Walk this Way:
The Economic Promise of Walkable Places in Metropolitan Washington, D.C.

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"Emerging evidence points to a preference for mixed-use, compact, amenity-rich, transit-accessible neighborhoods or walkable places."

Findings

An economic analysis of a sample of neighborhoods in the Washington, D.C. metropolitan area using walkability measures finds that:

- **More walkable places perform better economically.** For neighborhoods within metropolitan Washington, as the number of environmental features that facilitate walkability and attract pedestrians increase, so do office, residential, and retail rents, retail revenues, and for-sale residential values.

- **Walkable places benefit from being near other walkable places.** On average, walkable neighborhoods in metropolitan Washington that cluster and form walkable districts exhibit higher rents and home values than stand-alone walkable places.

- **Residents of more walkable places have lower transportation costs and higher transit access, but also higher housing costs.** Residents of more walkable neighborhoods in metropolitan Washington generally spend around 12 percent of their income on transportation and 30 percent on housing. In comparison, residents of places with fewer environmental features that encourage walkability spend around 15 percent on transportation and 18 percent on housing.

- **Residents of places with poor walkability are generally less affluent and have lower educational attainment than places with good walkability.** Places with more walkability features have also become more gentrified over the past decade. However, there is no significant difference in terms of transit access to jobs between poor and good walkable places.

The findings of this study offer useful insights for a diverse set of interests. Lenders, for example, should find cause to integrate walkability into their underwriting standards. Developers and investors should consider walkability when assessing prospects for the region and acquiring property. Local and regional planning agencies should incorporate assessments of walkability into their strategic economic development plans and eliminate barriers to walkable development. Finally, private foundations and government agencies that provide funding to further sustainability practices should consider walkability (especially as it relates to social equity) when allocating funds and incorporate such measures into their accountability standards.

Introduction

The Great Recession highlighted the need to change the prevailing real estate development paradigm, particularly in housing. High-risk financial products and practices, "teaser" underwriting terms, steadily low-interest rates, and speculation in housing were some of the most significant contributors to the housing bubble and burst that catalyzed the recession. But an oversupply of residential housing also fueled the economic crisis.

However, a closer look at the post-recession housing numbers paints a more nuanced picture. While U.S. home values dropped steadily between 2008 and 2011, distant suburbs experienced the starkest price decreases while more close-in neighborhoods either held steady or in some cases saw price increases.[2] This distinction in housing proximity is particularly important since it appears that the United States may be at the beginning of a structural real estate market shift. Emerging evidence points to a preference for mixed-use, compact, amenity-rich, transit-accessible neighborhoods or walkable places.

According to the National Association of Realtors, 58 percent of homebuyers surveyed prefer mixed-use neighborhoods where one can easily walk to stores and other businesses. Further, 56 percent expressed a preference for communities with amenities such as a mix of housing types, various destinations within walking distance, public transportation options, and less parking. The trend is swinging away from neighborhoods that contain primarily large-lot single-family housing, few sidewalks, ample parking, and where driving is the primary means of transportation. Sixty percent of those swinging toward newer amenities do so for the convenience of being within walking distance to shops and restaurants and two-thirds of buyers factor walkability into their home purchase decision.[3] Changing demographic trends— retiring baby boomers, first-time buyers preferring walkable places, and a rising number of households without children—are one reason for the increased housing market segment driven by walkability.[4]

In fact, the demand for walkable places may outpace its supply.[5] While this research is still emerging, one study posits that small-lot and attached housing units are under-supplied by 11 percent and 8 percent respectively, or an estimated 12 and 13.5 million units, while large-lot housing is over-supplied by an estimated 18 percent, accounting for approximately 28 million units.[6] Another study conducted in Atlanta found that only 35 percent of those who preferred to live in a walkable neighborhood actually did so.[7] Large price premiums attached to walkability, seemingly tied partly to a supply-demand mismatch, was revealed by additional research.[8] Real estate listings and Internet house-listing sites such as Zillow now assign "Walkscores" to their properties, signaling the growing interest of consumers.[9]

Despite increasing demand for walkability, the real estate industry has yet to fully embrace the concept since some public- and private-sector barriers complicate walkable development. Many municipal policies, zoning ordinances, public funding biases, and planning policies still encourage low-density, suburban type development.[10] Walkable urban places remain complex developments that still carry high risk and, as such, costly capital (both equity and debt financing.) The financial community continues to have difficulty underwriting high-density, mixed-use, walkable urban development. Banks, investors, and Wall Street analysts have traditionally adhered to investment and underwriting silos that reflect 19 standard product types, none of which speak to the nuances involved with walkable developments.[11] Overall, the real estate finance industry lacks the experience, institutional mission or even fiduciary latitude to appropriately consider walkable development investments or loans.[12]

We consider walkability to be a *mechanism* by which to increase a place's **triple bottom line**: profit (economics), people (equity), and planet (environment). On economics, recent studies show that both residential and commercial properties in neighborhoods with greater walkability have greater resale value.[13] For people, research shows clear links between elements of walkable communities and better public health outcomes.[14] In terms of the environment, while research on the direct relationship between walkability and greenhouse gas emissions from transportation is still nascent, there is evidence that walkability is related to decreased driving and increased walking and that CO2 emissions are linked to vehicle miles traveled.[15]

Despite the emerging evidence of the links between walkability and the triple bottom line, we lack an operational definition and performance metrics for walkable urban places that would facilitate their proliferation. In fact, the absence of a clear classification of the mix of residential, office, and retail

elements that comprise walkable urban places or of the built environment components (including area, density, land use characteristics, transportation facilities, etc.) necessary to produce sustainable, economically viable, socially equitable places has been one of the most significant barriers to addressing their demand.[16] Metrics to gauge walkable urban places' performance that could guide investment decisions and public policy development have also been absent.

This study seeks to establish an operational definition of walkable urban places that lays out observable, measurable factors that characterize them. It also seeks to develop a valid and reliable set of economic and social equity performance metrics that create a framework for stakeholders to consider the development of walkable urban places where most appropriate and applicable. We also sought to understand the differences between regional-serving and local-serving places, as they are thought to play different but complementary roles in promoting sustainable, economic growth in metropolitan areas. The Washington D.C. metropolitan area, which previous research identified as having a high number of walkable places per capita, serves as the focal place.[17]

Methodology

This study combines primary data on the built environment with a variety of secondary real estate, fiscal, demographic, transportation, and business data to establish an operational definition of, and performance metrics for, walkable urban places. A 2007 Brookings study surveyed U.S. real estate and planning experts to help identify walkable urban places within 30 U.S. metropolitan areas. That work conceptually defined walkable urban places as those considered to be regional serving, high density, mixed-use, and between 50 and 400 acres.[18]

For the current work, we employed a variety of exploratory, qualitative, and quantitative methods, including a literature review, industry and expert advisory panels, archival analysis, and an on-site built environment audit to help layout an objective, measurable definition of walkable urban places and identify key real estate, economic, and social equity benchmarks. While this study does not delineate all of the walkable urban places in metropolitan Washington, it employs a methodology that can be adapted for wider use in other U.S. metros.

We first set out to identify the universe of potential walkable urban places in metropolitan Washington. We catalogued over 400 comprehensive, sector, and small area plans as well as business improvement districts (BIDs), locally-defined regional activity centers, neighborhoods and other specially funded areas.[19] From these, we identified 201 walkable urban place candidates.[20] The criteria for inclusion were:

1. Located within the jurisdictions that are part of the Metropolitan Washington Council of Governments;[21]
2. Has an existing plan (e.g. special district overlay) that aimed to increase walkability, density, or mixed uses that was not restricted to small area road corridor based plans or is a neighborhood that contains a Metrorail subway station;
3. Not located in Census-designated rural blocks.[22]

We conducted archival analysis of existing land use plans, special district overlays, and other planning documents to determine whether a neighborhood met the second criteria.[23] We used established definitions of neighborhoods, when available, to delineate a place's boundaries. Some places (e.g. widely-known neighborhoods, such as Dupont Circle, without established jurisdictional boundaries) lacked official planning agency or documented definitions. In those cases, we used multiple methods to establish a place's boundaries, including census blocks and block groups, school districts, political districts, neighborhood commissions and local neighborhood organizations or blogs.[24]

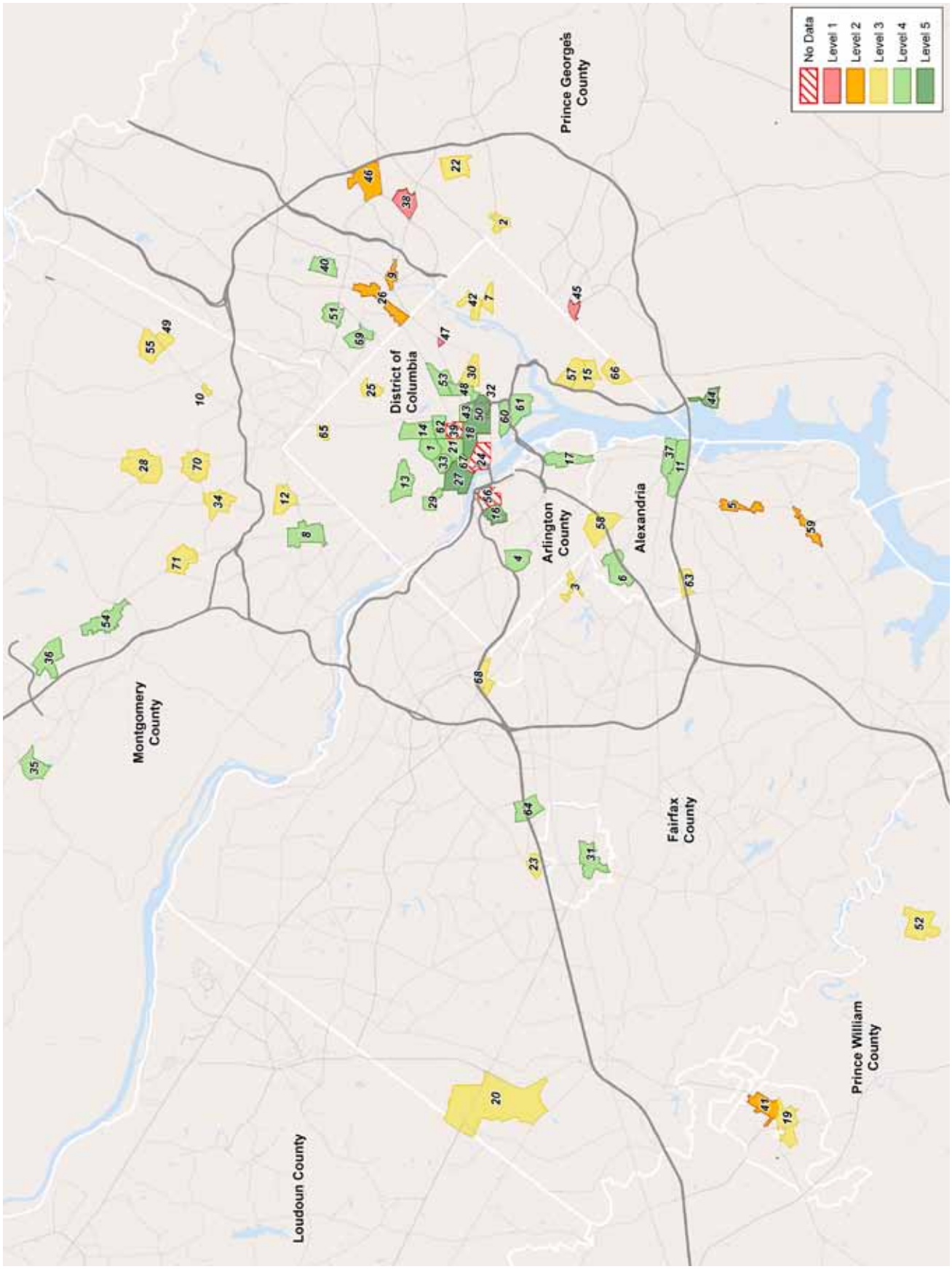

Figure 1. Neighborhoods Included in Study and their Walkability Scores

Figure 1 Map Key

Map ID number	Neighborhood	Acreage	Walkability Level	Map ID number	Neighborhood	Acreage	Walkability Level
1	Adams Morgan	268	4	37	King Street	299	4
2	Addison Road	274	3	38	Landover Road Metro Area	384	1
3	Bailey's West	120	3	39	Logan Circle	232	n/a
4	Ballston	351	4	40	M Square Research Park	346	4
5	Beacon/Groveton	195	2	41	Mathis Avenue	367	2
6	Beauregard	485	4	42	Minnesota Avenue	458	3
7	Benning Road	169	3	43	Mount Vernon	156	4
8	Bethesda	505	4	44	National Harbor	182	5
9	Bladensburg Town Center	131	2	45	Naylor Road	111	1
10	Burnt Mills Commercial Center	34	3	46	New Carrollton	559	2
11	Carlyle	607	4	47	New York Avenue	22	1
12	Chevy Chase Lake	355	3	48	NoMa	378	4
13	Cleveland Park	424	4	49	Paint Branch	142	3
14	Columbia Heights	417	4	50	Penn Quarter/Chinatown	164	5
15	Congress Heights	361	3	51	Prince George's Plaza	282	4
16	Courthouse	247	5	52	Prince William Gov't Center	1,530	3
17	Crystal City	226	4	53	Rhode Island Avenue Metro	508	4
18	Downtown DC	443	5	54	Rockville	529	4
19	Downtown Manassas	483	3	55	Rolling Acres	228	3
20	Dulles West	2,740	3	56	Rosslyn	292	n/a
21	Dupont Circle	315	4	57	Saint Elizabeth's	363	3
22	FedEx Field	211	3	58	Shirlington	37	4
23	Flint Hill Suburban Center	166	3	59	South County Center CBC	197	2
24	Foggy Bottom	261	n/a	60	SW Federal Center	257	4
25	Fort Totten	209	3	61	SW Waterfront	356	4
26	Gateway Arts District	395	2	62	U Street/Shaw	330	4
27	Georgetown	472	5	63	Van Dorn Transit Area	196	3
28	Glenmont	693	3	64	Vienna Transit Station Area	361	4
29	Glover Park	244	4	65	Walter Reed	65	3
30	H Street/Atlas District	347	3	66	Washington Highlands	307	3
31	Historic Fairfax City	449	4	67	West End	83	4
32	Judiciary Square	145	5	68	West Falls Church Transit Area	267	3
33	Kalorama	144	4	69	West Hyattsville	347	4
34	Kensington	407	3	70	Wheaton	441	3
35	Kentlands	108	4	71	White Flint	443	3
36	King Farm	495	4				

We drew a sample from the 201 places selected as candidates for walkable urban places for which we would collect detailed data. As such, we generated Walkscores for each of the 201 places to establish an initial continuum of walkability from which to draw our sample.[25] We then employed a modified stratified random sampling scheme, ultimately selecting a sample of 66 places that vary from low to high walkability.[26] We used the mean and standard deviation of the Walkscores for the population of candidates (N=199; M= 62.4, SD=18.8), eliminating outliers (N=2; with scores of zero), to establish five preliminary levels of walkability. We oversampled (at 100 percent) from the highest level (Walkscores > 90.6, representing 2.5 SD above the mean) and selected a random representative sample from the remaining strata (levels).

Walkscore, used as a tool to help generate our sample, is a metric that measures the walkability levels of any U.S. address on a scale from 0 to 100 based on the number of destinations present within

a specified distance. It differs from the walkability measure we ultimately employed in our sample in that Walkscore is based on solely on the number of destinations within walking distance (although the StreetSmart Beta version employed here also accounts for the type of destination and the connectivity of the walking route) whereas the walkability measure we ultimately employed for this study is based on a more robust set of micro-scale built environment features related to walkability, as discussed in the next section.

Using data drawn from this sample (see description of metrics below), we established our operational definition of walkable urban places, tested the relationship between walkability and economic performance, and compared various indicators of social equity between places with low and high levels of walkability.

We also sought to distinguish between regional-serving and local-serving places since these subsections serve different economic functions within metropolitan areas. In particular, we aimed to better operationalize the universe of options of metropolitan land use, which is based on form (walkability) and function (economic.)[27]

Our sample was drawn from places with established policies to promote walkability, density, or a mix of uses. (We recognize that this sampling technique may have weeded out places with low walkability relative to the region.) Further, we created five Walkscore levels based on the range in our population. Our sample included *all* places that scored 90 or better on Walkscore and a *representative* sample from the remaining Walkscore levels. The criteria for inclusion in our population and our sampling strategy produced a sample that likely contained a greater number of high walkable places relative to low walkable. As a result, the low walkable places in our sample tended to be closer-in urban places (that in some cases happened to be near a metro subway stop) as opposed to far-flung suburban places. In fact, many of the places in our sample that had "poor" or "very poor" walkability had average household incomes that were lower than the region as a whole. We anticipate the need to further explore the issue of social equity in places with low walkability across varying income levels.

This study employed four sets of metrics—walkability, regional serving, economic performance, and social equity—described below.

Walkability

To assess walkability and establish the operational definition of walkable urban places, we employed a 162-item audit tool—the Irvine Minnesota Inventory (IMI)—that collects objective data on built environment characteristics hypothesized to be related to physical activity.[28] We collected IMI data for a sample of blocks within each of the 66 places.[29] We relied upon a scoring system that calculates a composite walkability rating along ten urban design dimensions adapted from the findings of a meta-review study that outlined key environmental factors empirically linked with walkability:[30]

1. Aesthetics (attractiveness, open views, outdoor dining, maintenance)
2. Connectivity (potential barriers such as wide thoroughfares)
3. Density (building concentrations and height)
4. Form (streetscape discontinuity)
5. Pedestrian amenities (curbcuts, sidewalks, street furniture)
6. Personal safety (graffiti, litter, windows with bars)
7. Physical activity facilities (recreational uses)
8. Proximity of uses (presence of non-residential land uses)
9. Public spaces and parks (playgrounds, plazas, playing fields)
10. Traffic measures (signals, traffic calming)

The scores for each dimension are calculated based on the absence or presence of specific built environment features related to that dimension, providing easily identifiable high-score/low-score components that influence the overall score. This allows a user to understand how walkable a place is as well as *why* it is walkable. It explains why places with approximately the same overall IMI score may differ with respect to their scores along each of the ten dimensions. For example, while Downtown D.C. and National Harbor have similar IMI scores, the former has a higher proximity score while the latter has a higher traffic safety score.

Based on total IMI scores, we identified five levels of walkability and established an operational definition of walkable urban places that we applied to our stratified random sample of places in

Table 1. Irvine-Minnesota Inventory (IMI) Levels Based on a Sample of Washington D.C. Metropolitan Neighborhoods

	Classification Levels				
	1	**2**	**3**	**4**	**5**
IMI Total (Mean= -3.39)	Lowest thru -43.39	-43.4 thru -23.39	-23.4 thru -3.39	-3.4 thru 23.39	23.4 thru Highest
Region-Serving Places	0 (0%)	4 (12.1%)	8 (24.2%)	16 (48.5%)	5 (15.2%)
Example	N/A	New Carrollton	White Flint	Bethesda	Downtown D.C.
Local-Serving Places	3 (10.7%)	2 (7.1%)	16 (57.1%)	7 (25%)	0 (0%)
Example	Naylor Road	Bladensburg Town Center	West Falls Church Transit Area	Cleveland Park	N/A
Walkability Classification	Very poor walkability	Poor walkability	Fair walkability	Good walkability	Very good walkability
	Not Walkable Urban Places			Walkable Urban Places	

metropolitan Washington (Table 1). IMI scores ranged from –55.62 for the New York Avenue neighborhood to 39.39 for Downtown D.C.)[31]

Distinctions Between Regional- and Local-Serving Places

Regional-serving and local-serving places serve complementary but distinct roles within the metropolitan economy. The former, with a higher concentration of jobs that generate income from outside the region and regional-serving jobs (e.g. lawyers, bankers, hospital workers), act as significant economic engines for the region, while the latter, with a larger proportion of local-serving jobs (teachers, pharmacists, dentists), may support a region's day-to-day activities and contribute to overall quality of life. Classifying places based on their roles within the metropolitan region may help the private and public real estate industry and urban planners tailor their investment, lending, policy, planning, and design intervention strategies based on their needs and interests.

There is a lack of consensus, however, regarding what indicators—and at what thresholds—best serve to delineate between regional- and local-serving places. *Conceptually*, regional-serving places may contain one or more of the following: a significant amount of retail with a large catchment area; regional employment centers; industrial hubs; high concentrations of government activity; higher education uses; medical institutions; cultural/sport/recreational activities; civic uses; transportation hubs; or entertainment (e.g. theaters, movie theaters) uses. Local-serving places tend to contain a higher percentage of residential uses than do regional-serving places; primarily have neighborhood-oriented retail uses and services such as grocery stores, and medical offices; and have primary and secondary educational uses, post offices, libraries and other neighborhood supporting services.

Building on the literature and findings from the advisory panels, we established a working definition for regional-serving places: *A place that is a key economic contributor to a metropolitan area in terms of employment, entertainment, retail, education, or other institutional production, and has reached critical mass (or the point at which a place is self-sustaining and does not need government subsidies for subsequent development).*

Based on that, we developed a classification system for regional- and local-serving places. First, we classified a place as regional serving based on the *presence* of any of the following non-commercial uses: educational (e.g. Georgetown University), regional entertainment (e.g. Nationals Ballpark), or civic use (e.g. Superior Court of D.C.). Next, we considered the *concentration* of commercial uses. We identified two tiers (Table 2) of regional-serving places based on the total rentable building area for both office and retail.[32] Specifically, we found the tipping point for office and retail concentrations at which a statistically significant difference in office rents and retail sales, respectively, was observed as these are considered to be important indicators of real estate and economic performance.[33]

Table 2. Levels of Office and Retail-Based Regional Serving Places with Examples from Metropolitan Washington

	Super Regional Serving (Tier 1)	Regional Serving (Tier 2)	Local Serving
Office (based on statistically significant difference in average office rents)	>6 million square feet RBA (ex. Tysons Corner)	>1.4 million square feet RBA (ex. King Street)	<1.4 million square feet RBA (ex. Cleveland Park)
Retail (based on statistically significant difference in retail sales)	>2.3 million square feet RBA (ex. Pentagon City)	>340,000 square feet RBA (ex. U Street)	<340,000 square feet RBA (ex. Mount Pleasant)

RBA=rentable building area

Economic Performance

To understand the relationship between economics and walkability, we ran a hedonic regression analysis to measure the impact of a place's IMI score on various economic indicators, controlling for average household income as well as independent value t-tests (for capitalization rates.) Our original list of performance metrics was vast and fairly comprehensive. We narrowed the number to six, including retail rents, office rents, retail sales, residential rents, residential price per square foot, and capitalization (cap) rates.

Limited availability of relatively easily accessible, national data sets guided the selection of metrics, as we aimed to establish a replicable methodology for identifying and evaluating walkable urban places nationwide.

Social Equity

While there is a lack of consensus around a definition for social equity, we outlined five related indicators: diversity, income, education, affordability, and accessibility. We chose these metrics from a number of other potential indicators as they are consistently measurable and the data is generally widely available in multiple metropolitan areas.

- Affordability: percent of average median income (AMI) spent on transportation costs, percent of AMI on housing, and percent of AMI on housing and transportation;
- Income: average household income, per capita income, disposable income, and unemployment rates;
- Diversity: the Census-defined diversity index, and racial and ethnic composition;
- Education: percent of the population with a high school degree, bachelors degree, and graduate degree;
- Accessibility: access to transit, access to parks, number of transit lines, number of bus routes, average headway, and share of jobs reachable within 90 minutes.

To examine social equity performance, we compared places scoring poorly on walkability (those with IMI levels of 1 and 2) to places scoring at fair to very good on walkability (IMI levels 3, 4, and 5.)[34] We chose to examine the differences between those places with the most substandard walkability relative to those with at least fair walkability to better understand the social equity within the least walkable places in our sample.[35] Some places that fell within IMI level 3 (fair) may be on an upward trajectory in terms of walkability as many of the places in our sample have plans to become more walkable. We deemed it was more appropriate to examine differences between those places that currently have at best poor walkability relative to those with at least fair walkability. Much more effort would be required to retrofit the former to become more walkable, thus potentially exacerbating social equity issues. As such, we felt it was particularly important to examine these most vulnerable places. All of these metrics were also compared across the average for metropolitan Washington to provide a basis of comparison.

Findings

A. More walkable places perform better economically.

Based on our sample of places within metropolitan Washington, a neighborhood's walkability score relates positively to several key economic indicators.[36] Higher walkability, as measured by a place's IMI score, is related to higher economic performance, controlling for a place's household income (Table 3).[37] Specifically, considering the magnitude of influence that walkability has on economic performance, a one-level (or approximately 20 pt) increase in walkability (out of a range of 94 points) translates into a $8.88 value premium in office rents, a $6.92 premium in retail rents, an 80 percent increase in retail sales, a $301.76/square foot premium in residential rents, and a $81.54/square foot premium in residential housing values.

Table 3. The Relationship between Walkability and Economic Performance[38]

	1 IMI level increase (~20 pt. IMI)	Mean & Standard Deviation
Avg. office rent/square foot ***	$8.88	M=$32.47 SD=$10.21
Avg. retail rent/square foot **	$6.92	M=$33.24; SD=11.94
Percent Retail sales**	80%	*See footnote*
Avg. residential rent/month ***	$301.76	M=$1,550.64 SD=$538.41
Avg. for-sale home value/square foot ***	$81.54	M=$295.93 SD=$140.57

*p-values: ~=.10; *<.05; **<.01; ***<.001*

While the relationship between walkability and economic performance is continuous (increases in the former relate to increases in the latter), the economic value of walkability is perhaps best illustrated by the impact of moving from one level of walkability (e.g. Wheaton at a level 3 with "fair" walkability) up to the next (e.g. Adams Morgan at a level 4 with "good" walkability), holding housing values constant. For example:

Places with higher walkability perform better commercially. A place with good walkability, on average, commands $8.88/sq. ft. per year more in office rents and $6.92/sq. ft. per year higher retail rents, and generates 80 percent more in retail sales as compared to the place with fair walkability, holding household income levels constant.

Places with higher walkability have higher housing values. For example, a place with good walkability, on average, commands $301.76 per month more in residential rents and has for-sale residential property values of $81.54/sq. ft. more relative to the place with fair walkability, holding household income levels constant.

An examination of the impact of walkability on capitalization rates focused on the differences between places that were classified as walkable urban (levels 4 and 5) and those that were not (levels 3 and under). We found that:

Capitalization rates are lower in places that qualify as walkable urban places than in those that do not, especially in the period after the Great Recession.[39] Development in places with higher walkability has lower capitalization rates. The underlying value of real estate assets in walkable places is higher, facilitating private market financing (Figure 2).[40] On average, before the recession (2000 to 2007), retail and office space in walkable urban places had a 23 percent premium per square foot valuation. During the recession (2008 to 2010) that premium nearly doubled to 44.3 percent.

Figure 2. Capitalization Rates Before and After the Recession for Places with Above Average vs. Below Average Walkability

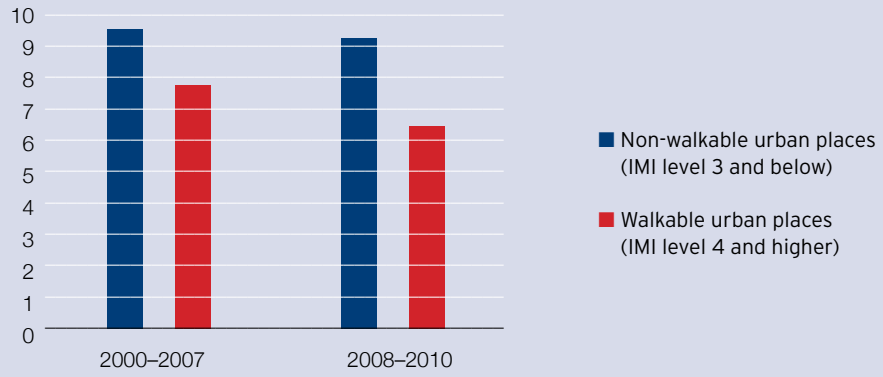

Table 4. Economic Performance of Walkable Districts vs. Single Walkable Places

	Walkable Urban Place Districts	Stand-alone Walkable Urban Places
Average office direct gross rent***	$ 41.98	$ 29.81
Average retail direct gross rent***	$ 42.10	$ 28.59
Retail sales**	$ 2,303,980	$ 1,030,259
Average residential rent**	$ 2,016.56	$ 1,544.04
Average for-sale home value/sf***	$ 465.95	$ 250.33
Assessed taxes	$ 3,241.30	$ 3,163.25
Percent retail*	4.6%	11.7%
Percent office	41.1%	24.8%
Percent residential	52.9%	55.7%
--Percent rental residential	10.2%	20.2%
--Percent for sale residential	42.7%	35.5%
Cap rate before recession	7.78	7.70
Cap rate after recession	6.37	6.85
Average # of rail stops	1.57	.75

*p-values: ~=.10; *<.05; **<.01; ***<.001.*

Note: retail sales were normalized into z-scores within the analysis.

B. Walkable urban places benefit from being near other walkable urban places.

Within metropolitan Washington, many of the places in the study sample with above-average walkability have clustered together. For example, within the District, Dupont Circle is adjacent to Georgetown, Adams Morgan, Kalorama, West End, Columbia Heights, U Street, Logan Circle, and Downtown D.C. All of these neighborhoods were classified as walkable urban places and have either an IMI level of 4 or 5. In northern Virginia, the adjacent neighborhoods of Clarendon, Virginia Square, Courthouse, and Ballston also form a walkable urban place district.

Comparing the sample's clustered walkable urban places to those that stand alone, such as Bethesda, we found that those clustered into a district performed better across a number of economic indicators (Table 4). For example, the clustered neighborhoods commanded nearly 41 percent more in office rents, 47 percent more in retail rents, and nearly 31 percent more in residential rents. Additionally, residential values in walkable urban place districts were on average 86 percent higher on a per square foot basis than in stand-alone walkable places.

Average retail sales in walkable urban place districts do not differ statistically from that of other walkable urban places. This may be due to the fact that places that do not cluster have a higher percentage of retail uses (11.75 percent) relative to the individual walkable urban places within a cluster (4.6 percent), which may help to make up for the difference in retail sales. But there is no difference in cap rates between clustered and single walkable urban places, nor is there a difference in transit access as measured by rail.

C. Residents of more walkable places have lower transportation costs and higher transit access, but also higher housing costs than residents of less walkable places

Based on data from the Center for Neighborhood Technology, we found that places with fair to very good walkability have significantly lower transportation costs than do places with poor to very poor walkability (Table 5). Alternatively, walkable areas have significantly higher housing costs than those with fewer environmental amenities. This finding affirms other studies that have indicated that living in more compact, mixed-use neighborhoods is related to reduced vehicle miles traveled and lower transportation costs. A composite set of built environment characteristics (accounted for by the IMI) is important with respect to household transportation expenditures. This includes more than just macro-level planning factors such as proximity to non-residential destinations, density, and connectivity. Micro-scale urban design features including pedestrian amenities, traffic safety, safety from crime, and aesthetics are also important.[41]

Table 5. Percent of Area Median Household Income Spent on Housing and Transportation, By Walkability Level

IMI Level	1	2	3	4	5	Region
%AMI Transportation Costs	14.7	15.9	15.7	12.7	12.3	13.8
%AMI Housing Costs	16.9	19.0	24.7	30.1	31.7	37.1

Source: Data for the neighborhoods from the Center for Neighborhood Technology; metro area data from Bureau of Labor Statistics

When compared to the overall metropolitan Washington area, places in the study sample with fair-to-very-good walkability spend 28 percent less of their average monthly income on transportation but 17 percent more on housing. Places with poor-to-very-poor walkability within our sample also see transportation savings relative to the region and spend 12 percent less on housing costs. The nature of our sample, insofar as it does not contain many far-flung suburban places, likely helps explain why all of the places observed have lower transportation costs relative to the region.

Finally, accessibility to jobs, transit, and recreation varies according to walkability. While overall there are no *significant* differences with respect to access between places with fair to very good walkability and places with poor to very poor walkability, there are important differences between the specific levels of walkability.[42] For example, residents of places at walkability level 4 on average can access over 15 percent more jobs in the region within 90 minutes than residents in places at level 3, and 21 percent more than residents in places at level 2. Additionally, places at level 5 have 3.4 and 2.4 times more bus lines, respectively, than places at level 2 or 3.[43] Moreover, level 5 places contain 3.4 to 3.6 times more parks on average than do places with fair or poor walkability.[44]

This analysis points to significant differences in access that vary with a place's walkability level. While the relationship outlined here between walkability and accessibility is not causal, the fact that they occur in tandem is problematic from a social equity standpoint. That is, residents of places with low walkability are not only faced with living in places that are not very walkable, they are also dealing with a lack of access to jobs, transit, and recreational amenities, relative to what is available to residents of places with higher walkability. When comparing our sample to the region overall, no significant differences emerge between poor to very poor walkable places and fair to very good walkable places relative to the total share of jobs accessible within 90 minutes and average headway, indicating that there are places in the region that are worse off from an accessibility standpoint (**Appendix Table 1**). Again, the lack of a significant difference may be attributable to the nature of our sample;

if we were to include more places, it is likely that we would find a significant difference with respect to accessibility. Nevertheless, the discrepancies in access identified here are quite important from a social equity standpoint.

D. Residents of places with poor walkability are generally less affluent and have lower educational attainment than places with good walkability.

Based on the sample, households in places with fair-to-very-good walkability have higher incomes, education levels, and employment rates than places with poor to very poor walkability.[45]

Indicators (Appendix table) related to income, education, and unemployment point to similar concerns as those related to accessibility. Within the sample, residents of places with poor or very poor walkability had lower average, disposable, and per capita incomes, constraining their housing choices. Further exacerbating this constraint is the fact that housing prices within fair to very good walkable places are higher than that of poor to very poor walkable places. Simply, if residents of the poor to very poor walkable places in the sample wanted to live in a more walkable place, it is unlikely they could afford to do so. This presents a serious social equity issue, especially considering the other health, social, and economic benefits that have been empirically linked to walkability. Further, the decreased accessibility within poor to very poor walkable places (relative to that of fair to very good walkable places) is especially disconcerting, as not only do the latter lack appropriate walkable amenities within their neighborhoods, their access to amenities (including jobs) within other neighborhoods is also limited.

Implications and Conclusion

Considering the economic benefits, walkability should be a critical part of all strategic growth plans. The implications of this study cut across the federal and state, metropolitan, and place levels.

Public policy should become more favorable toward walkable placemaking. Currently, many federal and state subsidies substantially favor low-density development and tip the scales against walkable development. Further, many local zoning codes make walkable development illegal, necessitating costly and time-consuming zoning changes with no guarantee of success. Federal, state, and local policy makers should conduct a systematic review of existing public policies that are biased against walkable development, and adopt new measures aimed at facilitating (or at least removing roadblocks to) this type of development.

For their part, local and regional planning agencies should incorporate assessments of walkability into their strategic economic development plans. Planning entities should identify where regional-serving and local-serving walkable urban places exist within a metropolitan area, seek out those places that are positioned to become more walkable, and determine potential locations of future walkable places. This type of assessment will help determine where infrastructure and other built environment improvements are needed. Since high-density walkable urban places seem to account for a small amount of a metropolitan area's existing land mass, it is probable that the infrastructure cost per dwelling unit or commercial square foot will be a fraction of that of existing low-density drivable suburban infrastructure costs.[46]

At the same time, the apparent supply-demand mismatch for walkable places may be contributing significantly to the price premium these places demand. To the extent that this is the case, the short- and medium-term shortage of walkable places makes them inaccessible (unaffordable) to many people who desire to live in such places. As such, it is important to have an affordable housing strategy in place while those improvements are being implemented.

Beyond the direct and indirect policy implications, the results of this study should also inform five sets of stakeholders: private developers and investors, social equity advocates, the public sector, place managers (such as business improvement districts and redevelopment agencies), and citizen-led groups/activists.

The first type of stakeholder, including investors, real estate developers, financers, lenders, etc., can use the walkability metrics to guide their investment and development decisions. The walkability

continuum based on IMI scores provides a classification system that is tied to economic performance. As such, a real estate developer and his investors may decide that they would like to target their investment into places at level 3 along the continuum, hopefully growing into a "4" because it may represent a place that is about to experience a significant increase in underlying property value. Stakeholders can clearly delineate what places fall under level 3 as well as track its progress against established metrics. A risk-sensitive institutional investor may decide that it only wants to purchase real estate assets in level 5 places since they have a proven track record of walkability and resulting high economic performance.

For advocates, a place's social equity performance level could help socially responsible investors focus on walkable urban places and projects where the need for increased affordable housing is most pressing or help highlight inequities that need to be addressed. In addition, stakeholders could measure the effectiveness of social equity policies, such as an affordable or workforce housing strategic plan.

Public stakeholders primarily provide the capital improvements for infrastructure and the operating funding for social service and public safety activities. The walkability, economic, and social equity metrics can inform funding allocation decisions and can be used to measure the effectiveness of that spending. For example, the U.S. Department of Housing and Urban Development could use these metrics not only to guide their selection of grantees for the next round of Sustainability Challenge Grants, but also to empirically track the progress of their grantees and hence establish further accountability standards. Federal and state departments of Transportation could require local jurisdictions to meet local economic and social equity standards in their grant applications and monitor their progress relative to these self-selected goals when determining whether to approve funding requests. Further, other granting agencies may only be interested in awarding funding to those places that already meet certain equity standards, but would like to enhance their economic performance related to walkability. Alternately, agencies may decide to invest in places that are advanced in their walkability standings but need to further social equity goals.

The next set of stakeholders includes on the ground place managers, public and private, that provide the strategy for and management of these places. For example, a BID may look to the walkability continuum to understand their current standing and set a goal to move to up a level. As such, these organizations can clearly lay out a roadmap for how to move further along the continuum with inbuilt justification (either for internal use by the organization or external use to secure funding) for implementing a strategy to do so. Additionally, planning agencies can use this continuum to evaluate their jurisdictions and establish strategic plans for strengthening (or increasing the number of) walkable urban places within their domain.

The final set of stakeholders is citizen-led groups and activists who can use their neighborhoods' IMI scores to better understand their strengths and weakness and, as such, to leverage positive, pedestrian-oriented change. By helping to diagnose neighborhoods' walkability, the IMI provides a tool for "tactical" and "Do-It-Yourself" (DIY) urbanites to engage communities, not only to advocate for change but also to actually begin to improve their neighborhoods.

There is also the opportunity for all five stakeholders to learn from comparable walkable urban places in their metropolitan area or other metropolitan areas. It is common for various local jurisdictions, a chamber of commerce and other regional organizations to sponsor visits to other metropolitan areas to exchange lessons learned and generate new ideas. Using the walkable urban place definition and performance metrics, they can compare performance in much more depth and on an apples-to-apples basis.

Evidence is beginning to show that demand for walkable places is on the rise. We believe the supply is already falling short of the demand and the findings outlined here around economic performance justify ameliorating this mismatch by facilitating this kind of placemaking.

I. Appendix

Appendix Table 1. Social and Economic Statistics in the Washington D.C. Metropolitan Area Based on Walkability Levels

	Walkability Classification Levels					
	1	2	3	4	5	Washington Metro Area
Per capita income (2010)[a]	$21,687	$25,173	$34,097	$49,075	$56,247	$36,618
Average household income (2010)[a]	$53,068	$69,252	$88,395	$93,145	$103,145	$81,213
Average disposable income (2010)[a]	41,773	$55,799	$69,364	$74,234	$77,523	N/A
Unemployment rate (2010)[a]	23.2%	9.1%	10.5%	8.4%	11.2%	7.5%
Diversity index (2010)[a]	23.0%	74.6%	51.8%	48.4%	47.1%	70.3%
% Change white (2000 to 2010)[b]	-20.6%	-33.1%	38.7%	122.8%	148.9%	2.19%
% Change black (2000 to 2010)[b]	66.4%	-.03%	20.8%	-31.8%	-.05%	12.41%
% High school as highest degree (2010)[b]	22.2%	17.8%	12.7%	7.8%	11.2%	13.2%
% Bachelors as highest degree (2010)[b]	9.3%%	9.2%%	14.7%%	22.2%	17.6%	16.8%
% Graduate/ professional as highest degree (2010)[b]	2.3%	7.7%	13.5%	28.0%	27.8%	14.8%
Average headway[c] (in minutes)	5.55	5.92	6.66	4.16	4.47	6.6
Share of jobs in region accessible within 90 min[c]	52%	39.2%	45.2%	60.3%	61.2%	36.6%
Average number of parks (2010)[a]	0	1.33	1.42	2.3	4.8	2.11

Sources: a: ESRI Demographics, b: Census 2010, c: Adie Tomer and others, "Missed Opportunity: Transit and Jobs in Metropolitan America," Washington: Brookings, 2011.

Further discussion of the methodology

At the onset of this study, we conducted a literature review of the relationship between the built environment and walkability, including examining preliminary operational definitions for walkability. We also surveyed literature on the concept of regional significance/serving, attempting to identify established, defining parameters for the term. Further, we reviewed the literature on social equity and related definitions and measures for such. Primarily, the literature review served to inform the development of an expert panel (Delphi panel) survey and related overview materials.

We identified and invited 20 potential Delphi panel participants, including academic and academic-affiliated experts on a range of topics related to walkable urban places, such as urban economics, sustainability, urban design, social equity, transportation, walkability, urban planning, housing, geography, and demography.

Delphi panelists were to provide feedback that would inform the development of an operational definition of walkable urban places. Specifically, the Delphi Panel survey presented participants with a preliminary list of potential walkable urban place parameters (based on the results of a literature review) and asked them to rate each parameter's importance relative to "walkable urban placemaking" as well as comment on potential measurement methods, data sources, and appropriate "scoring" mechanisms for each factor. Another key objective of the Delphi panel was to elicit input that would contribute to the development of a list of economic and social equity metrics with which to gauge walkable urban places' performance. Delphi Panel participants were asked to react to a list of potential social equity and economic metrics. Additionally, we asked panelists to provide input as to the best methodology by which to measure walkability and define neighborhood boundaries. We also solicited their help with defining several related terms, including "regional significance/serving" and "critical mass." The survey also allowed participants to suggest other potential parameters critical to the development and success of walkable urban places.

Economics/Development Panel

We convened 13 economic development and real estate industry experts for a four-hour panel in which we discussed the criteria for walkable urban places and key economic performance metrics and gathered feedback regarding a preliminary list of walkable urban place candidates and their boundar-

ies. Discussion centered primarily on the issue of regional significance, in terms of its definition and measurement; how regionally significant places differed fundamentally from locally serving places; and its overall importance as a criterion for distinguishing walkable urban place types.

Government Agency Panel

We convened 12 representatives of federal and local government agencies (including U.S. departments of housing and transportation, the Green Building Council, and the Washington Metropolitan Area Transit Authority) for a four-hour session. The federal panelists focused their discussion primarily on implementation issues (how they would integrate our methodology and results into their agendas and decision-making processes) and the identification of key performance measures.

Social Equity Panel

We convened 13 social equity experts for a four-hour panel. Social equity panelists focused primarily on identifying the most appropriate social equity metrics for walkable urban places. They suggested establishing metrics that were relative to their corresponding region as well as considering contextual issues in defining metrics, or rather, a set of metrics.

Finance Panel

We convened six representatives of the real estate finance community for a four-hour panel in which we discussed the decision-making process for real estate finance, especially as it relates to walkable urban places. The purpose of the panel was to ensure that the walkable urban places study produced a methodology and deliverable that the finance community can incorporate into their underwriting and/or lending approval and selection process.

Walkability – The Irvine Minnesota Inventory (IMI)

The IMI, one of the first micro-scale audit tools to be developed, measures a comprehensive set of built environment features, and has been widely used in the urban planning, design and public health fields. Auditors received in-class and on-site training; they collected data on test segments, which were then tested for reliability and validity. Auditors for this study included George Washington University undergraduate geography students who participated as part of a service learning partnership and other independent contractors.

Real Estate and Social Equity Data Collection and Sources

CoStar served as the primary database for commercial property data. We obtained nearly 1,200 real estate performance data points, including, but not limited to, square footage, vacancy, leasing and rental rates, and absorption rates. We collected this data for a variety of property types, including office (class A-F), flex, industrial and retail, across multiple time points. Longitudinal (yearly and quarterly) data was available for most variables dating back to 2000 (retail data was provided historically to 2006). While CoStar provided a robust set of economic indicators, it does not include owner-occupied related data.

Tax Assessor Data served as the starting point from which we estimated the floor area of government-owned buildings and owner-user occupied space. While other real estate data sources such as CoStar and REIS do not provide this data, most tax assessors do assign valuations to government-owned buildings and other tax-exempt properties from which floor area may be derived. To calculate approximate floor area, we aggregated building valuations by land use type and divided them by an assumed value per square foot.[47] Tax assessment data is collected and maintained at the county level, however. As such, significant inconsistencies between assessors datasets exist that limit their usefulness for estimating floor area.

Zillow provided point based data reflecting for-sale owner occupied residential property specific to the boundaries defined by the study. This data set includes square footage of residential property, assessed value, and tax information for 2005 and 2010. This data is categorized based on type of dwelling (single family, condo, duplex/triplex, and other).

REIS provided the total floor area of rental apartments housed in buildings with 40 or more dwelling units. The dataset includes building-specific data including building age, total units, average rent

per unit, number of bedrooms per unit, and comparable rents over a 5-year period within a defined area. REIS does not account for small rental apartment properties, however. As such, this dataset does not accurately represent gross rental apartment space in areas where the apartment stock is primarily housed in small buildings.

ESRI Demographic data served as the primary source of demographic data. With the elimination of the long form Census in 2010, we were unable to customize census data to our defined geographies. ESRI data, available at the block group geography, included social equity-related measures such as income, unemployment, and education attainment. We did obtain absolute count data regarding race and ethnicity at the smallest geography available (block) for 2000 and 2010 directly from the **Decennial Census**.

Brookings Institution Transit Accessibility Data provided information on the availability of public transit, average wait times, and percent of metropolitan jobs accessible at the block group geography. We aggregated block groups based on our geographies and produced a population-weighted value for each place.

Center for Neighborhood Technology (CNT) commissioned by the D.C. Office of Planning provided block group level data of housing and transportation costs as a percent of area median income, which were used to measure social equity.

ESRI Business data served as a source of industry sector and business data, including retail sales and employment data. Data were collected based on our geographies. Compared to other existing databases reporting on similar data, ESRI business data seemed incomplete. As such, we used (standardized) Z-scores for variables from this dataset rather than the actual raw numbers provided.

Endnotes

1. Christopher B. Leinberger is a nonresident senior fellow at Brookings, Charles Bendit Distinguished Scholar and research professor at the George Washington University School of Business, and president of LOCUS, a national network of real estate developers and investors. Mariela Alfonzo is a research fellow at the Polytechnic Institute of New York University and president of Urban Imprint. Note, the name of the Brookings affiliate is listed first.

2. Joe Cortright, "Driven to the Brink: How the Gas Price Spike Popped the Housing Bubble and Devalued the Suburbs," Chicago: CEOs for Cities, 2008; and Matthew Strozier, "Mapping Home-Value Drops by Zip Code," The Wall Street Journal, June 28, 2011. Available at http://blogs.wsj.com/developments/2011/06/28/mapping-home-value-drops-by-zip-code.

3. National Association of Realtors, "The 2011 Community Preference Survey: What Americans are Looking for When Deciding Where to Live," Washington, 2011. Available at http://www.realtor.org/research.

4. John McIllwain, "Housing in America: The Next Decade," (Washington: Urban Land Institute, 2010)

5. Jonathan Levine, Aseem Inam, and Gwo-Wei Torng, "A Choice-Based Rationale for Land Use and Transportation Alternatives: Evidence from Boston and Atlanta," *Journal of Planning Educating and Research*, 24: 317–330, 2005.

6. Arthur C. Nelson, "Resetting the Demand for Multifamily Housing: Demographic & Economic Drivers to 2020," Presentation to National Multi Housing Council, 2010.

7. Jonathan Levine and Larry Frank, "Transportation and Land-Use Preferences and Residents' Neighborhood Choices: The Sufficiency of Compact Development on the Atlanta Region. Transportation 34(2):255-274, 2007.

8. Joe Cortright, "Walking the Walk: How Walkability Raises Home Values in U.S. Cities," Chicago: CEOs for Cities, 2009.

9. One study revealed that one additional Walkscore point was associated with a $500-$3,000 increase in home sale value. On the commercial side, a ten-point increase in Walkscore was tied to a 9 percent increase in office and retail property values.

10. See Levine, Inam, & Torng, 2005; Rolf Pendall, Robert Puentes, and Jonathan Martin, "From Traditional to Reformed: A Review of the Land Use Regulations in the Nation's 50 Largest Metropolitan Areas," (Washington: Brookings, 2006); Robert Lang, Jennifer Lefurgy, and Steven Hornberg, "From Wall Street to Your Street: New Solutions for Smart Growth Finance," Alexandria: Metropolitan Institute of Virginia Tech, 2005; and Center for Transit-Oriented Development and others, "Fostering Equitable and Sustainable Transit-Oriented Development: Briefing Papers for a Convening on Transit-Oriented Development," February 24-25, 2009.

11. Christopher Leinberger, "Financing Progressive Development," (Washington: Brookings, 2001).

12. Center for Transit-Oriented Development and others, 2009; Christopher Leinberger and Sarah Kavage, "Barriers to Developing Walkable Urbanism and Possible Solutions," (Washington: Brookings, 2007).

13. Gary Pivo and Jeffrey Fisher, "The Walkability Premium in Commercial Real Estate Investments," *Real Estate Economics*, 39, (2), 185–219, 2011; and Cortright, 2009.

14. Nancy Wells and others, "Environment, Design, and Obesity: Opportunities for Interdisciplinary Collaborative Research," Environment Behavior, 39 (1), 6-33, 2007; and Larry Frank and Peter Engelke, "How Land Use and Transportation Systems Impact Public Health: A Literature Review of the Relationship between Physical Activity and Built Form," Centers for Disease Control, 2000.

15. A comprehensive study revealed that shifting 60 percent of development toward places that encompass the components of walkable urban places would save 85 million metric tons of CO2 annually, by 2030. Reid Ewing and others, *Growing Cooler: The Evidence on Urban Development and Climate Change*, Washington, Urban Land Institute: 2008; Larry Frank, and others, "Carbonless Footprints: Promoting Health and Climate Stabilization through Active Transportation," *Preventive Medicine*, 50, S99-S105, 2010.

16. Gary Pivo and Jeffrey Fisher, "Toward Sustainable and Responsible Property Investment Indices," Prepared for Strengthening the Green Foundation: Research and Policy Directions for Development and Finance held at Tulane University, New Orleans, March 10-11, 2011.

17. Christopher Leinberger, "Footloose and Fancy Free: A Field Survey of Walkable Urban Places in the Top 30 U.S. Metropolitan Areas," (Washington: Brookings, 2007).

18. Leinberger, 2007.

19. These were areas funded as part of Washington D.C.'s Neighborhood Investment Fund. Available at http://dmped.dc.gov/DC/DMPED/Opportunities/Grant+Opportunities/Neighborhood+Investment+Fund

20. Our initial list included over 400 potential places to study. As the fieldwork and analysis of the built environment features is intense and time-consuming, we developed a rubric by which to define and narrow the potential "universe" of places. We decided to use neighborhoods' Walkscores to place them along a walkability continuum. Walkscore is ideal since it does not require first-hand onsite data collection. However, to do so, we drew boundaries for each place within that "universe" so that a Walkscore could be generated. As such, we delineated the three criteria outlined herein to arrive at a manageable number of places from which we would later sample: one established the geographical areas from which we would draw; the second addressed our original aim to focus on places that were either walkable or aspired to be; the third reflected this project's focus on urbanized places.

21. According to its website, the Metropolitan Washington Council of Governments is an independent association of "elected officials from 22 local governments, members of the Maryland and Virginia state legislatures, and members of the U.S. Congress." The local governments members are: the District of Columbia; Bowie, College Park, Charles County, Frederick, Frederick County, Gaithersburg, Greenbelt, Montgomery County, Prince George's County, Rockville, and Takoma Park in Maryland; and Alexandria, Arlington County, Fairfax, Fairfax County, Falls Church, Loudoun County, Manassas, Manassas Park, and Prince William County in Virginia.

22. We chose to eliminate Census designated rural blocks to create a more manageable population of places from which to eventually sample and thus keep within the scope of our study. Future studies may examine the applicability of our findings within rural areas.

23. We did not include closed campuses (such as traditional universities and military bases.)

24. Note that the neighborhoods in our sample vary in acreage; we did not set an upper limit with respect to neighborhood size but rather followed the respective planning entity's definition for a specific neighborhood. We believe that defining neighborhoods based on existing governmental/jurisdictional boundaries produces more policy-relevant findings than does using an a priori range (e.g. ✣ mile radius) or arbitrary neighborhood size.

25. Walkscore generated a population-weighted score for each of our neighborhoods based on our defined boundaries.

26. Seven of the neighborhoods for which IMI data was collected—Ballston, Courthouse, M Square Research Park, Minnesota Avenue, Prince George's Plaza, U Street/Shaw, and West Hyattsville—were ultimately not "selected" into our sample. However, as the IMI scores were generated for them, we are reporting here for information only. These neighborhoods were not included in the regression. We collected data for three other neighborhoods—Rosslyn, Foggy Bottom, and Logan Circle—that proved faulty so they were eliminated from the analysis.

27. To help us operationalize the difference between regional and local-serving places, we collected economic performance data from CoStar. We gathered this data for the same 66 places in the sample for which built environment data was collected and also for an additional 37 places that were part of a convenience sample.

28. Kristen Day and others, "The Irvine-Minnesota Inventory to Measure Built Environments: Development. *American Journal of Preventive Medicine* 30(2):144-52, 2006.

29. Using GIS, we determined the total number of segments present within each of the 66 places. We selected a sample of segments for each site in order to minimize data collection time, as, on average, it takes 8-10 minutes to observe a segment. For places larger than 400 acres, we sampled 20 percent of the segments; for places between 250-400 acres, we sampled 25 percent of segments; for places smaller than 250 acres, we sampled 30 percent of segments, and for places with less than 75 segments, we sampled 35 percent of segments. We sampled a minimum of 10 segments and a maximum of 50 segments from each site. On average, we collected data on 25 percent of the segments within a neighborhood. Data were cleaned and entered into SPSS. Note, the IMI was designed to collect built environment data at the block (or segment) scale. See the Appendix for a more thorough description of the methods.

30. Mariela Alfonzo, Jennifer Wolch, and Genevieve Dunton, "Streamlining Walkability Audits for Smart Growth-Physical Activity Assessments," Presentation to *Society for Behavioral Medicine Annual Conference*, April 29, 2007; Mariela Alfonzo, "A Mall in a Former Life: How Converting Failing Malls Into Mixed-use Neighborhoods Impacts Sense of Community," PhD dissertation, University of California, Irvine, 2007; Mariela Alfonzo and J. Kaplan "State of Place," *Houston Magazine*, 2005; Brian E. Saelens and Susan L. Handy, "Built Environment

Correlates of Walking: A Review," *Journal of Medicine and Science in Sports and Exercise*, 40(7S), S550–566 (2005).

31. We have collected IMI data on all 66 places in our sample. Currently, however, we are reporting on only 61 of those because problems and irregularities in the data for five neighborhoods in the sample could not be corrected for inclusion in this study.

32. The differences between these categories are statistically significant. For example, tier one regional-serving office places are significantly different from tier two regional-serving office places with respect to office rents; tier one regional-serving office places are also significantly different from local-serving places. Tier 1 regional-serving retail places are significantly different from tier two regional-serving retail places with respect to retail revenues.

33. Throughout this study, the term statistically significant refers to a finding that has less than a 5 percent probability of being attributed to chance. In other words, the finding is not random.

34. To analyze the relationship between walkability and social equity, we chose to implement an independent sample t-test (that compares the average difference between two groups on a given variable– such as income). This approach is different from the analysis we implemented to analyze the relationship between walkability and economic performance (linear regression, which analyzes the amount of variance accounted for by one variable – walkability – in predicting another variable – retail sales). Because we did not believe that the relationship between walkability and social equity was a linear one, but rather were interested in how more walkable neighborhoods vs. less walkable neighborhoods faired with respect to social equity, we felt that a t-test was more appropriate.

35. IMI level 1 is more than two standard deviations away from the mean; IMI level 2 is more than one standard deviation from the mean. Places within these two levels have poor to very poor walkability, respectively. Note that there were a limited number of places in our sample that had an IMI level of 1 or 2. As such, we may have been unable to detect statistically significant differences. More research is needed to better understand how places with low and very low walkability fare with respect to social equity.

36. The findings for office rents, retail rents, retail sales, for-sale housing values, and residential rents are based on linear regression analyses of a place's IMI score and each individual economic indicator. The findings for cap rates were based on an independent samples t-test that examined the differences in cap rates between walkable urban places (levels 4 & 5) and non-walkable urban places (levels 3 and under).

37. Household income served as a proxy for other factors – crime, educational quality, etc. – that could also impact economic performance. Future studies should control for other neighborhood and regional level factors that could also impact economic performance.

38. A percentage rather than an actual figure is presented for Average Retail Sales because we believe there may have been consistent underreporting of retail revenues (based on the database we used) and therefore it is more appropriate to report the magnitude of this difference rather than the actual number.

39. Capitalization Rate is the net operating income of a real estate property divided by the market value. In other words, the capitalization rate serves as an indicator of the current market value of a real estate property on the basis of net operating income. It is an indirect measure of how quickly a property will pay for itself – or be fully capitalized. A cap-rate is a commonly used tool for investors to quickly value a property, evaluate risk, and estimate his or her potential rate of return.

40. We used CoStar data from 2000-2010 to derive capitalization rates for the walkable urban places in our sample, splitting them into before the recession (pre 2007) and after the recession. We had data for 27 places from before 2007 and 13 places from after 2007 for which IMI scores had been calculated.

41. Mariela Alfonzo and others, "The Relationship of Neighborhood Built Environment Features and Walking," *Journal of Urban Design*, 13, 1, 29-51 (2008).

42. While there do seem to be some large differences between IMI levels with respect to some of the transit indicators, in some cases, we do not have enough places within our sample to indicate whether the differences observed are due to chance or are statistically significant. We will continue to explore this issue in future research that will collect more data from a variety of different neighborhoods across several metropolitan areas.

43. Since our sample included all places with a Metrorail stop automatically, it is likely that these numbers reflect a higher average than the region overall.

44. These are just illustrative examples meant to convey the point that we need to further explore the relationship between social equity indicators and walkability.

45. A statistically significant finding has a p-value of less than 5 percent, which means that there is less than a 5 percent probability that the a finding is due to chance alone. A trend has a p-value between 5 and 10 percent and as such, is not as strong of a finding. However, in the case of unemployment rates, we may not have enough variability in our sample to observe statistically significant differences. Differences in unemployment will be further explored in Phase Two of this study.

46. Infrastructure provision, whether roads, sewer and water lines, transit, electric distribution, police and fire services, etc., are all linear functions. The cost per mile of running a sewer line is roughly the same for walkable urban versus drivable sub-urban provision (it may cost fractionally more for walkable urban but in the final analysis, that cost difference is not consequential). In a drivable suburban environment, that fixed cost per mile is spread over anywhere from four dwelling units per acre to 0.5 dwelling units per acre and less. In a walkable urban environment, that similar fixed cost per mile is spread over anywhere from 10 units per acre to hundreds of units per acre.

47. Based on current construction costs in the Washington MSA, we assume an average value of $180 per square foot of built space for drivable suburban places, or those with IMI scores below 3.39. For walkable urban places with IMI scores over 3.39, we assume an average of $225 per square foot.

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