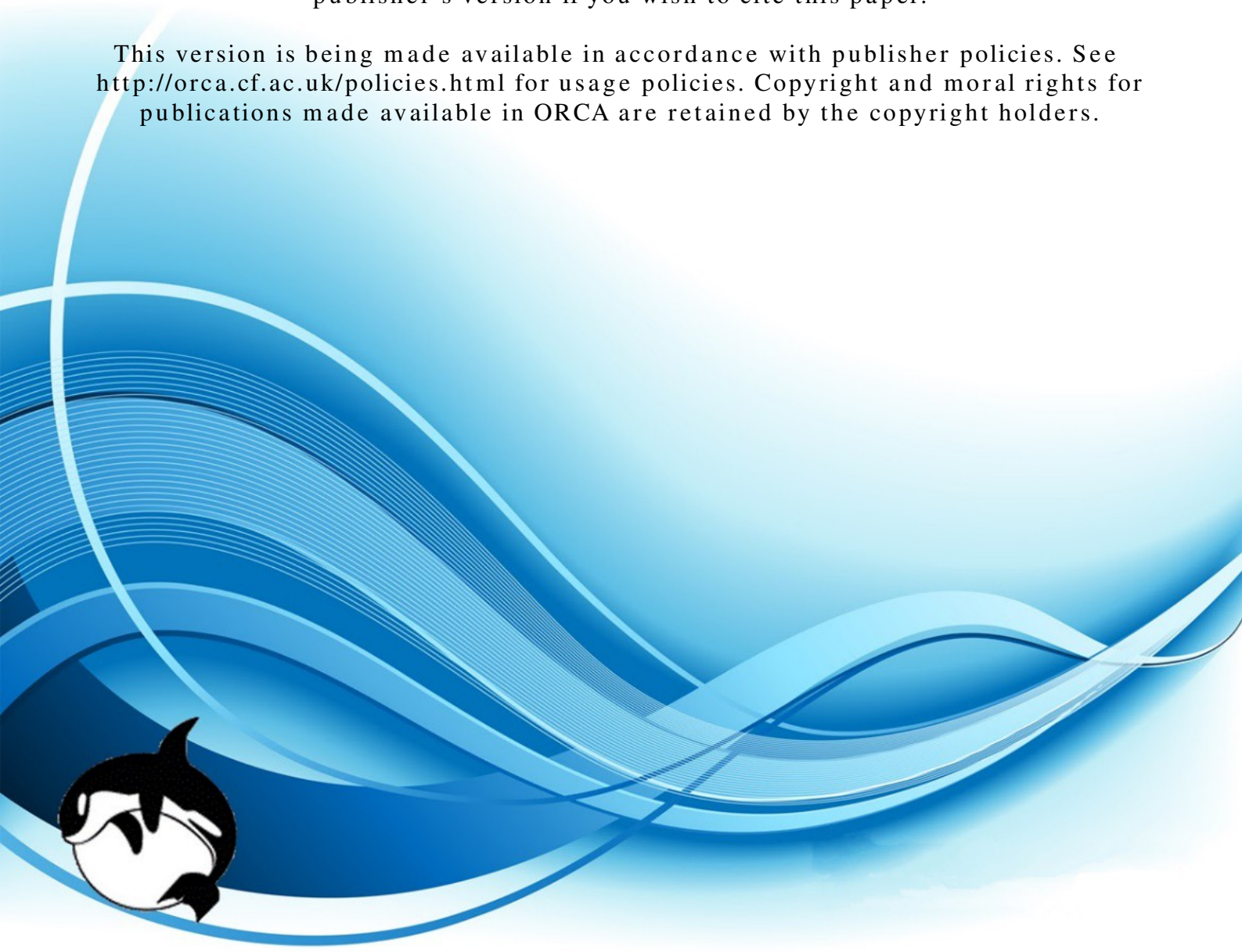

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Vacancy and Property Values in Shrinking Downtowns: A Comparative Study of Three New England Cities

Justin Hollander, Tufts University

Maxwell Hartt, Cardiff University

1. Introduction

For shrinking cities, falling demand can wreak havoc on downtowns, in particular. Generally, downtowns are considered to be in central zones and maintain a certain threshold level of density. When a city loses jobs and people, downtowns begin to face high vacancy rates and local governments have few tools to respond. For residential or industrial areas in decline, city governments can (and do) actively use demolition to address widespread vacancy (Williams 2013). But demolishing downtown buildings can be challenging due to costs, logistics, and historic preservation concerns.

Shrinking cities are often defined as places that have lost population while undergoing an economic transformation (Wiechmann and Pallgast, 2012). Despite often being considered synonymous, economic decline and population shrinkage are distinct phenomena (Ryan, 2012). Shrinkage is not an essential precondition for decline. After all, decline occurs even in the fastest-growing cities. Although population loss is not always accompanied by economic decline (Hartt, 2018a), the majority of U.S. shrinking cities do experience economic, physical and social distress (Weaver et al., 2017). In this paper, we explore the dual phenomenon of population shrinkage and economic decline. The process of population shrinkage and property abandonment has increasingly become a pressing issue as policymakers seek to avoid the misapplication of critical tax revenues (Davey, 2013). This has not gone unrecognized by the academic community, as illustrated by the formation of the Shrinking Cities International Research Network (SCIRN) (Wiechmann, 2008). Evidence emerging from this – and earlier – academic inquiry suggests that building abandonment is an indicator of contemporary economic decline as well as a harbinger of future decline (Brady, 1983; Accordino et al., 2000; Runfola et al., 2010; Dewar and Thomas, 2013; Pallagst et al., 2014; Hollander, et al. 2009). While earlier research has contributed much to

understanding the phenomenon of urban decline, less is understood about the relationship between decline and commercial centers and downtowns. In order to facilitate geographically targeted policymaking and offer guidance to urban and regional planners, this paper employs a combination of quantitative research methodologies to examine overall patterns of decline and downtown change in three New England (U.S. cities. Specifically, we examine the research question: *How does the process of urban decline impact occupancy, building conditions, and property values in downtown districts?*

2. Literature Review

2.1 The Phenomenon of Shrinking Cities and Neighborhood Change

Shrinkage in the urban planning literature has often been used to describe population loss, employment loss, or decrease in neighborhood quality (Bradbury et al., 1982; Berg et al., 1982; Clark, 1989; Rusk, 1995). In the U.S. dozens of cities have succumbed to massive depopulation in recent years. According to the U.S. Census, the City of Detroit lost 25 percent of its population from 2000 to 2010. But this trend is no longer confined to post-industrial Rust Belt cities: some of the most prominent population losses in this recent period can be found in Sun Belt locales that exploded in population in the 1990s and early 2000s, including cities such as Las Vegas, and Modesto. No single rationale or explanation exists as to why these and other cities have declined. Shrinkage has been explained by everything from natural disasters (Vale and Campanella, 2005), deindustrialization (Bluestone and Harrison, 1982), demographic shifts (Hartt and Hackworth, 2018), suburbanization (Jackson, 1985; Clark, 1989), globalization (Sassen, 1991; Hall, 1997) and the boom and bust economic cycles (Rust, 1975). Many shrinking cities scholars have taken a more holistic view, positing that urban growth and decline are a global multifaceted phenomenon, deeply

related to broader metropolitan and global processes that include demographic change, economic restructuring, deindustrialization and suburbanization (Audirac et al., 2012; Martinez-Fernandez et al., 2012a, 2012b; Haase et al., 2013; Hartt, 2018b). Although shrinking cities research has grown considerably in the past decade, the current literature lacks robust empirical studies examining the interplay of decline and property value change in downtowns.

2.2 The Landscape of Shrinking Cities

When individual people or groups leave an urban region, the physical form of the city does not naturally shrink – abandoned properties and infrastructure remain until it is either occupied by new tenants or maintained by a new group (i.e., see Runfola and Hankins, 2010). This can have a wide variety of frequently negative feedback effects on local economies and future abandonment. Glaeser and Gyourko (2005) studied the durability of housing in their time-series sample of 321 U.S. cities and towns with at least 30,000 residents in 1970, showing how housing prices declined at a faster rate in depopulating cities than prices grew in growing cities. Additional research has shown the role abandoned structures serve as havens for criminal activity, further deflating economic and social incentives for individuals to remain in an area or to move elsewhere (Wallace, 1989; Wilson and Kelling, 1982).

Amplifying the challenges posed by urban decline, poorer economic conditions can result in lower demand for housing and commercial units and, subsequently, a lower economic class of owners or renters (Hoyt, 1933; Temkin and Rohe, 1996). Ultimately, when demand sinks to a certain threshold level, owners tend to abandon their structures – resulting in even poorer economic conditions (Keenan et al., 1999). This process further reduces the tax base available to local municipal systems, potentially increasing crime rates and reducing funding for municipal activities

such as park and road maintenance and capital public projects (Dewar and Thomas, 2013). Some shrinking cities expand their municipalities in an attempt to recover their lost tax base. However, municipal expansion has also been found to be a cause of vacant land (Pagano and Bowman, 2000; Newman et al., 2016). This process has also been studied in the context of closed military facilities, where researchers have learned the value of community participation and how critical land use planning is for now vacant uses (Office of Economic Adjustment 1999; Hansen 2004).

Rust's (1975) study of population and employment decline in 30 U.S. metropolitan areas from the 1800s to the 1970s revealed much about *how* places decline. He found that these shrinking places experienced dramatic population loss followed by "a long period of profound resistance to demographic or economic change which continues until the people, artifacts, and institutions which were assembled in the truncated growth era gradually erode away" (p. 169). The very physical fabric of neighborhoods—these artifacts—is expected to "erode away" in a period of decline. For many of the cases Rust studied, once the decline began, the effects are "expected to be felt most strongly a generation after the cessation of growth and to persist for up to 50 years" (p. 187). For the booming cities of today, these results present a clarion call for a new way to do planning; a new model is needed to think about neighborhood change in the face of ongoing population and housing loss (Schilling and Logan, 2008).

2.4 Property Values and Urban Decline

There is a rich history of research examining the relationship between urban change and property values. An in-depth literature analysis of over 100 empirical studies by D'Acci (2014) quantified the increase of property value in relation to a range of urban factors including open space, noise, and public transit. He determined that the perceived amenities and dis-amenities of

an area could increase the value of a property by up to 143%. In addition to physical attributes and local amenities, Scheller (2015) found that the presence of homeowners' associations also increased property values. But can the quality of an area devalue property? In Manville and Kuhlmann's (2016) examination of the 110 largest US cities from 1980 to 2010, they found that vacancy was correlated with lower property values. In fact, property value research in declining or shrinking cities is largely focused on the impact of abandonment, vacancy and blight, as these changes to the built environment are generally understood to lower property values and increase crime rates (Goetz et al., 1998; Keenan, Lowe and Spencer, 1999; Shlay and Whitman, 2006).

Many studies have focused on the impact of residential vacancy on property. This is partially due to the availability of consistent data, but also due to the sheer scale of residential abandonment. Prener et al. (2018) found that residential properties accounted for approximately 75% of the almost 50,000 vacant parcels in St. Louis. Having just one abandoned property has been shown to reduce the value of all other properties on the block (Temple University Center for Public Policy, 2001; Shlay and Whitman, 2006; Griswold and Norris, 2007). And a decrease in property values over time can signal further decline as low property values have been shown to predict further abandonment (Aalbers, 2006; Hillier et al., 2003). Morckel (2013) found that market conditions (property value, foreclosures and sales) are a better predictor of abandonment then gentrification, physical neglect, socioeconomic conditions or financial neglect. In a follow-up study, she found that market conditions in surrounding neighborhoods have a greater impact on probability of abandonment than the conditions of the neighborhood itself (Morckel, 2014). Han (2014) determined that the longer a property is abandoned, the further its negative influence on property values reaches and the more those values are impacted.

Many studies exploring the relationship between vacancy and property value concentrate either solely on residential areas or a combination of residential, commercial and industrial areas. One important exception is Newman et al.'s (2016) study of urban elasticity and vacancy. Examining 40 US cities, they found that property value was negatively correlated to, and a significant predictor of, business vacancy rate. However, similar to most of the studies detailed in this section, Newman et al. (2016) relied upon aggregate property value data (median property value of owner-occupied units) rather than individual property appraisals for their analysis. Fine-grained, targeted analysis of the built environment in shrinking cities, and even more so their downtowns, is imperative to advance our understanding of the implications of decline, abandonment and vacancy. Detailed analysis is especially important to inform local decision-makers and help create targeted policy to improve the physical condition and resident quality of life in shrinking cities.

2.5 Literature on Downtowns

Prior to discussing our research on downtowns, a brief introduction to the concept is necessary. Traditionally, downtowns have been the "regional hubs of commerce, culture, and shopping" (Morcol, 2008, p. 140). Tough to define more stringently, the International Downtown Association has published on the notion of a tripartite definition comprised of firm data, jobs data, and household data (Levy and Gilchrist 2014). By drawing on disparate source, they calculate where downtowns are located based on where the biggest clusters of jobs emerge, then carve out bounded polygons of those zones based on the boundaries of existing census tracts (Levy and Gilchrist 2014).

While the concept of downtowns can be amorphous, the Central Business District (CBD) and its boundaries tend to be better defined locally by the business community. This CBD zone is a place where public and private investment efforts are most heavily concentrated in a city and its general dimensions are roughly agreed upon by business and government sectors. The CBD is often used as a proxy to measure the overall health of a city's broader real estate market. For example, several U.S. Presidential Executive Orders have directed federal agencies to locate their major offices and courthouses in central business districts of cities (E.O. 12072 and E.O. 13006). However, vacancy in the CBD can be problematic. Studies have shown that the closer the CBD is to vacant land, the more difficult it is to regenerate (Sternlieb et al., 1974; Newman and Kim, 2017).

With shifting technological, political, and economic forces at work over the last half-century, much of that center has physically shifted to further and further outside these downtowns into regional shopping centers and suburban office parks and, in some cases, a secondary CBD. When entirely new CBDs are formed, they tend to also be accompanied by emerging political and economic clout of property owners and businesses located in the new CBD, further diminishing investment and interest in the historic CBD. This pattern can represent a major challenge for a growing region as it sprawls far from its historic center, straining fiscal, transportation, and other infrastructure systems (Cullingworth, 2015). The strain of sprawl presents unique, and arguably more onerous, challenges in a contemporary context of shrinking cities and regions.

Blakely and Leigh's (2013) research found that during economic booms, downtowns benefit from an influx of residents and investments; but what about during downtimes? They, and others, have written about the role of government around the "provision of water and sewerage lines, street lighting, access roads, and sidewalks" (Blakely and Leigh, 2013, p. 239). Overlay

zoning allows developers to "place facilities where demand exists rather than where planners think they ought to be" (Blakely and Leigh, 2013, p. 241). But it is Business Improvement Districts (BIDs), Tax Increment Financing, and public-private partnerships that have received the most attention as solutions to the problems of the shrinking downtown (Mallet, 1994; Mitchell, 2001; Mitchell, 2008; Morcol, 2008). Blakely and Leigh (2013) conclude their research into historic shrinking downtowns with this advice:

> Many small towns believe tourism is the antidote to the collapse of their town centers. Although tourist dollars are important, local trade is important as well. Tourism is both cyclical and fickle. Commercial centers must ultimately survive on local traffic…One of the best ways to make the downtown area attractive is to embark on programs that give it character or restore some character to it. (p. 241)

When downtowns are in distress, it is common for property owners to convert vacant lots into parking locations as an interim strategy (Joseph 2012). The notion that surface parking is the highest and best use of any land in a central business district suggests a broader challenge to a city's real estate market and may be cause for concern.

What is missing in much of this literature is any substantial examination of ways that shrinking downtowns can adjust to a smaller business footprint, fewer jobs, and fewer businesses.

2.5 Mapping and Measuring Urban Decline

Bowman and Pagano (2004) conducted an exhaustive study about vacant land seeking to understand the extent of the vacancy problem in the U.S. They administered written surveys to

local officials and assembled a database of abandoned buildings and vacant lot counts across more than 100 cities in the U.S. Unfortunately, this survey-based method has been shown to be unreliable when crosschecked against housing unit counts from the Decennial Census. Local officials use very different strategies from one another to account for vacancy and abandonment, making the use of locally distinct administrative data sources a suboptimal approach for making national generalizations (Bowman and Pagano, 2000). Newman, et al. (2016) updated the 2004 study, finding only a modest increase in the ratio of vacant land to city size since 1998.

Hillier et al. (2003) examined Philadelphia's housing databases to track vacancy and abandonment data, but their systems are not interoperable and study domain has a limited scope, making broad-scope comparative analysis impossible. Wilson and Margulis (1994) developed a similarly localized analysis in Cleveland. Runfola and Hankins (2010) conducted field work in Atlanta to identify on-the-ground inventories of abandoned and derelict housing, but constructed information for only a limited subset of census block groups in the Atlanta region at a high time cost, making this approach infeasible for broad-scope analyses.

Many remote-sensing and GIS-based studies have worked towards measuring urban population change, including Weber and Puissant (2003), Xiao et al. (2006), and Yang and Lo (2002). Ryznar and Wagner (2001) attempted to use remote-sensing to study the effects of population decline. However, they were only able to measure net changes in forested and agricultural land and had to extrapolate their findings to examine housing and commercial land use changes. Banzhaf et al. (2007) explored shrinkage in Leipzig, Germany, but found that the necessary data to validate their findings was lacking. Additionally, Morckel (2014) compared some of these approaches, using census data, tax delinquency, and abandonment based on direct observation and concluded that they varied in statistical significant ways.

In order to overcome these issues, recent work has utilized housing occupancy counts produced by the United States Postal Service (USPS), a novel database available to interested researchers (Hollander 2011). Though changes in housing occupancy can happen for a variety of reasons, these data correlated strongly with segments of the U.S. Sunbelt that experienced widespread vacancy and abandonment during the Great Recession in the U.S., though Immergluck (2015) cautions that this kind of administrative data, that is, data collected for a very different reason than to monitor abandoned buildings, may not be a reliable measure.

A bigger challenge is understanding abandonment in commercial centers and downtowns. USPS data is also available for commercial properties, but businesses do not constitute themselves in the same way that residential households do: there are minimum square foot requirements for domiciles, where a business can occupy an address with only a mailbox. Beyond government sources, real estate scholars have developed their own proprietary databases for measuring and studying commercial vacancy.

3. Conceptual Framework

The aforementioned literature on shrinking cities and downtowns helps us consider a broader conceptual framework that can be applied in answering the key research question for this study: How does the process of urban decline impact occupancy, building conditions, and property values in downtown districts?

While certainly the myriad of forces at work in cities and regions play a role in shaping what happens in a downtown, the scholarly literature cited above tells a story which we present in Figure 1 below. Whatever broader economic, political, or social conditions might be at work, we begin at the top of the diagram with the notion that these forces will generate population and

economic decline for some places (e.g. in a booming economy, there will be fewer declining places than in a weakening economy). But this paper seeks to isolate the direct and indirect impacts of that decline, rather than interrogating precisely why or how it is occurring. As such, urban decline is treated as an independent variable in our analysis, but we recognize that it can result from other factors.

What follows such decline will most always be a concomitant decrease in demand for downtown real estate. Given that a downtown functions as a center for a city, in the face of larger decline, the number of firms, organizations, investors, and individuals seeking real estate in the downtown is expected to fall. The consequence of such a drop in demand for downtown real estate is a decrease in the occupancy rates of downtown buildings. With lower rents (and lower profits) building conditions are also expected to degrade due to decreased investment in maintenance, protection, and care.

Figure 1: Conceptual framework of downtown decline

Unfortunately, the story does not end there due to a well-documented trend of vacancy contagion explored in the literature above. Figure 1 indicates how the economic and demographic forces push down from the top of the diagram and forces of contagion impact downtown building occupancy and conditions from below. Figure 1 depicts a potentially devastating spiral effect of decline, vacancy and abandonment, lower property values, poor conditions, and depressed occupancy, contributing to a contagion effect of worsened conditions, occupancy, and property values. In this research, we seek to draw on this conceptual framework to examine how this process unfolds across three cities in New England.

4. Methods

4.1 Data

The empirical analyses conducted for this study focus on data sets that indicate change in downtown building stock. Population change is frequently used as a proxy to measure urban decline, though we find it to be an imperfect measure – and one that could in fact confound our analysis. Rather, this study looks to identify the prevalence of increasing vacant commercial and residential spaces and buildings, where contagion effects might play out differently than in a residential context.

This study offers a methodology for national comparison of downtown real estate trends over the last decade, adding to the gaps in the literature around the need to study, empirically, the processes of urban decline through a comparative lens. The choice of three New England cities was made due to the region's location within the famed U.S. Rust Belt, a swath of the U.S. that has struggled in the face of de-industrialization and globalization (Bluestone and Harrison 1982),

and based on the three subject cities' status as having substantial downtown vacancy and prolonged periods of depopulation: Bridgeport (Connecticut), Lewiston (Maine), and Springfield (Massachusetts). In our previous research on the New England region, administrative and census data on downtowns showed that each of the three cities ranked in the top decile of New England cities regarding downtown vacancy and prolonged depopulation (Hollander, et al. 2018).

For the three cities, housing occupancy data aggregated and disseminated at the postal code level by USPS was utilized in conjunction with U.S. Census demographic, housing, and employment data. Six days a week, every week of the year, USPS sends a postal worker up and down nearly every street in America and collects data on total deliveries for each ZIP code. After 90 days with no delivered mail, the address is considered "unoccupied" and is removed from the active inventory.

To identify the CBDs in each of the New England cities, we examined zoning maps or Chamber of Commerce diagrams to indicate the boundaries of CBDs and then ran descriptive statistics on Census tracts located either entirely within or partially within those boundaries.

4.2 Occupancy and Condition Methodology

In previous research, we conducted direct observation of the conditions of all buildings within the CBDs of the three case study cities (Hollander, et al. 2018). We developed a direct observation tool to record our observations. The unit of analysis we employed was the address (so even if there are multiple units or many different offices in a commercial building, we only looked at "4 Main Street" as one unit, for example). The observation tool consists of three parts. First, identifying the "occupancy status" – a categorical variable ranging from 0 to 4 where 1 is fully occupied; 2 is partially occupied with "for rent" signs; 3 is unoccupied; 4 is illegally occupied with

evidence of squatting; and 0 is for a location experiencing renovations/construction. Second, identifying the "structure condition" – again a categorical variable ranging from 0 to 4 where 1 is an empty lot where there is no structure or it is demolished; 2 is poor condition with evidence of fairly extensive disrepair, peeling paint or broken windows; 3 is fair condition with evidence of minor disrepair but is generally okay; 4 is excellent, in good condition, with exterior surfaces intact; and 0 is for a location experiencing renovations/construction. Members of the research team conducted a pilot test of this instrument in a distressed urban downtown close to our university campus. Those results helped to refine the specific categories employed and unit of analysis. Lastly, we also took detailed notes to characterize the quality of the exterior of the building and the interior when notable. For each city, a researcher travelled to the location and spent between 5-8 hours walking up and down each street in the delineated downtown district. At each address, the researcher recorded the occupancy and condition (per the rating system above) in a table (as well as their observational notes) and then took a photograph of each building.

A second member of the research team re-scored all locations using photographs taken at the site to ensure high inter-rater reliability. Likewise, if there were buildings that did not have clear addresses during the visit, we sought to determine this with online mapping sites (or just by typing a business name into a search engine).

4.2 Property Value Methodology

To study property values, we relied on the only publicly available data source which had property valuation data for all CBD parcels for all three cities: assessor's records. In New England states, each local government is required to conduct property valuations on all parcels within its borders for the purpose of calculating tax bills. While these valuations are not as precise as a full

appraisal, they are regularly updated and have been used widely in urban research studies (Mahan, Polasky, and Adams 2000; Palmquist 1982; Cervero and Duncan 2004; and many others).

For each city, we visited the assessor's website[1] and conducted address searches for all CBD parcels and used the most recent property valuation data, which varied among the cities: Bridgeport (October 2015), Lewiston (April 2015), Springfield (January 2016). This assessors' data was compiled and analyzed to explore key relationships between valuations, location, occupancy, and property condition.

4.3 Analysis

Our analysis began by mapping the spatial patterns of occupancy, condition, and property values. The data was geocoded using tabular data and Google's geocoding engine. The resulting KML file was imported to ArcGIS and joined with the complete direct observation findings. We also conducted spatial analysis of the occupancy, condition, and property value data to compliment the visual analysis of the mapped data. In order to capture whether any of the cities exhibited statistically significant clustered patterns of occupancy, condition, or valuation, the overall spatial autocorrelation of the data was tested in ArcGIS using global Moran's I. The local effects were tested using Local Indicator of Spatial Association (LISA) in GeoDa. Moran's I (Moran, 1950) tests the null hypothesis that the variable being examined is randomly distributed. If a significant p-value[2] is returned, the null hypothesis is rejected meaning that either: (1) the spatial distribution of high and/or low points are more spatially clustered than would be expected (indicated by a positive z-score), or (2) that the spatial distribution of high and low points are more spatially

[1] Bridgeport: https://www.bridgeportct.gov/content/341307/341403/343260/343310.aspx; Lewiston: https://lewistonmaine.tylertech.com; Springfield: https://www.springfield-ma.gov/finance/assessors/

[2] The significance level, represented by a p-value, indicates the probability of rejecting the null hypothesis. For example, a p-value significant at the 0.01 level denotes a 1% risk of falsely concluding a difference exists.

dispersed than would be expected (indicated by a negative z-score). Moran's I can determine whether spatial autocorrelation occurs, but it does not deliver spatial evidence of where statistically significant clusters occur. LISA provides localized analysis by measuring the similarity of each observation with its surroundings. LISA analysis returns one of five potential scenarios: (1) hot spots (locations with high values and high similarity with surroundings), (2) cold spots (locations with low values and high similarity with surroundings), (3) spatial outliers (locations with high values and low similarity with surroundings, (4) spatial outliers (locations with low values and high similarity with surroundings), and (5) locations without statistically significant autocorrelations.

Spatial autocorrelation relies on the notion that contiguous spatial elements can influence one another. Generally, a dichotomic contiguity matrix is defined based on whether one spatial area touches the boundary of another. However, with point data, a threshold distance is defined to gauge whether two points are contiguous. As this analysis concentrates on downtown CBDs, we defined the threshold distance to be 243 meters (800 feet) – roughly two average North American city blocks. Since the occupancy and condition data was ordinal, dummy variables were created to test the spatial autocorrelation of each of the variables (0 through 4) individually, as well as select combinations.

In addition to the spatial analysis, we also conducted statistical analysis of the occupancy, condition and property value data. Spearman's rank-order correlation was used to analyze the relationships between the variables, rather than Pearson's product-moment, due to the mix of continuous and ordinal variables. Spearman's correlation determines the strength and direction of monotonic relationships between variables. Generally speaking, it measures whether as one variable increases, the other either also increases, decreases or is unrelated. We also ran

multivariate regressions to better understand the factors impacting the property value. Although a number of our variables were ordinal, since the dependent variable (property value) was continuous, ordinal regression was not applicable. Therefore, we used dummy variables for the occupancy and condition data.

5. Results

5.1. Descriptions and Analysis of Demographic Data

The U.S. Census, combined with other U.S. real estate and housing databases, allowed for an exploration of both historic trends and contemporary conditions in each of the three New England locations at a fairly fine-grained level.

Table 1: Descriptive statistics of case study cities. Source: American Community Survey 2015 (5-year estimates)

	Bridgeport, CT	Lewiston, ME	Springfield, MA
Area (sq mi)	19.3	35.5	33.1
Population	147,340	36,356	153,947
Peak Population	158, 709 (1950)	41,779 (1970)	174,463 (1960)
Population Change from Peak	-7.2%	-13.0%	-11.8%
Population 65+	10%	17%	12%
Unemployment Rate	16%	8%	13%
Median Household Income	$41,801	$37,500	$34,728
Median House Value	$169,100	$144,300	$144,700
Gini index of inequality	0.48	0.46	0.49

5.2 Occupancy, Condition and Valuation Data

More than one-third of Springfield's addresses were either partially (occupancy 2) or completely (occupancy 3) vacant and Lewiston and Bridgeport also report the same for more than

one-quarter of properties. The cities all had low quality building conditions in their downtowns, ranging from 3 to 4% getting a poor rating.

Table 2: Descriptive statistics of the occupancy, condition and property value data in Bridgeport, Lewiston and Springfield

		Bridgeport, CT	Lewiston, ME	Springfield, MA
Occupancy	Full (1)	63%	72%	62%
	Partial (2)	8%	15%	16%
	Unoccupied (3)	22%	10%	20%
	Illegal (4)	1%	1%	0%
Condition	Empty lot (1)	5%	4%	2%
	Poor (2)	3%	5%	3%
	Fair (3)	16%	17%	17%
	Excellent (4)	71%	74%	76%
Property Value	Mean	$7,480,855	$257,506	$1,823,237
	Median	$1,082,680	$125,960	$1,018,000
	Min	$78,510	$17,160	$104,641
	Max	$80,826,250	$1,824,500	$9,872,700
	Mean $/SF	$71.69	$48.75	$39.09

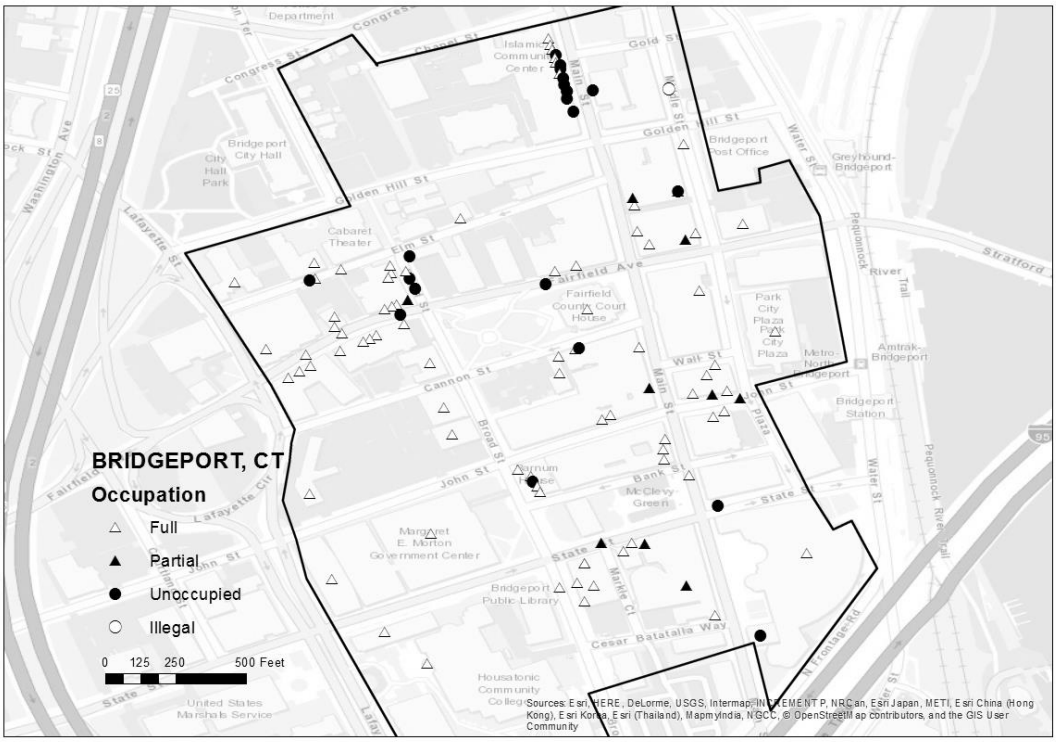

Figure 2: Occupation map of Bridgeport, CT

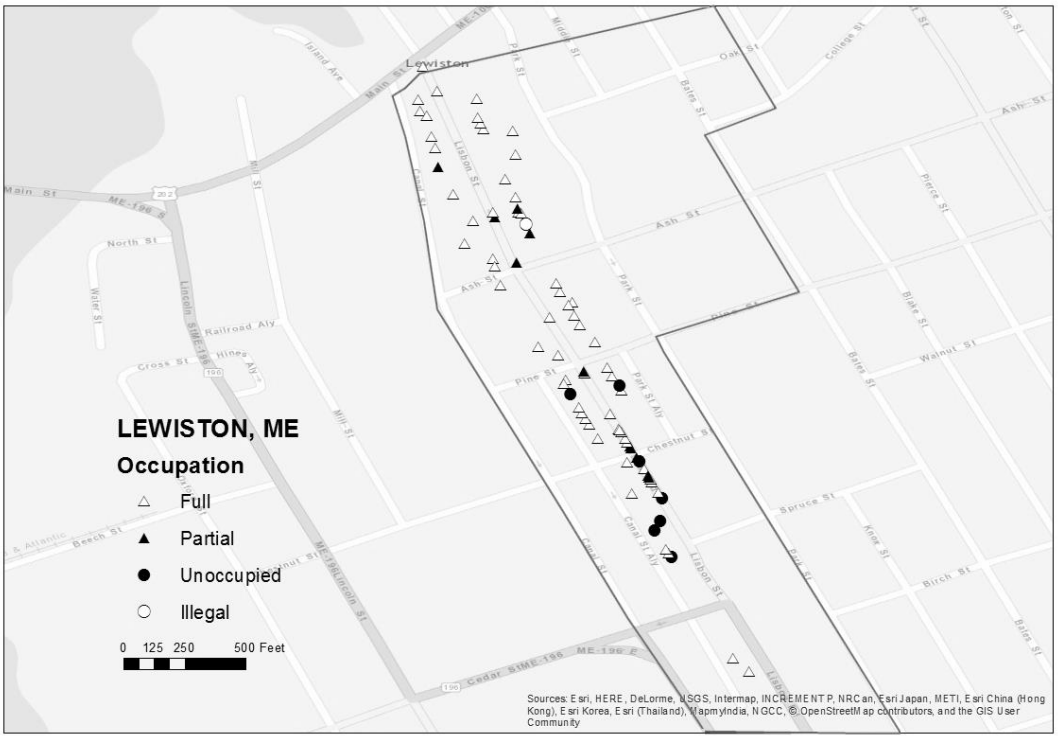

Figure 3: Occupation map of Lewiston, ME

Figure 4: Occupation map of Springfield, MA

To better understand these results and their spatial distribution, we mapped and analyzed these trends for the three cities. The maps show where concentrations of vacancy (Figures 2, 3 and 4) and poor conditions (Figures 5, 6 and 7) tend to exist, the intensity and strength of those patterns. Of particular interest is the tendency for spatial clustering. For Bridgeport, a clustering in the northern edge of the CBDs suggests a major source of disinvestment in that area, generating above average vacancy levels.

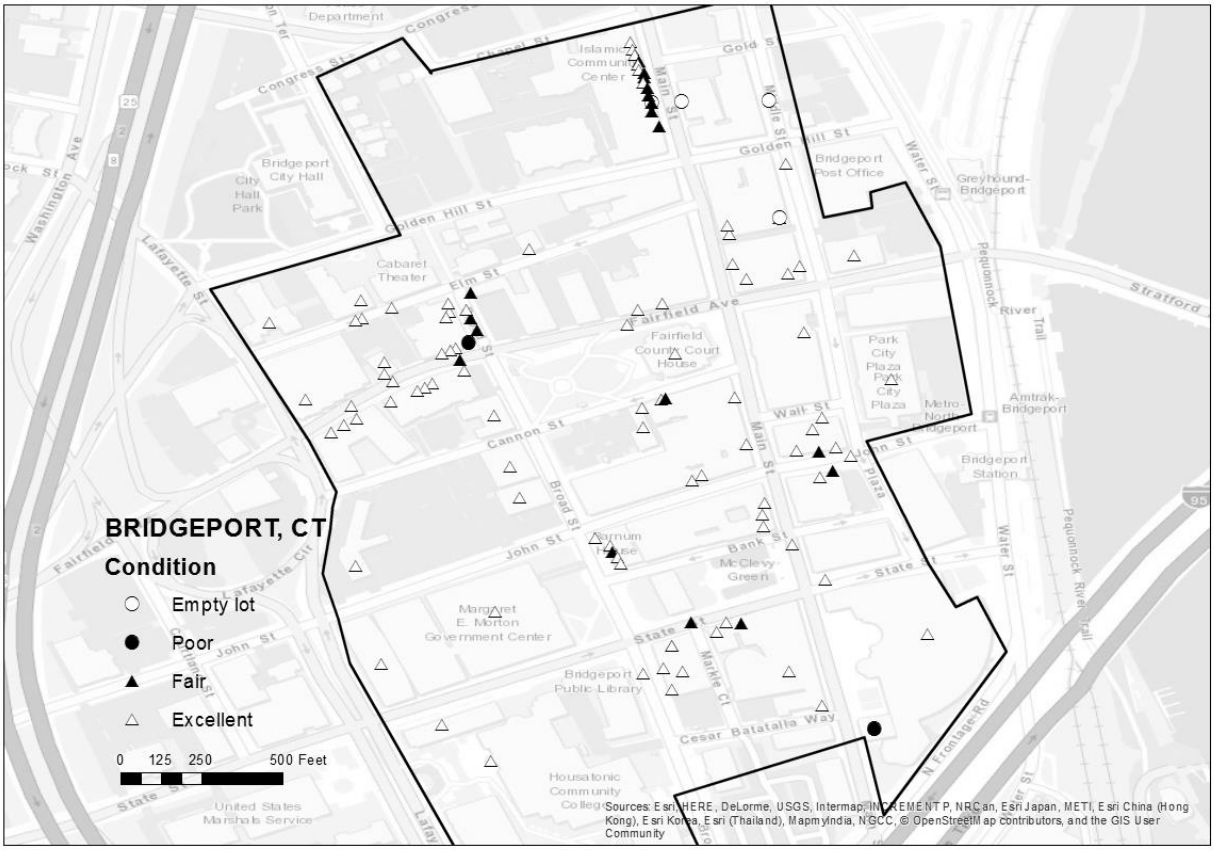

Figure 5: Condition map of Bridgeport, CT

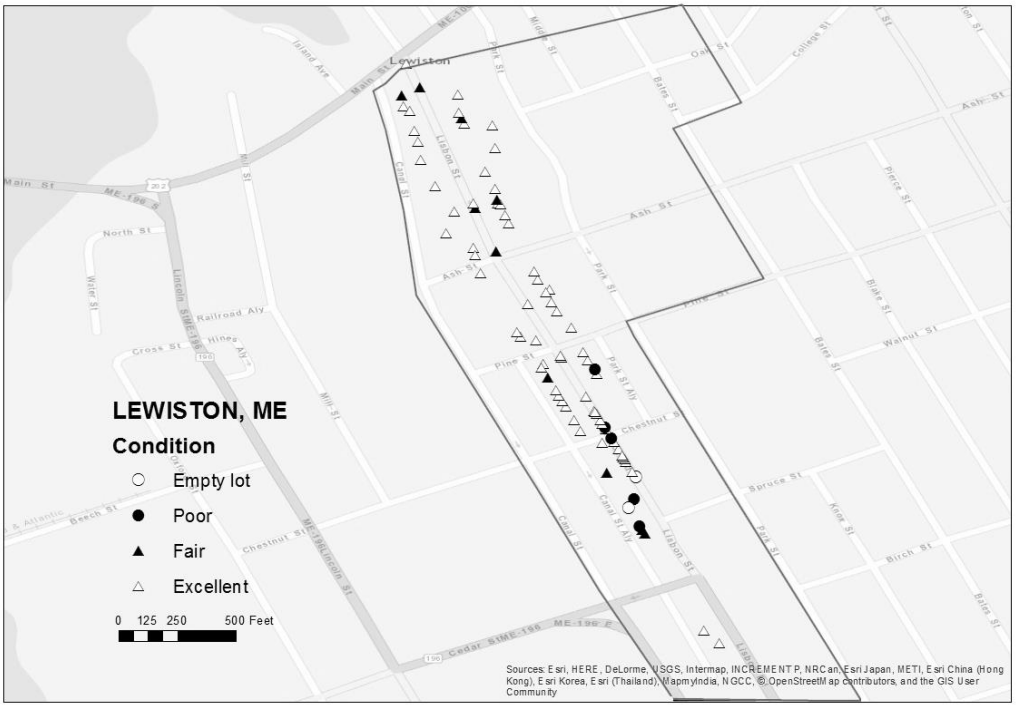

Figure 6: Condition map of Lewiston, ME

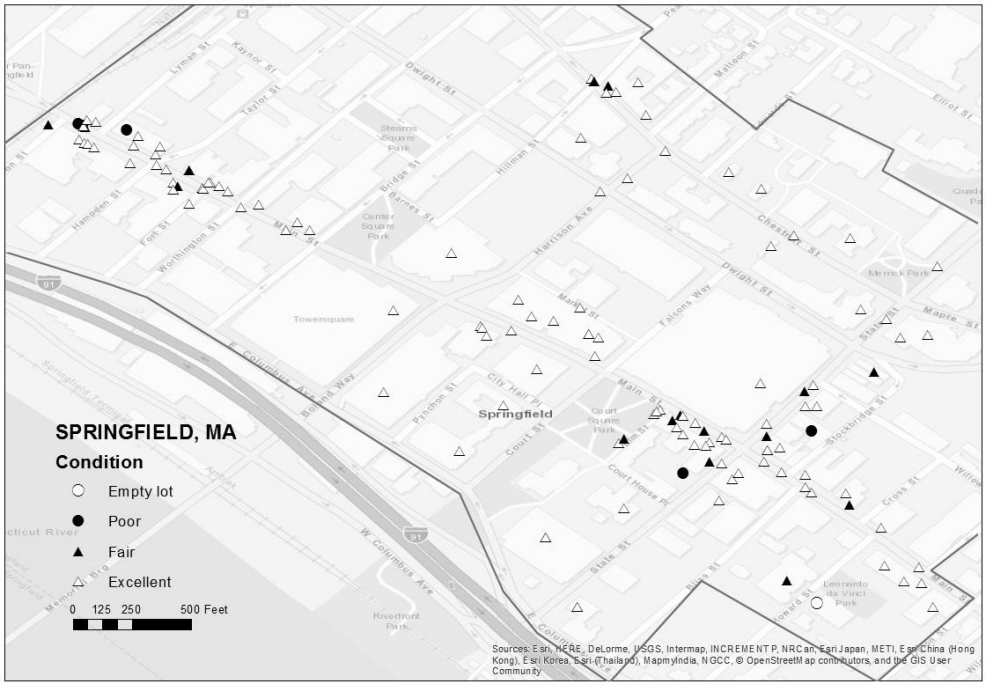

Figure 7: Condition map of Springfield, MA

Examining the condition of the CBDs, the three New England cities once again demonstrate the spatial polarization of their downtown built environments. Pockets of poor and excellent condition areas are clearly visible in the maps. In the cities studied (Bridgeport, Springfield, Lewiston), the spatial clustering of poor condition buildings closely matches the spatial clustering of higher occupancy.

5.3 Analysis of Occupancy, Condition, and Valuation Data

In order to gauge the relationship between occupancy, condition and property value in the downtowns of each city, we first calculated the Spearman rank-order correlation for each set of pairwise relationships. The summary of the correlation results can be seen in Table 3. Unsurprisingly, property size is highly correlated with property value in all three cities. However, beyond the size-value relationship, there is significant differentiation between the three case study cities. In Bridgeport, there is little connection between property value and either condition or occupancy. In Lewiston, on the other hand, all three variables are highly correlated. Unlike Bridgeport and Lewiston, in Springfield there is no significant relationship between occupancy and condition. In fact, condition is not significantly correlated with property value or value per square foot either.

Table 3: Summary of Spearman rank-order correlation results for downtown Bridgeport, Lewiston and Springfield.

Variable 1	Variable 2	Bridgeport, CT	Lewiston, ME	Springfield, MA
Property value	Property size	0.859***	0.511***	0.960***
Property value	Occupancy	-0.240	-0.511***	-0.464**
Property value	Condition	0.228	0.719***	0.291
$/SF	Occupancy	-0.171	-0.427***	-0.656***
$/SF	Condition	0.066	0.574***	0.123
Occupancy	Condition	-0.516***	-0.572***	-0.357

Note: * significant at the 0.1 level; ** significant at the 0.05 level; *** significant at the 0.01 level

Multivariate regressions were used to further understand the relationship between condition, occupancy and property value. The results of the various models (Table 4) generated sufficiently high R-squared values (between 0.548 and 0.788) to suggest a robust relationship. However, we found that property size was the only consistent significant predictor of property value. In Bridgeport ($R^2 = 0.788$) and Lewiston ($R^2 = 0.548$) property size was the only significant variable. In addition to property size, partial occupancy (Occupancy 2) was found to be negatively significant in Springfield ($R^2 = 0.864$).

Table 4: R^2 and standardized coefficients for regression models predicting property value

	Bridgeport, CT	Lewiston, ME	Springfield, MA
R^2	0.788	0.548	0.864
Area	0.882***	0.65***	0.897***
O_0	-	-	-
O_1	-	-	-
O_2	-0.067	0.083	-0.203**
O_3	-0.006	0.046	-
O_4	-	-0.02	-
C_0	-0.134	0.022	-
C_1	-0.015	-.121	-0.078
C_2	-	0.007	-
C_3	-	-	0.09
C_4	-0.038	0.161	-

Note: (a) * significant at the 0.1 level; ** significant at the 0.05 level; *** significant at the 0.01 level
(b) The R^2 value denotes how well the model fits the data. An R^2 value of 1 indicates that the model fits the data perfectly and therefore explains all of the variability. Conversely, an R^2 value of 0 indicates that the model does not fit and explains none of the variability.
(c) Regular regression coefficients use different scales and are therefore not comparable. By using standardized coefficients based on the same scale, we are able to compare the results.

The spatial autocorrelation of the occupancy, condition, and valuation data was measured using global Moran's I in ArcGIS. Results from the spatial analysis (Table 5) of the direct observation data support the trends identified visually using the maps (Figures 2 to 7). Concentrating on trends of poor condition and low occupancy, we found that there was no

statistically significant clustering of empty lots or buildings in poor condition (condition variables 1 and 2 respectively). And although there were practically no observations of illegal occupation in any of the cities (occupancy variable 4), there were statistically significant clustering patterns of partially occupied and unoccupied buildings (occupancy variables 2 and 3 respectively).

Table 5: Spatial analysis of occupancy in 3 case study cities

	Bridgeport, CT	Lewiston, ME	Springfield, MA
Occupancy 0 (construction)	0.3216	-	-
Occupancy 1 (fully occupied)	0.0120*	0.2085	0.7428
Occupancy 2 (partially occupied)	0.5877	0.0097***	0.4721
Occupancy 3 (unoccupied)	0.0000***	0.4654	0.1517
Occupancy 4 (illegally occupied)	-	-	-
Occupancy 2 & 3	0.0041***	0.0664*	0.7075
Condition 0 (construction)	0.3216	-	-
Condition 1 (empty lot)	0.9680	0.9324	-
Condition 2 (poor condition)	-	0.9097	0.1904
Condition 3 (fair condition)	0.0120*	0.2285	0.3371
Condition 4 (excellent condition)	0.0001***	0.1705	0.9645
Condition 1 & 2	0.5437	0.4594	0.3203
Size	0.2382	0.075*	0.9593
Property value	0.3457	0.083*	0.6864
$/SF	0.2328	0.046**	0.1442

Note: * significant at the 0.1 level; ** significant at the 0.05 level; *** significant at the 0.01 level

The stronger scope and scale of vacancy inferred from the map analysis was confirmed as Bridgeport and Lewiston both had statistically significant clustering patterns of vacancy. In Lewiston, partially occupied buildings with for rent signs (occupancy variable 2) were clustered, whereas Bridgeport had clusters of unoccupied buildings (occupancy variable 3). To explore the relationship between partially unoccupied and unoccupied buildings, we ran the spatial autocorrelation analysis again with the variables combined. Once again Bridgeport and Lewiston had significant levels of clustering. In addition to the spatial clustering of partial occupancy, Lewiston was also found to be clustered by property size, value and cost per square footage.

As Global Moran's I only provides results regarding overall clustering of the study areas, we also calculated LISA to gauge the local effects of spatial autocorrelation. Figures 8 and 9 depict the centers of "hot" and "cold" spots as well as spatial outliers (all points that were not statistically significant are not included in the Figures). Figure 8 shows several clusters of high occupancy (black dots) in the south east of the CBD in Bridgeport. Additionally, there are a few clusters of low occupancy (white dots) at the northern edge of the CBD. In contrast, the lone statistically significant cluster of low occupancy in Lewiston is squarely in the middle of downtown, with high occupancy clusters in both the south and north.

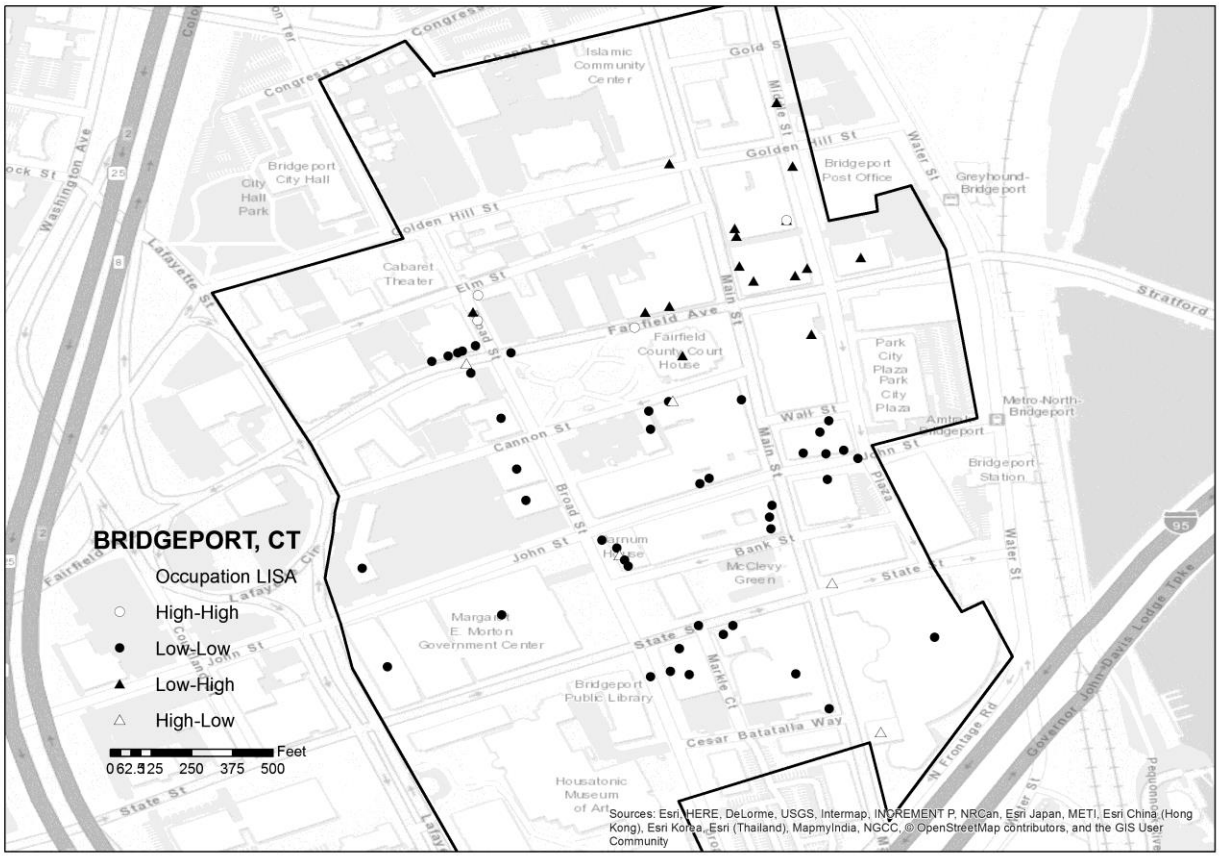

Figure 8: Local Indicator of Spatial Association (LISA) map of occupation in Bridgeport, CT, high-high depicts clustered hot spots of vacancy.

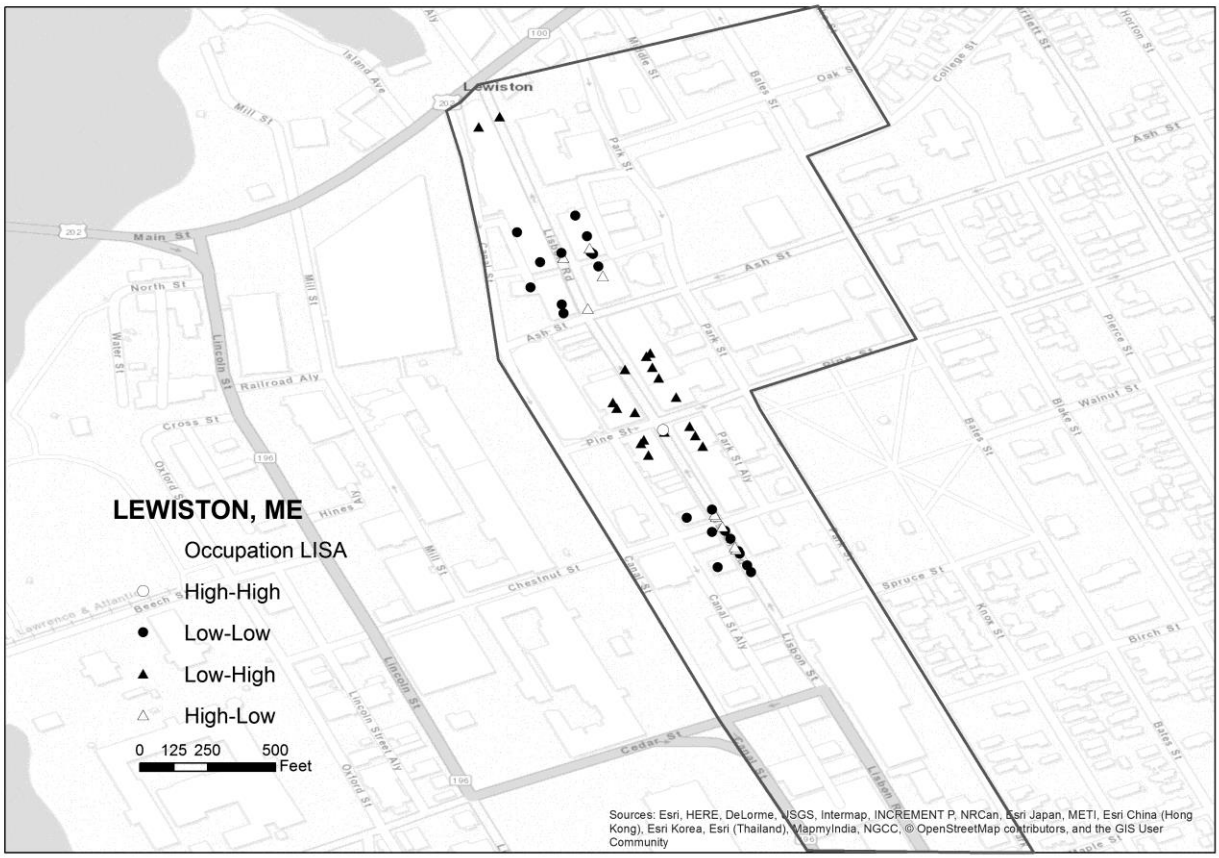

Figure 9: Local Indicator of Spatial Association (LISA) map of occupation in Lewiston, ME, high-high depicts clustered hot spots of vacancy.

6. Discussion and Conclusions

With measurable population decline and increases in vacancy across the three New England cities, we sought to understand how that change manifested spatially in downtown areas. Drawing on a conceptual framework presented in Figure 1, we were able to track the forces of decline in the three cities and pick up on evidence of a contagion effect in some cities, but ultimately discovered varying impacts of decline on occupancy, building conditions, and property values.

Our analysis provides an empirical baseline from which further studies can build upon. The methodological approach of this study allowed us to shed light on the spatial manifestation of

decline and vacancy in downtown areas. However, it did have limitations: 1) looking at only three cities limits our ability to generalize more broadly, 2) we used the concepts of vacancy, condition, and property values to organize the study, but each is challenging to operationalize and the variables we selected all represent only a point in time and have inherent biases built-in. Future work can build upon our findings by incorporating time series data and/or ratio data combined with logic regression analysis. Undertaking additional statistical analysis would provide a deeper understanding of the processes associated with the clustering effects observed in this paper.

This research offers a particularly compelling view of how shrinking downtowns can be reused and repurposed to better advance local objectives. The spatial analysis revealed clusters of low occupancy in several of the cities and the direct observation data and resulting maps (Figures 2 to 7) show a distinctive pattern of hot spots of vacancy in the edges of the downtowns. While surface parking and other vacant spaces may be located in the most central parts of a CBD, these results warrant further attention to how the morphology of a CBD can inhibit creative reuse and rightsizing. In fact, local officials can use this kind of information to develop land use plans for those areas, considering market demand, highest and best use, and the overall health of the local and regional economy. Specifically, these edge zones may be better suited for non-CBD uses, in order to direct and focus CBD uses (office, retail, housing, arts) into what could then be a smaller, denser CBD.

Economic development efforts by local officials and community leaders can support the core CBD areas through Business Improvement Districts, Tax Increment Financing, Low-interest loans and grants, and other financial incentives (see Leigh and Blakely 2003). At the same time, those edge zones could be rezoned (or their zoning can be relaxed) (see Hollander 2011) for low-intensity uses like parks, open space, or urban agriculture, driving market demand towards the

smaller CBD, what is sometimes referred to as rightsizing, smart shrinkage, or smart decline (Popper and Popper 2002; Hollander and Nemeth 2011; Schatz 2017).

For urban and regional planners, the findings demonstrate the highly context-specific nature of vacancy in shrinking downtowns and the important ways in which property size, condition, and occupancy tend to correlate with property values and demand. The modest evidence of spatial clustering of poor condition or vacant properties in two of the three cities suggests that such impacts should be a part of any neighborhood-oriented planning process. Most importantly, these results challenge existing norms around the best way for urban planning to respond to depopulation, vacancy, poor conditions, and depressed property values. These results present planners with a new and powerful lens to look at their downtowns in the face of these kinds of problems: instead of solely investing in growing them and rebuilding them, some downtowns may benefit from a smaller, more compact footprint. This kind of rightsizing might mean rezoning the peripheries of downtowns for low-intensity uses and direct high-intensity uses into a smaller, but potentially livelier and more robust area.

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