Hatfield Graduate Journal of Public Affairs

Volume 6 | Issue 1 Article 6

6-3-2022

Regional Growth Concept to Promote Densification and Mixed Land-Use in the Suburbs of the Portland Metropolitan Area

Sangwan Lee
Portland State University

Recommended Citation
Lee, Sangwan (2022) "Regional Growth Concept to Promote Densification and Mixed Land-Use in the Suburbs of the Portland Metropolitan Area," *Hatfield Graduate Journal of Public Affairs*: Vol. 6: Iss. 1, Article 6.
https://doi.org/10.15760/hgjpa.2021.6.6

1. Introduction

A recent study by Bertaud (2018) asserts that "normative" conceptions of urban design and planning, such as compact cities, have an insignificant impact on the formation of spatial concentration. Instead, market mechanisms serve as the foundation for forming spatial order and shaping cities. As a result, using the Portland Metropolitan Area as a case study, this paper investigates how regional planning promotes the development of densified and mixed-use neighborhoods in suburban areas. There are two research questions that appear to be unrelated but are connected. The first question is: What variables influence the categorization of communities into regional and town centers under a regional planning framework (the 2040 Growth Concept) for the Portland Metropolitan region? Second, have the regional and town centers achieved their purpose of promoting densification and diversified land use as outlined in their strategic plans? The objective of this study is to give empirical evidence to answer the research questions and discuss if government intervention through urban design and planning helps produce the spatial patterns desired by the planning authority. The next section of the paper provides the data and methodological approach, the third section presents and interprets the results, and the last sections present a discussion and conclusion.

2. Research Design

2.1. Study area

This research focuses on seven regional and twenty-seven town centers designated in the 2040 Growth Concept of the Portland Metropolitan area (Metro, 1995) to promote the concentration of activities and oppose conventional sprawl development practices (see Figure 1). In detail, the 2040 Growth Concept establishes a planning framework for how the Portland region should be growing over the next 50 years. The planning framework aspires to develop regional and town centers as edge cities. Garreau (1992) defined an edge city in the U.S. context as the concentration of activities in the suburban area with better access to transportation, such as freeways and ramps. Accordingly, the two centers are intended to serve as hubs of amenities, employment opportunities, and local government services in suburban areas of the region. Thus, through urban design and planning, the regional and town centers are supposed to transform into densified and mixed-use neighborhoods by encouraging spatial concentrations on particular areas in the suburbs of the Portland Metropolitan area.

The unit of analysis was Census Block Groups (CBGs) in suburbs of the Portland Metropolitan area (see Figure 1). Given that regional and town centers are designated in suburban areas, I eliminated 43 CBGs located in the Central City of Portland. Moreover, I dropped CBGs outside of the Urban Growth Boundary of Portland. The final number of census block groups in this analysis was 822.

10.15760/hgjpa.2021.6.6

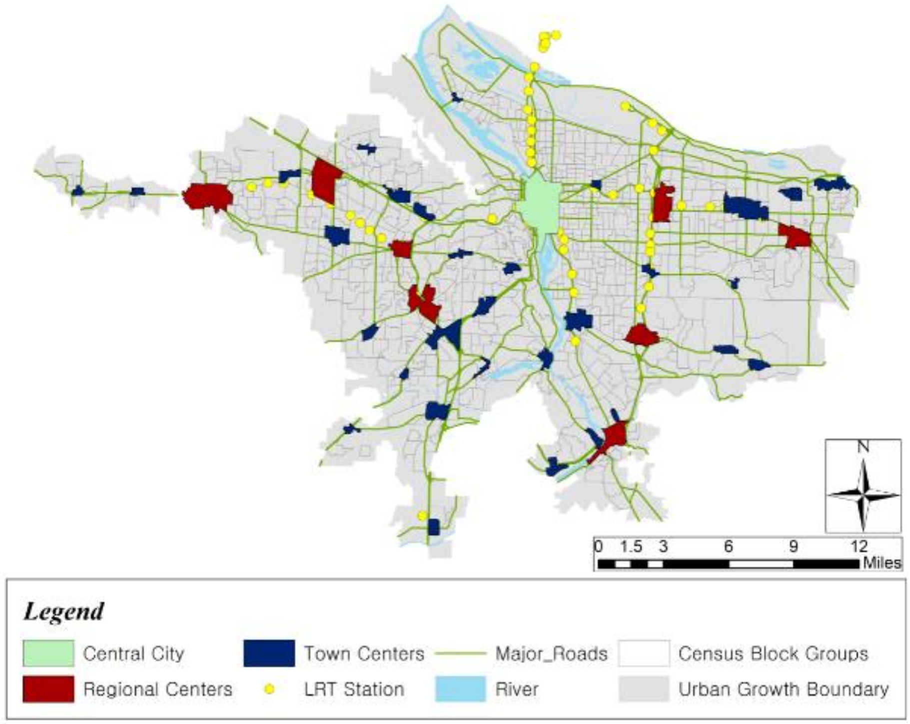

Figure 1 Study Area

2.2. Methodological Approach

2.2.1. Multinomial Logistic Model

The first question for empirical inquiry is regarding factors influencing the categorization of the suburb, town center, and regional center in the plan. Thus, I used discrete choice modeling (DCM), Multinomial Logit (MNL) model, developed by McFadden (1973). MNL model can explore why a CBG is designated as either suburb, town center, or regional center. MNL model in this study used two sets of explanatory variables (see Table 1), including transportation-related features (e.g., distance to Central Business District) and other neighborhood characteristics (e.g., median household income). The parameter estimation of the model can offer insights on the importance and magnitude of the variables (Ben-Akiva and Lerman, 1985).

Although the MNL model has been widely used in diverse fields, it has a limitation, in particular, regarding the IIA property (Koppelman and Bhat, 2006). The IIA property, which implies equal competition between all alternatives, can restrict the ratio of the predicted probabilities for alternatives. Thus, the similarities between suburb, town center, and regional center can lead to a correlation between the errors associated with the alternatives, which violates assumptions that underlie the MNL model. Thus, I tested if the Nested Logit

Model is appropriate in this study, as the town center and regional center could be into one nest. The estimated log-sum coefficient and log-likelihood test indicated that the MNL model is appropriate.

2.2.2. Propensity Score Matching and Paired T-test

To answer the second research question of this paper, I first used Propensity Score Matching (PSM) to construct matched sets of treated and control groups that share similar observed characteristics (Austin, 2011; Rosenbaum and Rubin, 1983). Since the randomized experiment is often limited in observational studies and might introduce a biased treatment effect, PSM is used (Choi and Guhathakurta, 2020). The matching approximates a randomized experiment, meaning that it roughly assembles a true experiment with random assignment (Dong, 2017).

Here, the pools of the treated group include CBGs intersected with town centers and regional centers, while other CBGs in the suburbs are the pool of the control group. PSM identified matched sets of treated and control groups. To find a better pair, I used the nearest neighborhood method with a caliper distance to exclude treated subjects from the resultant matched sample that were not below some prespecified threshold (Austin, 2011). When using calipers of width equal to 0.2, approximately 99% of the bias due to the measured confounders can be eliminated (Austin, 2011).

Once finding appropriate pairs, I used the paired t-test to examine whether there is a statistically significant mean difference in population, employment density, and land-use mix between treated and control groups.

2.2.3. Variables used in the research

The covariates used in the analysis included transportation-related features, such as distance to light rail (LRT), and neighborhood characteristics, such as median household income. Data on the variables are mainly from three publicly available sources: Portland Metro’s 2019 Regional Land Information System (RLIS), the 2019 American Community Survey (ACS) 5-year estimates, and the 2015 U.S. Longitudinal Employer-Household Dynamics. Table 1 shows further details on the variables used in this study, and Table 2 shows the descriptive statistics of each variable.

Table 1 The description of variables used in the research

Variable name	Description	Source
Transportation-related Features		
ln(Railyard)	Log-transformed Euclidean distance in feet between each the centroid of a census block group and the nearest rail yard	GIS

ln(CBD)	Log-transformed Euclidean distance in feet between each the centroid of a census block group and downtown (the City Hall of Portland) (Dong, 2017)	GIS
ln(Airport)	Log-transformed Euclidean distance in feet between each the centroid of census tract and the airport (PDX)	GIS
ln(LRT)	Log-transformed Euclidean distance in feet between each the centroid of census tract and the nearest LRT stations, including MAX and WES	GIS
Major Road	Whether the census block group has major roads (freeway, highway, ramp, and major arterials)	GIS
Bus Density	The total number of bus stops per square miles at the census block group level (Sabouri et al., 2020)	GIS
Neighborhood Characteristics		
Activity Density	The sum of population and employment per square mile at census block in 10,000 (Sabouri et al., 2020)	L, A
Land Mix Index	The evenness in the spatial footprint of three land uses at census block group level: residential, commercial/industrial, and others $$land\ mix\ index = 1 - \left\{ \frac{\left\lvert \frac{r}{T} - \frac{1}{3} \right\rvert + \left\lvert \frac{c}{T} - \frac{1}{3} \right\rvert + \left\lvert \frac{o}{T} - \frac{1}{3} \right\rvert}{4/3} \right\}$$ Where r is building's area (square footage) in residential use, c is commercial/industrial use, o is acres in other land uses, and T is $r + c + o$ (Bhat and Gossen, 2004)	R
SFR Density	The total square footage of single-family homes per 100,000 square footage at census block group level	GIS
MFR Density	The total square footage of multi-family homes per 100,000 square footage at census block group level	GIS
COM Density	The total square footage of commercial properties per 100,000 square footage at census block group level	GIS
Population Density	The total population per 10,000 square miles at census block group level	A
Employment Density	The total employment per 10,000 square miles at census block group level	L
Manufacture Job Density	The total number of manufacturing jobs (NAICS sector = 31) per 10,000 square miles at census block group level	L
Retail Job Density	The total number of retail jobs (NAICS sector = 44) per 10,000 square miles at census block group level	L
Management Job Density	The total number of management jobs (NAICS sector = 55) per 10,000 square miles at census block group level	L

White	The proportion of non-Hispanic white at the census block group level	
Median HH Income	Median household income at the census block group level	A
Median Home Value	Median home value for all owner-occupied housing units at the census block group level	A
Median Structures' Age	Median year structure built at census block group level	A
Average HH Size	Average household size at census block group level	A

Data Sources: (L) The 2015 U.S. Longitudinal Employer-Household Dynamics (R) the Regional Land Information System (RLIS), (A) 2019 American Community Survey 5-year estimates, and (GIS) the data is obtained from the 2019 Regional Land Information System (RLIS) and calculated in ArcGIS.

Table 2 The descriptive statistics on the variables used in the research

Variables	N	Mean	St. Dev	Minimum	Maximum
ln(Railyard)	822	9.3	0.8	3.0	11.2
Railyard	822	14,502.5	9,977.0	20.1	69,516.0
ln(CBD)	822	10.4	0.5	8.6	11.6
CBD	822	37,187.8	18,585.5	5,319.6	113,047.4
ln(airport)	822	10.7	0.5	9.1	11.8
Airport	822	52,559.1	24,574.9	9,087.7	137,111.4
ln(LRT)	822	8.7	0.8	4.71	10.6
LRT	822	7,620.5	5,764.5	110.9	40,391.9
Major Road	513	0.6	0.5	-	-
Bus density	822	36.5	32.4	0.0	269.9
Activity Density	822	2.0	1.8	0.1	15.8
Land Mix Index	822	0.5	0.4	0.0	0.8
SFR density	822	30.4	15.8	0.0	87.9
MFR density	822	5.3	12.0	0.0	181.3
COM density	822	6.4	10.9	0.0	122.5
Population Density	822	0.7	0.4	0.03	4.3
Employment Density	822	0.3	0.2	0.02	1.7
Manufacture job density	822	0.1	0.1	0.0	2.9
Retail job density	822	0.1	0.1	0.0	1.2

Management job density	822	0.1	0.1	0.0	0.6
White	822	32.6	12.1	32.6	100.0
Median HH Income	813	8.1	3.4	1.9	25.0
Median Home Value	798	4.	1.5	0.1	11.1
Median Structures' Age	717	1973.1	15.7	1940.0	2013.0
Average HH size	822	2.6	0.4	1.3	4.2

3. Results

3.1. What factors influence categorizing Census Block Groups into suburbs, town centers, or regional centers?

Table 3 shows the best fit Multinomial Logit (MNL) model included eight covariates, such as distance to the railyard and downtown of Portland. A forward-stepwise procedure to find the best set of covariates was used to arrive at the final MNL model specifications. Specifically, beginning with only the constant in the MNL model, the final model was built-up from there and kept only significant variables. In other words, I found that other covariates, such as population and employment density, and bike facility density, were insignificant factors. The McFadden R squared of 0.244 suggested that the final model had a fairly good goodness-of-fit.

Additionally, the log-sum coefficient (iv) and likelihood-ratio tests to assess the goodness of fit between the nested logit (NL) model with one nest of the regional center and town center, and the MNL model rejected the NL model and suggested it should be reduced to MNL model. Thus, I present and interpret the results of the MNL model here.

Regarding the interpretation of the model in Table 3, transportation-related factors, such as distance to Central Business District, were found to be significant predictors when the Census Block Groups (CBGs) were categorized into town centers or regional centers. In contrast, only a few neighborhood characteristics were significant. In detail, the log odds of being categorized into the regional center or town center versus suburb increased by 1.355 and 1.768, respectively, if the CBG was closer to Central Business District. Also, distance to light rail transit (LRT), airport, and railyard significantly impacted the categorization.

Table 3 The results of the best fit Multinomial Logit model

	Regional Center		Town Center	
	Parameter estimates	Standard errors	Parameter estimates	Standard errors
Intercept	-48.583***	5.160	-29.019***	3.697

ln(Railyard)	0.531**	0.216	-0.038	0.126
ln(Airport)	2.259***	0.472	0.698**	0.290
ln(CBD)	1.355***	0.430	1.768***	0.331
ln(LRT)	2.777***	0.346	0.961***	0.233
Major Road	0.621*	0.344	0.510**	0.235
Bus Density	0.024***	0.005	0.015***	0.004
Activity Density	0.099	0.123	-0.527***	0.125
Land Mix Index	0.417	1.329	2.988***	1.034
Model Statistics				
Observations	822			
McFadden R^2	0.244			
Log-Likelihood	-487.189			

Note: Base alternative = Suburbs
* Significant at $p < 0.10$; ** Significant at $p < 0.05$; *** Significant at $p < 0.01$

3.2. Have the planned regional and town centers attained their goal to promote more populated and diversified neighborhoods?

Analysis 1 compares regional centers and suburbs, whereas analysis 2 compares town centers and suburbs. Through PSM, I found that the first set of analysis 1 had 51 pairs of Census Block Groups (CBGs), and the second set of analysis 2 had 140 pairs of CBGs (see Table 4). To find appropriate sets of matched treated and control observations, I used covariates found to be significant in the previous subsection (e.g., distance to CBD) and additional neighborhood characteristics (e.g., the proportion of non-Hispanic whites).

After finding appropriate sets of matched treated and control samples, I used the Standardized Difference (SD) and paired t-test to evaluate the balance between the two groups on observed covariates. Table 4 shows that none of the covariates in analyses 1 and 2 are above SD of 0.25, indicating the perfect matching (Rubin, 2001). Moreover, the means differences on covariates between matched two groups were not significant in the paired t-tests, which confirmed that the sets of matched two groups are identical in terms of covariates used in PSM.

Table 4 The results of propensity score matching diagnostics of analyses 1 and 2

Variable	Analysis 1		Analysis 2	
	Standardized difference	P-value of Paired T-Test	Standardized difference	P-value of Paired T-Test
ln(Railyard)	0.068	0.689	0.040	0.708
ln(Airport)	0.052	0.553	0.172	0.015

ln(CBD)	0.092	0.489	0.102	0.189
ln(LRT)	0.172	0.359	0.117	0.284
Major Road	0.085	0.602	0.150	0.223
Bus density	0.061	0.759	0.089	0.384
White	0.188	0.363	0.053	0.657
Median HH Income	0.058	0.740	0.089	0.465
Median Home Value	0.086	0.632	0.005	0.963
Median structures' age	0.021	0.908	0.010	0.920
Average HH size	0.130	0.441	0.086	0.483
Sample size	51 pairs		140 pairs	

Note:
Analysis 1: Comparison between regional centers and suburbs
Analysis 2: Comparison between town centers and suburbs

With the appropriate sets, I conducted paired t-test on variables of interest regarding population density, employment density, and land-use (see Table 5). Unexpectedly, Table 5 shows that CBGs in the suburbs showed higher population density compared to CBGs categorized into regional and town centers. Specifically, the mean difference in population density between CBGs in town centers and suburbs was 690 persons per square mile at a marginally significant level. Moreover, CBGs in the regional and town centers had lower employment densities than those in the suburbs with similar characteristics. For instance, CBGs in the suburbs had around 520 and 430 jobs per square mile with higher employment density than those in the regional center and town center, respectively. As expected, the single-family housing density of CBGs in the suburbs was significantly higher than that of CBGs in regional and town centers (the difference of the mean of -6.265 and -5.591, respectively). While the CBGs in regional had a higher density of the commercial property than those in the suburbs at a marginally significant level, the difference in land mix index was insignificant. However, CBGs in town centers showed a more mixed land-use compared to those in the suburbs (the difference of the mean of 0.042).

Table 5 The results of paired t-tests of analyses 1 and 2

	Analysis 1	Analysis 2
	Difference of the mean	Difference of the mean
Population density		
Population density	-0.089	-0.069*
Employment Density		
All Job density	-0.052***	-0.043***

Manufacture job density	-0.046*	-0.027*
Retail job density	-0.041	-0.025**
Management job density	-0.015**	-0.011***
Land-Use		
Single-family housing density	-6.265***	-5.591***
Multi-family housing density	0.620	0.711
Commercial property density	2.907*	1.108
Land Mix Index	0.027	0.042***

Note:
Analysis 1: Comparison between regional centers and suburbs
Analysis 2: Comparison between town centers and suburbs
Difference of the mean: mean of the matched treated group (regional center or town center) – mean of the matched control group (suburbs)
Significance level: * p<0.10; ** p<0.05; *** p<0.01

4. Discussion

Researchers and planners have been long acknowledged the concentric effect of transportation on spatial structures. For instance, location theories have answered why activities, jobs, and people are located in particular places (Ottaviano & Thisse, 2004). The economic theories have suggested that transportation plays a significant role in establishing economic geography (Burgess, 1925; Weber, 1929; Hoyt, 1964; Thünen and Hall, 1966). Moreover, a book chapter illustrated the spatial evolution of the American metropolis according to transportation improvements (Muller, 2004). Transportation has been an essential factor influencing the spatial pattern in practice.

However, this paper found that the regional and town centers that considered transportation-related aspects have become neither densified nor mixed-use neighborhoods regardless of the expectation of the planning framework. The findings raise further discussions on the reasons behind them.

The first discussion is whether transportation has remained influential in determining spatial patterns. Since transport cost is declining across all modes, it may play an increasingly irrelevant role in the urban economy, at least in moving goods. Also, advanced information and telecommunication technology have weakened the importance of physical proximity. Thus, the decline allows firms to become indifferent to their location in terms of market proximity and enables consumers to become indifferent to location for purchasing goods with additional transportation costs (Mori, 1997). Moreover, since metropolitan areas in the U.S. had well-developed transportation systems, even significant transportation developments and investments such as new freeway segments would play only a marginal role in improving accessibility. Accordingly, although expected land-use changes at the local level occur, overall regional patterns cannot change in a significant way (Giuliano, 1995).

Second, the regional planning may overlook the role of developers: specifically, Henderson and Mitra (1996) point out that large-scale land developers create strategic office development in the suburbs, which may, in turn, lead to the phenomenon of densification. Also, as Bertaud (2018) argues, since the viewpoints of urban planners that usually are ideology-driven may be different from those of developers (Medda et al., 1999), the intended outcomes were not achieved. Thus, without incorporating the viewpoints of developers into the planning framework, it may be challenging to attain all of the desired objectives.

Third, a single dominant aspect, transportation, may not significantly influence forming densified and mixed land-use neighborhoods in the suburbs. Specifically, when households, firms, and businesses make their own locational decisions, they consider diverse aspects, such as not only transportation accessibility but also land price, structure's condition, and neighborhood characteristics. Therefore, focusing on a single element may not be sufficient to ensure the predicted spatial patterns.

5. Conclusion

This study answered two research questions to provide empirical evidence and offer further discussion. First, what factors influence being regional and town centers in the 2040 Growth Concept in the Portland Metropolitan area to promote spatial concentration and mixed land-use in the suburbs? Second, have population and employment opportunities been concentrated, and land use been highly mixed in the regional and town centers compared to suburbs, as expected in the plan? This paper found that the regional and town centers were selected with significant influence of transportation-related features. More importantly, after around 20 years of the plan, the centers have become neither densified nor mixed-use neighborhoods regardless of the expectation of the planning framework.

This paper has several limitations. For instance, this study captured a single period to examine if the intended outcomes have been shown. Thus, longitudinal analysis is required in future research to answer the research question in further detail. Moreover, the regional plan may have guided the transportation development in those centers rather than their denitrification and diversification. Thus, other land-use policies or plans should be examined to provide a better context for the two research questions. In this vein, an additional research question that needs to be answered is whether have the regional spatial patterns changed in the years following the passage of Oregon House Bill 2001 (requires cities of more than 25,000 people to allow triplexes, fourplexes, cottage clusters, and townhouses in residential areas)? Also, this study used a coarse distance measurement to estimate the distance to CBD, LRT, and so on.

Reference

Austin, P.C., 2011. An Introduction to Propensity Score Methods for Reducing the Effects of Confounding in Observational Studies. Multivar. Behav. Res. 46, 399–424. https://doi.org/10.1080/00273171.2011.568786

Ben-Akiva, M.E., Lerman, S.R., 1985. Discrete Choice Analysis: Theory and Application to Travel Demand. MIT Press.

Bertaud, A., 2018. Order without Design: How Markets Shape Cities. The MIT Press.

Bhat, C.R., Gossen, R., 2004. A mixed multinomial logit model analysis of weekend recreational episode type choice. Transp. Res. Part B Methodol. 38, 767–787. https://doi.org/10.1016/j.trb.2003.10.003

Burgess, E.W., 1925. The Growth of the City: An Introduction to a Research Project. Ardent Media.

Choi, Y., Guhathakurta, S., 2020. Do people walk more in transit-accessible places? J. Transp. Land Use 13, 343-365-343–365. https://doi.org/10.5198/jtlu.2020.1530

Dong, H., 2017. Rail-transit-induced gentrification and the affordability paradox of TOD. J. Transp. Geogr. 63, 1–10. https://doi.org/10.1016/j.jtrangeo.2017.07.001

Garreau, J., 1992. Edge City: Life on the New Frontier, Illustrated edition. ed. Anchor, New York, NY.

Giuliano, G., 1995. The Weakening Transportation-Land Use Connection. ACCESS Mag. 1, 3–11.

Henderson, V., Mitra, A., 1996. The new urban landscape: Developers and edge cities. Reg. Sci. Urban Econ. 26, 613–643. https://doi.org/10.1016/S0166-0462(96)02136-9

Hoyt, H., 1964. Recent Distortions of the Classical Models of Urban Structure. Land Econ. 40, 199–212. https://doi.org/10.2307/3144351

Koppelman, F.S., Bhat, C., 2006. A Self Instructing Course in Mode Choice Modeling: Multinomial and Nested Logit Models. U.S. Department of Transportation Federal Transit Administration.

McFadden, D., 1973. Conditional logit analysis of qualitative choice behavior, in: Frontiers in Econometrics. pp. 105–142.

Medda, F., Nijkamp, P., Rietveld, P., 1999. Urban Industrial Relocation: The Theory of Edge Cities. Environ. Plan. B Plan. Des. 26, 751–761. https://doi.org/10.1068/b260751

Metro, 1995. Metro 2040 Framework Update, Spring/Summer 1995.

Mori, T., 1997. A Modeling of Megalopolis Formation: The Maturing of City Systems. J. Urban Econ. 42, 133–157. https://doi.org/10.1006/juec.1996.2018

Muller, P.O., 2004. Transportation and Urban Form: Stages in the Spatial Evolution of the American Metropolis, in: The Geography of Urban Transportation. Guilford Press, pp. 59–85.

Ottaviano, G., Thisse, J.-F., 2004. Chapter 58 Agglomeration and economic geography, in: Handbook of Regional and Urban Economics. Elsevier, pp. 2563–2608. https://doi.org/10.1016/S1574-0080(04)80015-4

Rosenbaum, P.R., Rubin, D.B., 1983. The central role of the propensity score in observational studies for causal effects. Biometrika 70, 41–55. https://doi.org/10.1093/biomet/70.1.41

Rubin, D.B., 2001. Using Propensity Scores to Help Design Observational Studies: Application to the Tobacco Litigation. Health Serv. Outcomes Res. Methodol. 2, 169–188. https://doi.org/10.1023/A:1020363010465

Sabouri, S., Park, K., Smith, A., Tian, G., Ewing, R., 2020. Exploring the influence of built environment on Uber demand. Transp. Res. Part Transp. Environ. 81, 102296. https://doi.org/10.1016/j.trd.2020.102296

Thünen, J.H. von, Hall, P., 1966. Von Thünen's isolated state: an English edition of Der isolierte Staat, 1st ed. ed. Pergamon Press, Oxford, New York.

Weber, A., 1929. Theory of the Location of Industries. Univ. Chic. Press.