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Bus Transportation Accessibility – Does It Impact Housing Values?

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Abstract

Integrating public transportation and land use policies is one of the key strategies in an attempt to achieve more sustainable communities. While economic consequences are an essential dimension in decision making, there is yet very limited evidence for the impact of accessibility to bus transportation on surrounding residential property values. This study is the first of its kind investigating the price impact in Tampere – the largest city outside the capital region of Finland. An empirical strategy utilizing fixed-effect hedonic pricing models has been applied to specify valuation effects of accessibility to bus transportation.

A premium of 1.1 percent was estimated for housing units located no farther than 50 meters from a bus stop. Housing units located in zones with more diverse amenities and better bus connections were also estimated to be higher appreciated, with the exception that housing units in Private car zone sell at higher prices than units in Intensive public transportation zone. As Tampere is a relatively monocentric city with great coverage and service frequency of public bus transportation, the distance to CBD seems to be a more important determinant in terms of accessibility than proximity to the closest bus stop; one kilometer increase in distance to CBD was estimated to command 4 percent depreciation in housing values.

As there are significant differences between cities, some limiting factors should be taken into account when interpreting the results. Price impact on residential property values was studied only in Tampere, Finland, and it is important to notice that the city structure, extensive coverage of the bus network, local market conditions, and other potential differences between cities may have a notable impact on the outcomes. Thus, more studies are needed before the results may be generalized across other geographical locations.

The evidence gained in this study can be utilized when striving for more viable and sustainable cities. Understanding the influence of accessibility to bus transportation on housing values should be of interest to a wide range of city planners, policymakers, and community stakeholders.

Keywords: bus stops, bus traffic, housing prices, public transportation, residential property values, traffic related zones, urban form

1. Introduction

Integrating public transportation and land use policies has been identified as one of the key strategies in an attempt to achieve more sustainable communities (Newman and Kenworthy, 1996; Todes, 2012). It has also been recognized that public transportation investments and land use policies may induce changes in housing prices. (Du and Mulley, 2006; H.M. So et al., 1997; Henneberry, 1998).

Accessibility of public transportation is one of the factors taken into account when city planners are searching for to identify potential locations for new housing. In addition to their influence on land use decisions, public transportation stops may also impose externalities capitalizing into housing prices (Cervero and Kang, 2011). Previous studies have found that investments in public transportation may – particularly within walking distance – command a premium in housing prices (Dubé et al., 2013). However, Mohammad et al. (2013) suggest that due to researchers' tendency to publish only statistically significant results, published literature may introduce a biased general view of housing price effects from bus transportation.

Property value effects may depend on income level of residents in the area (Munoz-Raskin, 2010). Osland and Thorsen (2008) argue that there are two important components of accessibility that should be taken into consideration when estimating housing price effects. The first component is accessibility to central business district (CBD) where urban attractions are located, and most of activities occur. The second major component is recognized to be labor-market accessibility as commuting to work places is a central part of people's daily lives.

Public transportation connections are usually relatively stable, which may promote their propensity for capitalizing into housing values. However, the propensity may be dependent on transportation technology. A subway or suburban train is usually associated with higher appreciation in housing prices than bus connections (Bocarejo et al., 2013). The reasoning behind this may be that rail traffic always requires heavy infrastructure and substantial investments, resulting in relatively permanent structures. While, it is much harder to predict future development of bus connections as substantial investments on infrastructure are not needed, and thus, the system is more flexible for changes. Consequently, the impact of bus connections on housing prices may be less than what alternative forms of public transportation would induce.

Given that both positive and negative estimates of land and property values have been reported in different studies investigating rail project impacts (Mohammad et al., 2013), it is not self-evident that the impact from public transportation would only be positive. Although improvements in accessibility are likely to induce positive impacts, also a number of negative externalities, such as increase in noise and crime, can be linked to a better access to public transportation (Pope and Pope, 2012; Szczepańska et al., 2015). Attempts to control traffic volume by road tolls has been reported to have minor positive impact at least on residential leases which may result from decrease in negative externalities (D'Arcangelo and Percoco, 2015).

To date, there are relatively few studies investigating the impact of public transportation on housing values in developed countries. Mulley (2014) argues that, presently, there is a lack of evidence for the residential land value impact of bus networks in the developed countries. Particularly, the housing price impact from bus transportation in the Nordic Countries is underexplored. This study contributes to the existing body of literature, addressing the void in knowledge by investigating the impact of accessibility to bus transportation on housing prices in Tampere, Finland.

2. Data and Public Transportation System in Tampere

The data utilized in this study is from the city of Tampere in Finland – the largest urbanized area outside the capital region and home to more than 220,000 residents by the end of December 2015. Tampere is also the provincial center of Pirkanmaa region with slightly more than 500,000 residents. Tampere is an example of a quite monocentric city as for its bus network. Interestingly, the city center can be accessed through almost every bus line with only a couple of exceptions that do not pass through the city center. The public transportation system is mainly based on busses as there are no subways or streetcars. Tampere railway station is one of the central hubs in the Finnish railway network. However, the only stop for passenger trains is the Tampere central railway station located in the city center. Thus, in Tampere, the railway network only serves transportation to other cities and municipalities, but not the local traffic within the city limits. As the public transportation is relying on busses, Tampere is a potential geographical location to be studied to reveal the relevance of bus network to housing prices.

The impact of accessibility to bus transportation on residential property values was investigated by utilizing five unique datasets, including i) housing sales transactions from 2008 to 2012, ii) complete property registry for the city of Tampere, iii) spatial boundaries for traffic related zones of urban form (©SYKE), iv) locations of bus stops in the city of Tampere, and v) grid data containing information on residents' median income (©SYKE and TK). The spatial nature of the data allowed all five data sets to be combined using locational attributes.

The Finnish housing market is diverse in nature with property types ranging from single-family detached to multifamily apartment blocks. The average housing unit was constructed 39.8 years ago and sold for €137,047 (or €2,179 per square meter for a 62.9 square meter unit). The average number of rooms was 2.4 including bedrooms, living rooms, and studies, but not kitchens, bathrooms, private saunas, and walk-in closets. Private saunas are an important amenity, associated with 45 percent of the apartments sold. Housing transactions occurred on average in areas where the annual median income is 32,997 € and distance to Tampere Central Square is 4.42 kilometers. 63 percent of sold apartments were considered to be in good condition, whereas brokers reported 22 percent to be in acceptable condition and 1 percent in poor condition. Condition for 14 percent of the observations was not reported. 2 percent of the sold apartments were located in properties that have an elevator. The average distance to a bus stop was 137 meters. 22 percent of the transactions were located in Pedestrian friendly zone, 1 percent in Fringe zone, 19 percent in Public transportation zone, 9 percent in Private car zone, and 5 percent in Suburban center zone. The remainder of 44 percent was located in Intensive public transportation zone, which was the comparison level for the analysis. Table 1 presents summary statistics for the residential transactions.

Table 1: Summary statistics

Variable	*Mean*	*Std dev*	*Min*	*Max*
Sale price (€)	137,047	63,451	40,000	750,000
Property age (years)	39.8	20.1	5	160
Unit size (sq. meters)	62.9	23.9	15	275
Weeks on market	38.1	25.7	1.0	104.0
Number of rooms	2.4	1.0	1.0	8.0
Maintenance dues (€)	163	67	0.0	867.0
Floor number	2.6	1.8	1.00	12.00
I{Multi-story apartment block}	0.79	0.41	0	1
I{Townhouse}	0.17	0.38	0	1
I{Single-family house}	0.02	0.14	0	1
I{Duplex}	0.02	0.14	0	1
I{Sauna}	0.45	0.50	0	1
I{Elevator}	0.02	0.16	0	1
Income	32,997	13,234	9305	105796
Distance to CBD (km)	4.42	2.77	0.06	10.81
I{Condition: Acceptable}	0.22	0.41	0	1
I{Condition: Poor}	0.01	0.12	0	1
I{Condition: Unavailable}	0.14	0.35	0	1
I{Pedestrian zone}	0.22	0.41	0	1
I{Fringe zone}	0.01	0.12	0	1
I{Public transport zone}	0.19	0.39	0	1
I{Private car zone}	0.09	0.29	0	1
I{Suburban center zone}	0.05	0.22	0	1
I{Not within a zone}	0.12	0.32	0	1
Distance to bus stop (m)	137.49	86.56	7	756
I{Bus stop within 50 meters}	0.11	0.31	0	1
I{Bus stop within 100 meters}	0.38	0.49	0	1
I{Bus stop within 150 meters}	0.65	0.48	0	1
I{Bus stop within 300 meters}	0.95	0.21	0	1

Notes: This table presents the means, standard deviations, minimum and maximum values for the full sample of residential transactions. Price is the transaction price for residential units, in Euros (€). Time on market is measured in weeks. Building size and Unit size are measured in square meters. Property age is in years. Floor number is for the unit. The I{·} operator designates an indicator variable, taking on a value of one for the characteristic in brackets and zero otherwise. Property types included in the analysis are Duplex, Single-family (detached), Townhouse, and Multifamily (suppressed). Property condition categories include Acceptable, Poor, Unavailable and Good (suppressed). Maintenance dues are reported as monthly fees in Euros, and take on a value of zero for units in buildings that have no maintenance dues.

3. Estimating housing price impact

The empirical strategy in this study was to estimate a hedonic regression model for residential transaction prices. The objective was to evaluate price differences between different traffic related zones of urban form, and isolate the impact that proximate bus stop has on surrounding housing values while controlling for differences in property characteristics. The first estimated hedonic equation takes the following form:

$$\begin{aligned}
\ln(Price) &= \beta_0 + \beta_1 \cdot \ln(\textit{Property age}) + \beta_2 \cdot \ln(\textit{Unit size}) + \beta_3 \cdot \ln(\textit{Time on market}) \\
&+ \beta_4 \cdot \ln(\textit{Number of rooms}) + \beta_5 \cdot \ln(\textit{Maintenance dues}) + \beta_6 \cdot \textit{Floor number} \\
&+ \beta_7 \cdot \mathrm{I}\{\textit{Type: Single family}\} + \beta_8 \cdot \mathrm{I}\{\textit{Type: Townhouse}\} + \beta_9 \cdot \{\textit{Type: Duplex}\} \\
&+ \beta_{10} \cdot \mathrm{I}\{\textit{Sauna}\} + \beta_{11} \cdot \mathrm{I}\{\textit{Elevator}\} + \beta_{12} \cdot \ln(\textit{Income}) + \beta_{13} \cdot \mathrm{I}\{\textit{Condition: Acceptable}\} \\
&+ \beta_{14} \cdot \mathrm{I}\{\textit{Condition: Poor}\} + \beta_{15} \cdot \mathrm{I}\{\textit{Condition: Unavailable}\} + \beta_{16} \cdot \text{Distance to CBD} \\
&+ \beta_{17} \cdot \mathrm{I}\{\textit{Pedestrian zone}\} + \beta_{18} \cdot \mathrm{I}\{\textit{Fringe zone}\} + \beta_{19} \cdot \mathrm{I}\{\textit{Public transportation zone}\} \\
&+ \beta_{20} \cdot \mathrm{I}\{\textit{Private car zone}\} + \beta_{21} \cdot \mathrm{I}\{\textit{Suburban center zone}\} + \beta_{22} \cdot \mathrm{I}\{\textit{Not in the zone}\} \\
&+ \beta_{23} \cdot \mathrm{I}\{\textit{Distance to bus stop}\} + \textstyle\sum_{i=1}^{4} \beta_{i+23} \cdot \mathrm{I}\{\textit{Year}_i\} + \sum_{j=1}^{31} \beta_{j+27} \cdot \mathrm{I}\{\textit{Submarket}_j\} + \varepsilon. \qquad (1)
\end{aligned}$$

The dependent variable is *Price*, logged. *Property age* is included to reflect the impacts of depreciation and technical obsolescence on housing values. Variables measuring the physical property dimensions include *Unit size*, *Number of rooms*, and *Floor number*. *Time on market* reflects one dimension of real estate marketing outcomes, and *Maintenance dues* reports monthly financial obligations connected to the property sale. *Distance to CBD* captures locational impacts, measuring distance to the Tampere Central Square. Indicator variables are used to classify property pricing according to property type, sauna, elevator and property condition. The sample of property sales spans from 2008 to 2012, and 4 year indicator variables are included to control for calendar year fixed effects. In addition, 31 submarket indicator variables are included to control for geographic differences in pricing at the zip code level. β are parameters to be estimated and ε is the normally distributed error term.

To capture the impact of different traffic related zones of urban form[1] on residential property values, five indicator variables are included for housing units that are located in *Pedestrian zone*, *Fringe zone*, *Public transportation zone*, *Private car zone*, or *Suburban center zone*. Indicator for *Intensive public transportation zone* is suppressed from the equation to refrain from linear combination. Variable *I{Not within a zone}* is included to capture pricing difference for housing transactions that are not located within any of the above mentioned zones. The log-linear model structure allows the coefficients for included traffic related zone indicators to be interpreted as the percentage difference in housing values to residential transactions occurred in

[1] The classification of traffic related zones of urban form is based on a spatial dataset by the Finnish Environment Institute (SYKE). For a detailed description, please see the Meta Data Portal: http://metatieto.ymparisto.fi:8080/geoportal/catalog/search/resource/details.page?uuid={96F338EA-75AF-432C-A780-31A3CDECBDF2} (in Finnish).

the *Intensive public transportation zone*. Furthermore, *Distance to bus stop* variable is included to isolate the impact of proximity to a bus stop. Results from the estimation of Equation (1) are presented in Table 2.

Table 2: Estimated price impact

Variable	*Coefficient*	*(t-stat)*
Intercept	8.831 ***	(150.9)
ln(Property age)	-0.144 ***	(-51.5)
ln(Unit size)	0.669 ***	(79.6)
ln(Weeks on market)	-0.013 ***	(-8.7)
ln(Number of rooms)	0.051 ***	(7.7)
ln(Maintenance dues)	-0.012 ***	(-5.1)
Floor number	0.010 ***	(12.9)
I{Townhouse}	0.177 ***	(38.3)
I{Single-family house}	0.266 ***	(18.3)
I{Duplex}	0.232 ***	(25.2)
I{Sauna}	0.131 ***	(36.6)
I{Elevator}	-0.001	(-0.1)
ln(Income)	0.065 ***	(13.6)
I{Condition: Acceptable}	-0.109 ***	(-36.7)
I{Condition: Poor}	-0.207 ***	(-21.3)
I{Condition: Unavailable}	-0.044 ***	(-12.3)
Distance to CBD	-0.040 ***	(-17.6)
I{Pedestrian zone}	0.125 ***	(12.0)
I{Fringe zone}	0.093 ***	(6.4)
I{Public transportation zone}	-0.023 ***	(-6.4)
I{Private car zone}	0.021 ***	(3.9)
I{Suburban center zone}	0.027 ***	(4.2)
I{Not within a zone}	-0.004	(-0.5)
Distance to bus stop	0.000	(-0.0)
Year indicators:	Included (4 variables)	
Sub-market indicators:	Included (31 variables)	
Adjusted R^2*:*	90.97%	
Observations:	12,449	

Notes: This table presents results from the least squares estimation of Equation (1). The dependent variable is Price, logged. The coefficients for I{*Pedestrian zone*}, I{*Fringe zone*}, I{*Public transportation zone*}, I{*Private car zone*}, and I{*Suburban center zone*} indicate the estimated price impact of traffic related zones of urban form. The coefficient for *Distance to bus stop* variable indicates the estimated price impact of distance to the closest bus stop. T-statistics corresponding to the coefficients are reported in parentheses. ***, ** and * designate statistical significance for the estimated coefficients at the 1%, 5% and 10% levels, respectively.

The estimated coefficients reveal that housing values are decreasing as properties age, likely resulting from depreciation and technical obsolescence. Housing values are increasing in unit size, but units that require longer marketing periods are revealed to sell at a significantly lower price. Units with higher maintenance dues are discounted. Units on higher numbered floors sell at a premium, estimated at 1 percent per floor. Single-family, duplexes, and townhouses all sell at positive and significant premiums relative to multifamily apartments (which is suppressed to avoid perfect multicollinearity). In Finland, the sauna is considered a precious amenity, associated with premiums in the magnitude of 13 percent. Elevator does not command a positive premium, which might not be the case if only transactions in multi-story apartment buildings were investigated. Higher median income is associated with higher housing values as wealthier people tend to live in higher appreciated neighborhoods. Housing units located farther from CBD (Tampere Central Square) sell at lower prices, so that 1 kilometer increase in distance commands 4 percent depreciation. Property condition identified as less than good (which is omitted to avoid linear combination) are discounted accordingly.

Estimates of indicator variables for traffic related zones of urban form reveal that housing prices are relatively highest in the Pedestrian zone, which usually indicates location in downtown area, and is associated with 12.5 percent premium relative to Intensive public transportation zone. In Fringe zone premium is estimated to be 9.3 percent, in Suburban center zone 2.7 percent, and in Private car zone 2.1 percent relative to Intensive public transportation zone. While, housing units located in Public transportation zone with weaker public transportation connections than in Intensive public transportation zone sell at 2.3 percent lower prices.

The coefficient for *Distance to bus stop* does not differ from zero, indicating that proximity to bus stop does not have an impact on housing values. However, the price impact is not likely to be linear resulting in that the continuous variable may not tell the whole truth. To further investigate the price impact of proximity to a bus stop another specification of the model was estimated. The second specification of the model takes the following form:

$$\begin{aligned}
\ln(\mathit{Price}) = {} & \beta_0 + \beta_1 \cdot \ln(\mathit{Property\ age}) + \beta_2 \cdot \ln(\mathit{Unit\ size}) + \beta_3 \cdot \ln(\mathit{Time\ on\ market}) \\
& + \beta_4 \cdot \ln(\mathit{Number\ of\ rooms}) + \beta_5 \cdot \ln(\mathit{Maintenance\ dues}) + \beta_6 \cdot \mathit{Floor\ number} \\
& + \beta_7 \cdot \mathrm{I}\{\mathit{Type{:}\ Single\ family}\} + \beta_8 \cdot \mathrm{I}\{\mathit{Type{:}\ Townhouse}\} + \beta_9 \cdot \{\mathit{Type{:}\ Duplex}\} \\
& + \beta_{10} \cdot \mathrm{I}\{\mathit{Sauna}\} + \beta_{11} \cdot \mathrm{I}\{\mathit{Elevator}\} + \beta_{12} \cdot \ln(\mathit{Income}) + \beta_{13} \cdot \mathrm{I}\{\mathit{Condition{:}\ Acceptable}\} \\
& + \beta_{14} \cdot \mathrm{I}\{\mathit{Condition{:}\ Poor}\} + \beta_{15} \cdot \mathrm{I}\{\mathit{Condition{:}\ Unavailable}\} + \beta_{16} \cdot \text{Distance to CBD} \\
& + \beta_{17} \cdot \mathrm{I}\{\mathit{Pedestrian\ zone}\} + \beta_{18} \cdot \mathrm{I}\{\mathit{Fringe\ zone}\} + \beta_{19} \cdot \mathrm{I}\{\mathit{Public\ transportation\ zone}\} \\
& + \beta_{20} \cdot \mathrm{I}\{\mathit{Private\ car\ zone}\} + \beta_{21} \cdot \mathrm{I}\{\mathit{Suburban\ center\ zone}\} + \beta_{22} \cdot \mathrm{I}\{\mathit{Not\ in\ the\ zone}\} \\
& + \beta_{23} \cdot \mathrm{I}\{\mathit{Bus\ stop\ close}\} + \textstyle\sum_{i=1}^{4} \beta_{i+23} \cdot \mathrm{I}\{\mathit{Year_i}\} + \textstyle\sum_{j=1}^{31} \beta_{j+27} \cdot \mathrm{I}\{\mathit{Submarket_j}\} + \varepsilon. \qquad (2)
\end{aligned}$$

The second specification is consistent with Equation (1) with the difference that the continuous variable *Distance to bus stop* is replaced with an indicator variable *I{Bus stop close}*. To understand the price impact of proximity to a bus stop, four separate variations of the model were estimated. All four estimated models are consistent with Equation (2), and the difference is that each one has unique definition for a proximate bus stop. The following radii for proximity are estimated: 50 m, 100 m, 150 m, and 300 m.

Results from the estimation of Equation (2) for the 50 m, 100 m, 150 m, and 300 m radii are presented in Table 3. In the interest of brevity, only estimates for I{*Bus stop close*} are reported in Table 3 as the remainder of coefficient estimates is consistent with the results in Table 2. Testing various radii for proximity reveals that better accessibility to public transportation commands a premium which diminishes relatively fast with distance. Housing units located within 50 meters from a bus stop sell at 1.1 percent higher prices, but statistical significance seems to disappear already beyond 50 meters. Interestingly, the coefficient for 300 m radius indicates that transactions within 300 m radius from a bus stop are discounted 1.4 percent relative to observations that are located farther away. At this point it is important to notice that only 5 percent of the housing transactions are not located within 300 meters from a bus stop, potentially resulting in a bias. Thus, it is likely that the estimated negative price impact cannot directly be associated with proximity to a bus stop, but rather captures price impact from other factors.

Table 3: Estimated price impact, Equation (2)

Radius for close proximity:	**50 m**		**100 m**		**150 m**		**300 m**	
Variable	*Coefficient*	*(t-stat)*	*Coefficient*	*(t-stat)*	*Coefficient*	*(t-stat)*	*Coefficient*	*(t-stat)*
I{Bus stop close}	0.011 ***	(3.0)	0.000	(0.2)	0.004	(1.3)	-0.014 **	(-2.1)
Year indicators:	Included (4 variables)							
Sub-market indicators:	Included (31 variables)							
Adjusted R^2:	90.98%		90.97%		90.97%		90.97%	
Observations:	12,449		12,449		12,449		12,449	

Notes: This table presents results from the least squares estimation of Equation (1) for the 50 m, 100 m, 150 m and 300 m radii. The dependent variable is Price, logged. The coefficient for I{*Bus stop close*} indicator variable indicates the estimated price impact of proximity to a bus stop. T-statistics corresponding to the coefficients are reported in parentheses. *** and ** designate statistical significance for the estimated coefficients at the 1% and 5% levels, respectively.

It is reasonable to assume that price impact from proximity to a bus stop may vary between different locations. Thus, to investigate interactions between distance to a bus stop and location in different traffic related zones of urban form, the third and fourth specifications of the hedonic model were estimated. The third specification is consistent with Equation (1) with the difference that six interaction terms are included to capture the joint impact of each traffic related zone and distance to bus stop. Also interaction term *Dist to bus stop*Dist to CBD* is included to capture if the price impact from the distance to a bus stop differs with the distance to Tampere Central Square. The fourth estimated specification of the hedonic model is consistent with Equation (2), but with the difference that six interactions terms are included to capture the joint impact of each included zone indicator and the indicator variable for a proximate bus stop. Results from the estimations of the third and fourth model specifications suggest that price impact may vary between traffic related zones, but due to inconsistencies drawing reliable conclusions based on the results is difficult. The issue behind the inconsistent results is likely to derive from that the third and fourth model specifications divide the full data sample into several subgroups. This results in too small and unevenly distributed subsamples, potentially introducing a bias in the results.

4. Conclusions and Discussion

Although economic consequences are an essential dimension in decision making, yet little is known about the impact of accessibility to bus transportation on housing values. In this study, the void in knowledge was addressed investigating the bus transportation related housing price impact in Tampere, Finland. An empirical strategy utilizing fixed-effect hedonic pricing models was applied.

Results from the estimations indicated that there are statistically significant valuation differences between traffic related zones. The analysis was performed relative to *Intensive public transportation zone*, and estimates revealed that housing prices are relatively highest in the Pedestrian zone, usually indicating location in downtown areas. In Pedestrian zone, housing prices were estimated to be 12.5 percent higher than in Intensive public transportation zone. In Fringe zone, usually located in close proximity to downtown areas, the premium was estimated to be 9.3 percent, in Suburban center zone 2.7 percent, and in Private car zone 2.1 percent relative to Intensive public transportation zone. While, housing units located in Public transportation zone with weaker public transportation connections than in Intensive public transportation zone sell at 2.3 percent lower prices. In an attempt to capture the price impact of distance to the closest bus stop with a continuous *Distance to bus stop* variable, no statistically significant price difference was found. However, testing another model specification utilizing indicator variables, a premium of 1.1 percent was found for housing units located no farther than 50 meters from a bus stop. *Distance to CBD* (Tampere Central Square) was estimated to be an important determinant for housing prices as one kilometer increase in distance results commands 4 percent depreciation in housing values.

The estimation results are in line with assumptions, given that Tampere is a relatively monocentric city with notably extensive bus transportation network; almost every bus line passing through the city center, and 95 percent of the housing transactions being located no farther than 300 meters from the closest bus stop. Due to the great coverage and service frequency of public bus transportation, the CBD is relatively easy to access from anywhere within the city limits. Thus, in Tampere, the distance to CBD seems to be a more important determinant in terms of accessibility than location of the closest bus stop. Valuation of traffic related zones is also mainly consistent with the assumptions as housing units located in zones with more diverse amenities and better bus connections are higher appreciated, with the exception that housing units in Private car zone sell at higher prices than units in Intensive public transportation zone. However, this observation is logical as Private car zone can be associated with comfortable and secure suburban neighborhoods where owner-occupied single-family houses are the predominant form of housing. In this kind of neighborhoods, bus transportation is of less importance as wealthier suburban residents often choose to use their own cars.

This study is the first of its kind investigating the impact of accessibility to bus transportation on housing values in the largest city outside the capital region of Finland. The results do not provide any big surprises but rather confirm authors' presumptions. However, as there are significant differences between cities, some limiting factors should be taken into account when interpreting the results. Price impact on residential property values was studied only in Tampere, Finland, and it is important to notice that the city structure, extensive coverage of the bus network, local market conditions, and other potential differences between cities may have a notable impact on the outcomes. Thus, more studies are needed before the results may be generalized across other geographical locations. In this study, the price impact was studied using Euclidean distance between the housing unit and bus stop. However, in reality, the accessibility to a bus stop is a much more complicated phenomenon than distance measured as the crow flies (Kang, 2015).

To improve the analysis, it might be useful to use a more advanced approach to define accessibility in further research. For example, accessibility could be defined more precisely taking into consideration the actual characteristics of the surrounding neighborhood. The analysis could also be extended to cover more detailed information on which bus lines serve the proximate bus stop, how often the busses arrive, which areas can directly be accessed via the bus stop, and what is the average driving time to the destination. Adding these above mentioned dimensions in the analysis would allow better understanding of the actual accessibility and its impact on housing values. Also alternative empirical strategies, such as geographically weighted regression (GWR) or combining matched sample methodologies with the hedonic regression, could be applied in an attempt to improve the analysis.

The evidence gained in this study can be utilized when striving for more viable and sustainable cities. Understanding the influence of accessibility to bus transportation on housing values should be of interest to a wide range of city planners, policymakers, and community stakeholders.

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