Appendix C: What the Hedonic Price Literature Tells Us[3]

Theoretically, if the market values pedestrian- and transit-oriented design, as suggested by the survey literature outlined in Chapter 1, that valuation should be reflected in the price people are willing to pay to live in well-designed places. In the words of the economist, pedestrian- and transit-friendly design features should be capitalized in the purchase or rental price (Landis, Guhathakurta & Zhang, n.d.). Characteristics such as land use mix (Cao and Cory 1981; Song and Knaap 2004), street pattern (Guttery 2002), municipal amenities (Shultz and King 2001; Benson et al 1998), proximity to transit stations and commercial centers (Bowes and Ihlanfeldt 2001; Song and Knaap 2004), etc. have been shown to affect the value of residential properties located nearby.

Hedonic Price Analysis

The most commonly used method for assessing the impacts of urban conditions on the price of real estate is the "hedonic" model developed by Rosen (1974). Hedonic models are based on the intuitive understanding that the value of a piece of real estate is not monolithic nor completely intrinsic to the property itself, but is the result of a multitude of characteristics, many of which come from the context in which the property is situated (Kestens, Theriault & des Rosiers 2004). Each of those characteristics adds or detracts from the property's overall total price according to how buyers in the market value that characteristic. To understand the relative influence of these characteristics, a typical hedonic price study will use sales data for a large number of real estate transactions across a wide range of development conditions to tease out the amount that buyers are willing to pay for the individual features that make up the total price for a piece of real estate (Can 1990, 1992; Dubin 1998).

The method incorporates several underlying assumptions that have been the basis for some criticism (e.g., Wilhelmsson 2000). First, construing the marginal price of a particular characteristic as the willingness of buyers to pay for that characteristic assumes that the real estate market is in equilibrium—that for each seller of real estate in a particular market there is a buyer. This is never the case. In any market, demand and supply change rapidly, with sometimes more buyers than sellers and at other times the reverse condition. Second, hedonic methods implicitly assume possession of complete information on the nature of the characteristics important to the value of real estate by all sellers and all buyers. This, too, is almost never the case: buyers are nearly always at an information disadvantage. The midnight braying of a neighbor's beagle, with which the seller is all too familiar, will very likely not be known by potential sellers. Nevertheless, despite these problems, hedonic analysis's reliance on empirical data provide it with a

3 This appendix is taken from Bartholomew, K. and Ewing, R. (2011). Hedonic price effects of pedestrian- and transit-oriented development, *Journal of Planning Literature*, 26(1), 18-34.

strength missing from alternative methods that largely rely on stated preference survey data (Federal Transit Administration 2000; Tajima 2003; Whitehead, et al. 2008).

The characteristics included as explanatory variables in hedonic models are of two basic types—those related to structures built on the land and those related to the land itself (Bowes & Ihlaneldt 2001; Fujita 1989; Debrezion, Pels & Rietveld 2007). In the case of residential hedonic studies, which are the most common type, structural attributes often include features such square footage of living, number of bedrooms and bathrooms, presence of a garage, the age of the house, the presence of a pool, and other features known to influence sales transactions. Characteristics related to the land, apart from the structure, are frequently further separated into attributes related to the land's location and those related to the environment surrounding the land. Locational attributes will often include distance from a regional central business district or other commercial hub, distance to parks, transit stations, and other amenities, distance to airports, landfills, heavy manufacturing and other disamenities, and location in particular neighborhoods. Environmental attributes will sometimes include measurements of noise and air pollution, crime rates, and density of development. Another way to categorize non-structural attributes that is more aligned with the purpose of this chapter is to group them into access-related characteristics and amenity-related characteristics.

Access-Related Price Effects

The old adage about real estate being about location, location, location, is really a statement about the role that accessibility plays in the development potential of property and, hence, its value. Any discussion about the urban economic influence of accessibility invariably starts with the work of Johann von Thünen, who in 1863 theorized about the value of farm land as a function of the land's relative proximity and, thus, its accessibility to the market place. The closer (and more accessible) the land, the higher the value. Assuming equal levels of soil productivity, as values rise, farmers are induced to plant crops that yield higher returns per unit of land. Thus, accessibility to the market place not only influences the relative price of land, but also the intensity to which the land is used. Later work translated von Thünen's work beyond the farmland context to other types of land use categories, showing similar relationships between accessibility, property value, and development intensity (Alonso 1964; Mills 1967; Muth 1969). The function laying behind these relationships is the relative market attractiveness of a given piece of land. As land becomes more accessible, its perceived usefulness as a location for business or residential activity increases, leading to increased demand for the land, which raises its value and induces the ultimate land developer/user to use the land more efficiently by increasing the development intensity (Landis & Huang 1995).

Proximity to the CBD

Traditionally, these relationships between accessibility, property value, and land use intensity have been explained by physical proximity to a city's or region's central business district (CBD). Because CBDs have, at least historically, been the areas with the greatest accessibility to the largest number and variety of activities, land values were observed to be inversely proportional to distance to the CBD—the shorter the distance to the CBD the higher the land values, and vice versa. The reason for this effect is sourced in transportation and convenience costs associated with accessing various locations. Because central locations are highly accessible, the transportation and convenience costs of getting to and from those locations are lower compared to other locations in a region. This increases demand for central locations, thereby driving up the price. On the other hand, more distant locations are generally less accessible, meaning that their transportation and convenience costs are higher, which reduces the demand for those locations and, hence, the price (Fujita 1989).

Although these effects have been reduced somewhat by the replacement of the pre-1950s single-centered metropolitan pattern with a modern multi-centered form (Anjomani & Chimene 1982), they are still observable, particularly in older metro regions that retain some of their mono-centric past. A 1997 analysis of the price effects of agricultural open space in the Washington, DC region, for example, shows a 1.7% decrease in the sales prices of single-family homes for every 10% increase in the distance from DC, all other things being equal (Geoghegan, Wainger & Bockstael 1997). Similar relationships have recently been observed in London (Gibbons & Machin, 2008), Quebec (Kestens, Theriault, des Rosiers 2004), Dallas (Peiser 1989), Bangkok (Chalermpong 2007), Atlanta (Bowes & Ihlanfeldt 2001). As might be expected, the higher land costs associated with central locations usually translates into greater development density in such locations (Hansen 1959; Peiser 1989; Wassmer & Baass 2006). Hence, central locations not only benefit from the destination accessibility effects on travel behavior outlined in Chapter 3, but also from higher density and, not infrequently, other "D" variables that tend to co-locate.

Figure C-1. Proximity to the CBD (Charlotte, NC)

Dan Burden

The Transit Effect

The introduction of transit service to an area increases travel options for residents and employees of the area and can reduce travel times to the CBD and other activity centers, particularly if the service operates in its own right of way (Fejarang 1994). This has the net effect of increasing the relative accessibility of that area compared to other areas at the same distance from the CBD/activity centers but without transit (Baum-Snow & Snow 2000). In theory, the increase in relative accessibility translates into increased development potential and land values (Hess & Almeida 2007; Nelson 1992, 1999; Nelson & McClesky 1990).

Results from empirical studies of these relationships are varied and at times contradictory. The majority of the evidence, however, points to the introduction of transit facilities leading to enhanced land values, as the theory predicts (Bowes & Ihlanfeldt 2001). Most of the studies use some continuous measure of distance to the transit platform, either as the crow flies or actual walking distance, as the primary explanatory variable, while controlling for structural and other locational variables (Landis, Guhathakurta & Zhang, n.d.). Some studies make simpler assessments by comparing prices of real estate located within a certain cordon around a transit station (e.g., ½ mile) with real estate outside that cordon. The extensiveness of the literature is now so vast that even the literature reviews are becoming numerous (Anas 1982, 1983; Cambridge Systematics 1998; Cervero, Ferrell & Murphy 2002; Cervero et al. 2004; Huang 1994; Knaap 1998; Landis & Huang 1995; Parsons Brinckerhoff 2001; Ryan 1999; Smith & Gihring 2004; Vessali 1996). Cervero's 2004 review synthesizes studies completed since 1993, showing price premiums for housing located within a ¼ to ½ mile radius of rail transit stations of between 6.4% and 45%, compared to comparable housing outside of the station areas (see Figure C-2). The same review shows premiums for commercial property values ranged from 8% to 12% along Denver's 16th Street Mall to 40% for the area surrounding Dallas' Mockingbird light rail station.

Figure C-2. Percent price premium for housing in transit station area vs. non-station areas.

Source: Cervero et al. (2004)

Figure C-3. Premium for Commercial Property on the 16th Street Transit Mall (Denver, CO)

Dan Burden

Not all of the studies show such strong value/transit relationships, and in a small number of cases the data indicate a negative relationship (i.e., proximity to the transit station results in a price penalty). In an effort to rationalize the wide ranging results, Debrezion, Pels, and Rietveld (2007) conducted a meta-analysis that used data drawn from multiple studies, giving them 57 transit/property value observations. The conclusion from their regression analysis is that transit proximity still matters, with residential property values increasing 2.4% for every 250 meters closer to a station and commercial properties increasing 0.1% for every 250 meters. The effects are greater for stations served by commuter rail than for those served by heavy rail. In the case of bus rapid transit stations, the data show a price discount for nearby properties. These results are, in all likelihood, conservative estimates, given the number of potentially confounding factors that could not be controlled for, including housing types, local real estate market conditions, possible negative disamenities (e.g., crime and noise), and whether other complementary TOD planning strategies were being used (e.g., pedestrian-oriented street design, mixed-use zoning).

Some of these factors are being teased out in some of the more recent studies. Consistent with Debrezion et al., Cervero and Duncan (2002) show that price premiums for commercial property vary with the degree of regional access provided by different transit technologies. Using the San Jose, California area, which is served by both commuter and light rail, they show that downtown properties within a ¼ mile of a station in the regional commuter rail system commanded a $25 per square foot premium, while downtown properties within a ¼ mile of a station for the city-wide light rail system showed only a $4/sq. ft. advantage. The effects of differing levels of transit service and regional access are further demonstrated in Debrezion, Pels, and Rietveld’s 2011 analysis of Amsterdam, Rotterdam, and Enschede. Duncan (2008), in his analysis of the San Diego light rail system, shows that the “rail proximity premium” for multi-family housing is three times (16.6%) than that for single family housing (5.7%), supporting the notion that buyers in the condominium market have a stronger demand for transit access than buyers of single-family homes.

In his assessment of the light rail system in Buffalo, New York, where both population and transit ridership are declining, Hess (2007) shows that the price advantages of transit-served properties appear to withstand adverse market conditions. Bowes and Ihlanfeldt (2001) demonstrate that, at least with heavy rail systems, there can be a "disamenity zone" close to the station where noise and potential crime effects offset the transit accessibility benefits. Their findings show that properties within the first ¼ mile of a MARTA station in Atlanta had a 19% discount compared to properties more than three miles away, while properties within 1 to 3 miles of the station had a significant price bonus. Similarly, Landis et al. (n.d.) show that residential properties outside of downtown San Jose and within 300 feet of the same commuter rail line observed in Cervero and Duncan had a discount of as much as $51,011. Goetz, et al. (2010) show that proximity to light rail tracks can have a similar disamenity effect on residential prices, but at a much lower level, perhaps reflecting light rail's lower noise and vibration levels. Moreover, the disamenity effect—starting at $-16 for every meter closer to the tracks—is, in most cases, outweighed by positive accessibility benefits—which start at $30 for every meter closer to a light rail station.

In a study of the new Phoenix light rail system, Atkinson-Palombo (2010) show distinct impacts of TOD zoning, apart from the accessibility effects of the transit system. In single-use residential neighborhoods, the imposition of TOD zoning had a negative effect on real estate prices, whereas the TOD zoning brought an addition 37% premium to condos located in mixed-use areas.

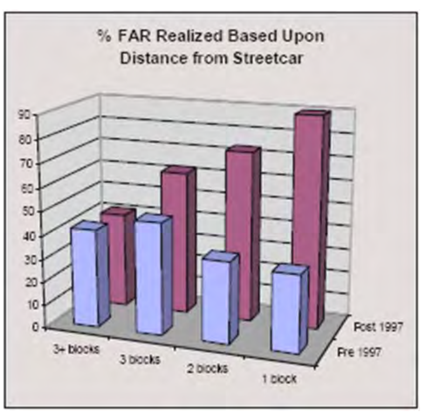
As outlined above, theory would predict that the increased property values in transit station areas would translate into higher intensity/higher value development projects. Evidence from the land use and transit development history of the London region supports the theory, showing that as the network of surface and underground transit facilities were constructed over a 150-year period, the residential densities of the station areas outside the central core increased, while the commercial densities proximate to core area stations also increased (Levinson 2008). Another leading example of this effect is the Pearl District, near downtown Portland, Oregon where the city constructed a new streetcar line in 1997 (City of Portland 2008). Before the streetcar was built, development in the area was constructed at less than half the density (as measured by floor-area-ratio (FAR)) that was allowed by zoning. Projects built since 1997, however, have been constructed at 60% to 90% of the allowable density (see Figure C-5). To date, more than $3.5 billion in private capital has been invested within the two blocks of the streetcar alignment, including more than 10,000 units of new housing and 5 million square feet of commercial space.

Figure C-4ab. Investment in the Pearl District (Portland, OR)

Dan Burden

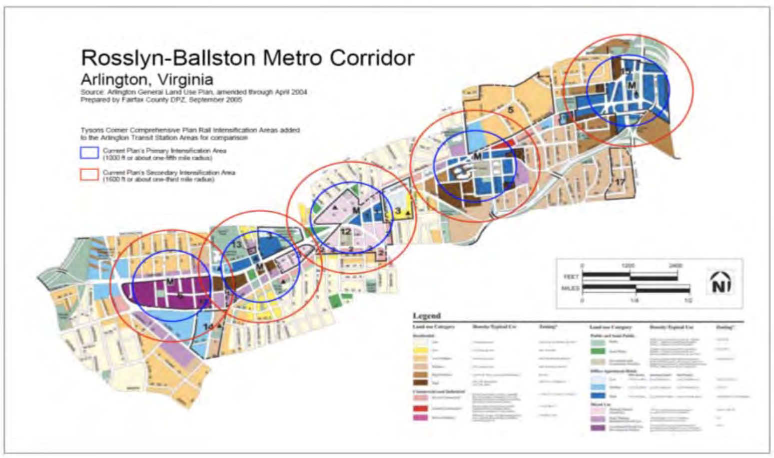
Dan Burden

Figure C-5. Percent of allowable density constructed within 3+ blocks of the Portland, Oregon streetcar line—pre-streetcar (pre-1997) vs. post-streetcar (post-1997) (City of Portland, 2008).



Another example is the Rosslyn-Ballston corridor of Arlington County, Virginia, which includes five stations along the Washington Metrorail system's Orange Line. In the 1960s, this corridor was characterized by failing low-density strip-malls, but by 2004, the corridor had become host to more than 58 million square feet of new commercial and residential development (Fairfax County 2005). Planning for the corridor's station areas, which began well before the Orange Line's opening in 1979, focuses high-intensity development in Primary Intensification Areas that include lands within 1000 feet of each station. Secondary Intensification Areas, running from 1000 to 1600 feet of the station, step down density levels in stages, both to facilitate blending with surrounding neighborhoods and to help focus the market for high-density development in the primary areas (see Figure C-6).

Figure C-6. Plan for the Rosslyn-Ballston Metrorail Corridor, Arlington, Virginia.



By 2004, development in these planning areas had resulted in the construction of more than 21 million square feet of office space (plus another 2 million approved), 2.8 million square feet of retail space, and 26,000 units of housing (see Table C-1). As with Portland's Pearl District, the Rosslyn-Ballston Corridor shows how the accessibility advantages provided by a transit investment can, when supported by appropriate planning and zoning, result in higher intensity/higher value developments.

Source: Fairfax County (2004).

Another phenomenon suggested by the Arlington example is the tapering off of the accessibility-related property value impacts as the transit station distance from the CBD increases. Zoning around the Rosslyn station—the closest station in the corridor to the Washington, D.C. CBD—generally allows for floor-area ratios (FARs) of 3.8 to 4.8. In recent years, however, the county board has allowed denser projects to be built, some of which are as high as 9.9 FAR. This has effectively bumped up the average FAR of development constructed or permitted in the station area to 1.78, which is 23% higher than the built FAR in the next station area in the corridor (Courthouse) and 36% higher than the corridor average. Studies of other Metrorail station areas show a similar effects: the further a station is from the CBD, the lower the property value, other things being equal (Federal Transit Administration 2000). These findings comport to theory-based expectations, which posit that the capitalization of accessibility benefits in transit station area property values is not only a function of a property's proximity to a station, but also the station's proximity to the center of the region. Similar studies in other metropolitan areas confirm these expectations (Bowes & Ihlanfeldt 2001; Cervero & Duncan 2002; Chalermpong 2007; Debrezion, Pels & Rietveld 2007; Pan & Zhang 2008).

Amenity-Related Price Effects

Most of the hedonic price studies cited in the previous section focused on the accessibility benefits of transit-oriented development (TOD), not on the pedestrian design and mixed-use attributes that are commonly understood to be central to the TOD concept.[4] In fact, very few studies have sought to separate out the effect of TOD design/mixed-use amenities on real estate prices, apart from the transit accessibility benefits. Mindful of the distinction now recognized between transit-*oriented* development and transit-*adjacent* development,[5] the differences in real estate price effects between accessibility- and amenity-based benefits are important. As has been noted, the failure to make those distinctions in past studies may have confounded, in part, assessments of presumed TODs.

Pedestrian Design in Transit Station Areas

Probably the first hint that the design components in TOD are important comes from studies suggesting that the construction of transit—even high-capacity heavy rail—into auto-oriented suburban environments without supportive transit-oriented design, planning, and zoning provisions has a negligible effect on station area land use

[4] The Maryland Transit Administration defines *transit-oriented development* as "a relatively high-density place with a mixture of residential, employment, shopping, and civic uses located within an easy walk of a bus or rail transit center. The development design gives preference to the pedestrian and bicyclist" (Cervero, et al., 2004, p. 6).

[5] *Transit-adjacent development* (TAD) is variously defined as "conventional single-use development patterns, with conventional parking requirements" (Cervero, et al., 2004) and "development that is in close proximity to transit, but with a design that has not been significantly influenced by it" (CalTrans, 2000).

development. Landis and Zhang's (1995) evaluation of suburban station areas in the San Francisco Bay Area BART system showed that sites closer to the stations were *less* likely to be developed than sites further away. This finding was true for both the period of time when BART was under construction (1965-75), as well as the system's first 15 years of operation (1975-1990). In the same study, Landis and Zhang analyzed station areas along the San Diego Trolley, finding that although sites closer to those stations were more likely to have been developed then sites further away, the effect was weak, leading the authors to conclude: "neither BART nor the San Diego Trolley has had a significant effect on land-use patterns in their immediate station areas" (p. 79). One of the compelling reasons the authors cite for the outcome is the presence of significant institutional barriers to change, including a lack of supportive local government planning and zoning provisions. Bollinger and Ihlanfeldt (1996) and Gatzlaff and Smith (1993) make similar findings with respect to Atlanta's MARTA rail system and Miami's Metrorail, respectively. These findings are further bolstered by Atkinson-Palombo's analysis (2010), outlined above, of the independent impacts that TOD zoning has on real estate prices.

Figure C-7. One Station Area that Has Developed (Pleasant Hill, CA)

Another strand suggesting an independent effect of the non-transit dimensions of TOD is the variation in real estate price effects between "park and ride" and "walk and ride" transit stations. The former are, at least in American practice, almost uniformly auto-oriented in their designs, while the latter are more likely to be pedestrian-oriented. In his extensive study of gentrification trends in transit station areas across 14 metropolitan areas, Kahn (2007) shows that, over a 10-year period, the prices of homes in park and ride station areas suffer a 1.9% price decrease, while those in walk and ride station areas enjoy a 5.4% increase. Over 20 years, the walk and ride premium increases to 10.8%. Bowes and Ihlanfeldt (2001) show a similar effect in their study of Atlanta's MARTA system. The price of homes located between ½ and one mile of a park and ride MARTA station demonstrate a 1.4% discount, while homes more than three miles from a park and ride station show a 4.7% price premium. These results suggest that for close-in residents the disamenity of being near a parking lot (that they probably do not need to use to access the transit system) outweighs the accessibility benefits of the transit service itself. On the other hand, the more distant residents are able to enjoy the benefit of using the parking lot to access the transit system, while being located far enough away to not feel the downside of living proximate to a large parking facility. Atkinson-Palombo's study (2010) of Phoenix shows comparable results on this issue as well.

These findings are bolstered by Goetz, et al.'s (2010) study of the Hiawatha light rail line in Minneapolis, which shows substantial differences in residential prices between properties on the west side of the rail line—which have direct access to station platforms—and those on the east side—which are separated from the stations by an arterial and industrial buildings. In the west side station areas, condos and single-family houses receive price premiums of $350 and $45 per meter of proximity to station platforms, respectively. On the east side, however, the disamenity effects of the arterial and industrial uses overwhelm the transit accessibility benefits. Interestingly, because the researchers make calculations both before and after the construction of the rail line, they are able to identify a moderating of the negative impacts from the arterial and industrial uses as a result of transit accessibility. In other words, having transit nearby, while not overcoming the negative attributes on the east side neighborhoods, makes them less onerous.

Mixed-Uses

As outlined above, the presence of a relatively high degree of mixed land uses within a walkable area is central to most definitions of TOD, as well as to other related development concepts such as Smart Growth and New Urbanism (Congress for the New Urbanism 1996; Smart Growth Network 2009). From a planning perspective, the principle reason for mixing uses is to provide the residents and workers in a neighborhood with easy access to at least some of the destinations that comprise a typical daily itinerary, such as employment, housing, schools, shopping, local services, and cultural and recreation facilities. This increase in proximity and convenience has been linked to smaller daily activity spaces, shorter daily travel distances, lower average vehicle trip rates, and fewer total vehicle miles of travel (Ewing & Cervero 2001; Fan & Khattak 2008). Logically, the increased convenience should also find favor in real estate markets. Anecdotally, we observe this logic when we read real estate ads that list things like “close to shopping” and “easy walk to elementary school” as positive features. We should then expect to see these advantages capitalized in the prices of properties within or close to a mixed-use environment. There is evidence that this is the case, although the literature on the question is sparse.

One of the early studies in this area is Grether and Mieszkowski’s (1980) analysis of the impacts of non-residential land uses on the prices of nearby housing. Their objective was not to assess the effects of mixed-use development, per se, but to test one of a central assumption for modern, single-use zoning—that allowing non-single-family residential uses within single-family neighborhoods suppresses the value of the homes in those neighborhoods. To test the assumption, the authors conducted 16 “experiments” using hedonic methods to assess price impacts on single-family homes located in homogeneous neighborhoods within ¼ mile of a variety of non-single-family residential uses, including an elevated highway, garden apartments, public housing projects, light industrial areas, strip commercial areas, and neighborhood commercial districts. Of the 16 areas tested, proximity to the non-residential uses was statistically significant at the 0.01% level in only 3 areas, suggesting that proximity to non-residential uses has little effect on home prices. Of the 3 significant tests, two showed proximity (to an industrial district and a public housing project) had a discount effect. The other test, however, showed proximity to neighborhood commercial to have a positive price effect. Cao and Cory (1981) make similar findings in their analysis of Tucson, Arizona.

Figure C-8. Neighborhood Commercial (Tucson, AZ)

Similar to Grether and Mieszkowski, another early analysis by Li and Brown (1980) focuses on the “micro-scale” externalities of noise and visual pollution, as well as proximity to non-residential uses. While acknowledging the accessibility benefits of proximity to daily destinations such as shopping, Li and Brown recognize that such destinations frequently have noise and congestion elements associated with them that may a negative impact on the prices of surrounding housing. In a manner consistent with the discussion above about proximity to transit, Li and Brown postulate that the impacts of the negative externalities decrease more rapidly with distance than the positive effects of accessibility (see Figure C-9). In other words, the disamenities of the commercial uses tend to be “next door” phenomena, experienced primarily by those immediately adjacent to the shops, while the benefits of having easy access to shopping are enjoyed by residents in a wider geographic area.

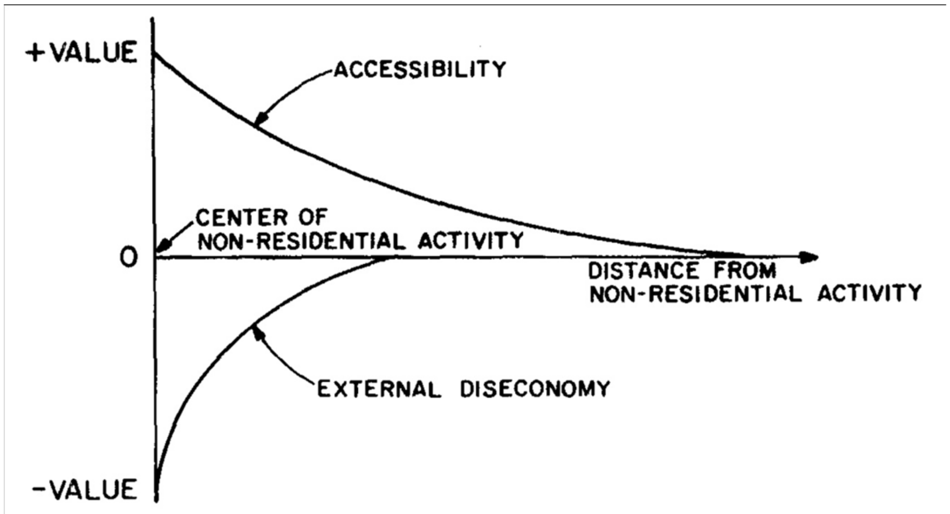


Figure C-9. Postive and negative influences on residential land prices of proximity to non-residential land uses (source: Li and Brown 1980).

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Although their analysis of single-family home sales in suburban Boston is inconclusive on the effects of disamenities, the results do show a relationship on the accessibility benefits that is significant and negative. In other words, as distance to the commercial use decreases, the home price increases. The authors estimate the magnitude of this effect at $1,486 for every 10 meters.

Among the more recent analyses of the impacts of mixed uses, Din, Hoesli, and Bender’s (2001) analysis of a variety of environmental variables, including proximity to shopping, produced inconclusive results. De Graaff, et al. (2007) assessed the value that employees of an “edge city” outside Amsterdam place on having shopping, day care, and other facilities near their places of work. The analysis, while showing that many employees find the availability of such services important, used a “willingness to pay” methodology which is generally considered less reliable than hedonic model approaches (Federal Transit Administration, 2000; Tajima, 2003). Mathur’s (2008) analysis of King County, Washington shows accessibility to retail jobs increasing the price of “low-quality” housing while decreasing the price of “high-quality” housing. As the study measures accessibility only to retail jobs, and does so on the basis of auto driving time, its value to assessing the impacts of TOD-style mixed use is limited. Matthews and Turnbull (2007) find that the price effect of mixed uses depends on the development pattern of the neighborhood. In automobile-oriented neighborhoods with curvilinear and cul-de-sac street patterns, the presence of retail uses within walking distance has no significant effect. In pedestrian-oriented neighborhoods with interconnected streets, however, retail proximity has both positive and negative effects relating, respectively, to the accessibility and disamenity influences postulated by Li and Brown (1980): the negative externalities associated with retail uses (noise, light, traffic, trash, etc.) depress the price of immediately adjacent houses by as much as $14,453, while the accessibility benefits result in a $9,675 premium. The negative effects fall off quickly with distance, though, and at approximately 235 feet from the retail use they are overwhelmed by the accessibility effects.

Song and Knapp (2004) make similar findings in their analysis of Washington County, Oregon:

> Our fundamental conclusion is that mixing certain types of land uses with single family residential housing has the effect of increasing residential property values. This is especially true for houses that are closer to public parks or are located in neighborhoods with a relatively large amount of land devoted to public parks. Housing prices also increase when they are close to neighborhood-scale commercial uses, or are part of a community with a relatively large amount of neighborhood-scale commercial uses. In other words, a house tends to be sold at a higher price if it is closer to a public park or a neighborhood store. Additional premium exists when the neighborhood store is situated within pedestrian walkable distance. It is important to note that the research indicates that the size and scale of the commercial development is important to consumers. The larger or more intense the commercial development, the more it can have a negative effect on housing prices (pp. 675-676).

In a 2011 study of the San Diego Trolley light rail system, Duncan makes comparisons between station areas containing various levels of “population serving employment” (i.e., entertainment, food-related, retail, and service businesses). The results show that proximity to a light rail station has no significant effect in condo sales prices in neighborhoods with average levels of population serving employment. With higher levels of these types of uses (above the 68th percentile of the variable’s range), station proximity significantly increases sales prices, suggesting that the capitalization of accessibility benefits of transit is conditioned, in part, on the presence of mixed uses.

Open and Public Spaces

While the effects of mixed uses on home prices has not been studied extensively, the literature on the hedonic price effects of urban parks and open space is extensive (Benson, et al. 1998; Bolitzera & Netusilb 2000; Irwin 2002; Shultz & King 2001). Studies in Washington County, Oregon; Austin, Texas; Minneapolis–St. Paul; and other areas have used residential sales data, census data, and Geographic Information Systems (GIS) to examine the marginal values of different types of open space (Anderson & West 2006; Nicholls & Crompton 2005; Song & Knaap 2004). These studies find that urban parks, natural areas, and preserved open spaces have positive effects on property values

A recent review of more than 60 published articles concluded that while studies generally show that there is value to most types of open space land uses, the magnitude of effect depends on the size of the area, the proximity of the open space to residences, the type of open space, and the method of analysis. The review found the marginal implicit price of being located 200 meters closer to a given open space area ranges from negative to 2.8 percent of the average house price (McConnell & Walls 2005). The economic boost in property value exists up to 500–600 feet away from the park. In the case of community-sized parks over 30 acres, the effect may be measurable out to 1,500 feet, but 75 percent of the premium value generally occurs within the 500–600-foot zone (Crompton 2004). Walsh (2007) calculated that the average household living one-half mile from open space would be willing to pay a one-time amount of $4,104 (in 1992 dollars) to reduce its distance from open space by one-quarter mile.

The size of the park itself may have a bearing on the magnitude and proximity of the economic effect. Using data from Portland, Oregon, Lutzenhiser and Netusil (2001) found house prices increase with the size of the natural area nearby and estimate the optimal size of parks and natural areas to be similar to that of a golf course. Increasing the percentage of open space land surrounding a property tends to increase average house prices between 0 and 1 percent of the total property value (Acharya & Bennett 2001; Geoghegan, et al. 2003: Irwin 2002).

Figure C-10. Trail System Along the River (Portland, OR)

The type of open space providing the highest economic value to the surrounding property may depend on location (Anderson & West 2006). In rural and suburban areas, preserved farmland has greater value on surrounding real estate values than potentially developable land. There is mixed evidence about how much households are willing to pay to preserve the farmland, but studies do find that there is a price premium when farmland perceived to be under the threat of development is preserved (Geoghegan 2002; Geoghegan, et al. 2003; Irwin 2002; Irwin & Bockstael 2003).

The value of all kinds of open space may be higher in urban areas than in suburban locations, with parks, greenways, forests, and other natural areas providing increased economic benefits as density increases (Acharya & Bennett 2001; Anderson & West 2006). Greenbelts, urban growth boundaries, and open spaces in clustered subdivisions also appear to have value, but the relationship is difficult to distinguish from the effect of supply of buildable land (Knaap 1985; Nelson 1985 1986).

Although most of the literature in this area is focused on medium to large scale open and green spaces, the market also seems to value smaller amounts of greenery. In an analysis recently completed by the Forest Service's Pacific Northwest Research Station, researchers estimate the impact of street trees on neighborhood real estate prices (Donovan & Butry 2010). Analyzing more than 3000 residential properties in the Portland metropolitan area, the researchers determine that two tree-related variables—the number of trees fronting a property and the crown area within 100 feet of a house—are statistically significant. Together, these two variables can add more than $8000 to the price of a house, the equivalent of adding 129 finished square feet to the floor plan.

Street Design

A final feature common to TOD, Smart Growth, and New Urbanism is the design of streets that provide a pedestrian- bicycle-friendly environment while still facilitating auto travel. One element of that type of street design is the adoption of connected street system, rather than one dominated by dead ends and cul-de-sacs. Although this does not necessarily mean a gridiron-like street pattern, many people equate connectivity with grids. In their study of Seattle neighborhoods, Mathews and Turnball (2007) find that the effect of gridded street patterns depends on the nature of other design features. In neighborhoods containing other pedestrian-oriented features—narrow street cross-sections, neighborhood retail—a more grid-like pattern increases house prices, while the opposite is true in more auto-oriented neighborhoods. Focusing more broadly on street connections and block size, Song and Knaap (2003) find that home buyers in Portland, Oregon are willing to pay a premium for houses in neighborhoods containing interconnected streets and smaller blocks. They also show a preference for pedestrian accessibility to commercial uses. Duncan's (2011) study of San Diego light rail, outlined above, similarly shows that condo buyers will pay more for proximity to light rail stations if the neighborhood contains higher levels of street intersections per hectare.

Figure C-11. Housing on Gridded Streets (Seattle, WA)

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On the other hand, Guttery (2002) examined the sale prices of 1672 houses located in the Greater Dallas-Fort Worth-Denton metroplex and found negative impacts from having rear-entry alleyways, a feature characteristic of traditional development. Likewise, Asabere (1990), using data from Halifax, Nova Scotia, showed that location on a cul-de-sac yields a 29 percent price premium over houses located on a grid street pattern, the grid again being characteristic of traditional development.

The impact of bicycle facilities on house prices is mixed and appears to depend on the neighborhood location within a region and on the type of facility. Krizek's (2006) analysis of on-road and off-road bicycle lanes and paths in the Twin-Cities region shows that city residents will pay more for a house close to an off-road path, but less for a house near a road-side path, even after controlling for the disamenity of being proximate to the busy streets where these facilities tend to be located. On-road bike lanes, meanwhile, have no significant effect on city house prices. In the suburbs, all three facility types have a significant and negative impact on house prices, with a discount of between $364 to $1058 for locating 400 meters closer to these facilities.

Traffic calming, one type of street design treatment, uses changes in street alignments, the installation of barriers, and other physical measures "to reduce traffic speeds and/or cut-through volumes, in the interest of street safety, livability, and other public purposes" (Fehr & Peers 2008). There are two theories relating traffic calming to property values. One theory is that traffic calming eliminates or lessens negative externalities of motor vehicle use. Property values rise in response. The other theory is that traffic calming stigmatizes a street, announcing to all prospective property owners that traffic is a problem. Property values fall in reaction. Absent much empirical evidence one way or the other, property values might be expected to depend on the aesthetics and functionality of measures and the severity of preexisting traffic problems. A series of over-marked and over-signed speed humps on a low-volume residential street may detract from the appearance of the street and advertise a problem. Nicely landscaped devices that eliminate some or all through-traffic from a street previously overrun is bound to enhance residential amenity. The subject of aesthetics is covered in Chapter 4.

The two rigorous studies of the property value impacts from traffic calming in the literature point empirically in different directions. This is doubtless for the reason just cited -- different measures were employed under different conditions. In one study (Bagby 1980), one neighborhood was traffic calmed with diagonal diverters in the aftermath of a fatal traffic accident, while another with a nearly identical street network and land-use pattern was not calmed. In the period following treatment, residential property appreciated at a much faster rate in the neighborhood with the traffic calming than in the non-calmed neighborhood. In the other study (Edwards & Bretherton 1998), neighborhoods treated with speed tables were paired with similar neighborhoods left untreated. The rate of price appreciation was compared for arms-length home sales. For six pairs, the neighborhoods with tables showed more appreciation. For three, they showed less. For one pair, the rate of appreciation was the same. In most cases, the differences were slight.

Beyond these two studies, only anecdotal evidence is available. In the Old Northwood neighborhood of West Palm Beach, streets were closed and traffic circles, neckdowns, and humps installed for speed control. Home sale prices, which averaged $65,000 in 1994, now average $106,000. For the first time in years, real estate agents have lists of potential home buyers just waiting for the right resale unit to come on the market (Lockwood 1998).

Figure C-12. Traffic Calming in the Old Northwood Neighborhood (West Palm Beach, FL)

Reid Ewing

If the evidence of the price effects from pedestrian-friendly street design are ambiguous, the price-effects from the presumed opposite treatment—auto-oriented street design—are a bit less equivocal. It is intuitive that houses located on busy, noisy, high-trafficced streets would sell at lower prices than houses on quieter—calmer—streets, and the literature says as much (Hughes 1992; Kawamura & Mahajan 2005; Nelson 1982). Wilhelmsson (2000) reports a 0.6% discount in house price for each increase in decibel (dB) from traffic noise, resulting in a 30% price differential between a house on a noisy street and one on a quiet street. Bateman, et al. (2001) estimate the per decibel discount at 0.2%, while Kim, Park, and Kweon (2007) find the rate to be -1.3% for every 1% increase in volume. Thebe (2004) asserts that the noise discount does not rise linearly with the sound level, finding that sound levels below 55 dB do not result in a price discount, but levels above 65 dB "appear to be capitalized into prices, with a maximum discount of approximately 12 percent" (p. 227).

Perhaps the final word on this topic belongs to the two studies analyzing the real estate price effects of replacing major highways with boulevards and parks. Tajima (2003) estimates the price impacts on real estate surrounding Boston's "Big Dig"—the replacement of the elevated Central Artery freeway with an underground facility and the transformation of the surface to a linear parkway and boulevard. Though written while the project was still under construction, Tajima uses coefficients of the price impacts from the proximity to parks in Boston neighborhoods to conclude that "the demolition of the highway should result in $732 million increase in property values, and the new parks should increase property values by at least $252 million" (p. 649). More convincing is Cervero, Kang, and Shively's (2009) analysis of the price effects resulting from the demolition of the Embarcadero and Central freeways in San Francisco after the Loma Prieta earthquake made them structurally unstable. Both freeways were replaced with a surface boulevard that while having important pedestrian amenities, still carry large volumes of traffic. In the case of the Embarcadero Freeway, real estate prices tended to decrease with distance from the freeway before the earthquake because of the amenity value of the waterfront just on the other side of the freeway. After the replacement of the freeway with the new boulevard, that effect was amplified, suggesting the freeway had had a disamenity effect mitigating the benefit of being proximate to the waterfront. The authors find that this effect was about $118,000 (in inflation adjusted dollars) for a typical residential unit. In the case of the Central Freeway, real estate prices tend to climb with distance from both the freeway and the boulevard that replaced it. However, the steepness of the curve is significantly less with the boulevard. The authors estimate that the price of the typical residential unit in the corridor increased by $116,000 the year that the boulevard opened.

Synergistic Effects

While the studies reported so far attempt to address individual features of pedestrian-oriented design independently, there is a body of literature that addresses the subject holistically. Understanding that design is probably perceived in an integrated way by most consumers, this literature makes some intuitive sense.

Consumers seem willing to pay a premium to locate in New Urbanist developments that feature higher-than-average densities, a mix of housing types, commercial centers, interconnected streets, and prominent public spaces (Eppli and Tu 1999, 2002, 2007; Plaut & Boarnet 2003). Compact developments can command a price premium of as much as 40 to 100 percent compared to houses in nearby single-use subdivisions, according to Chris Leinberger of the Brookings Institution (2008). The homes at Kentlands, Maryland sell at a 25 percent premium over comparable large-lot developments in the same zip code (Tu & Eppli 1999). Song and Knaap (2003) show a $24,255 premium for Portland-area homes in New Urbanist areas compared to those in conventional suburban neighborhoods. Ryan and Weber (2007), on the other hand, find a 21% to 27% discount for housing located in traditional neighborhood developments

(TND) compared to infill projects. Critics of this latter analysis, however, suggest a series of possible confounding variables that may have influenced the analysis, including variations in design quality, the inclusion of public housing in the TND projects, and the use of assessed values instead of sales prices (New Urban News 2007).

Of course, key to the TOD concept is integrating these design features with high-quality transit. Returning to Duncan's analysis of the San Diego Trolley (2011), the author shows that a good pedestrian environment—which he defines as people serving jobs, connected streets, and flat (i.e., walkable) terrain—located in a transit station area can result in a condo price premium as high as $20,000, or 15%. More importantly, he demonstrates a degree of mutual dependence between pedestrian design and of transit proximity. As already outlined, the author shows that transit station proximity provides no statistically significant price premium in the absence of a good pedestrian environment. He also shows that the reverse appears to be true—that a good pedestrian environment provides no price premium in the absence of station proximity. For example, at 0.1 km distance to a transit station, the presence of people serving jobs provides a significant and strong price premium; the premium declines with distance from the station and at 0.9 km becomes insignificant. This reciprocity between design and transit leads Duncan to conclude that "TOD does seem to have a synergistic value greater than the sum of its parts, at least in the San Diego condo market" (p. 121). Atkinson-Palombo (2010) shows similar effects in Phoenix, with single-family houses in mixed-use neighborhoods enjoying a 6% premium because of proximity to light rail, while the effect of station proximity is insignificant for houses in residential-only neighborhoods. Condos in mixed-use neighborhoods enjoy a 16% premium if they are walking distance to transit plus an additional 37% if the area is zoned for TOD. In the residential-only neighborhoods, however, condos within walking distance achieve a only a 3% premium, and that small advantage is overwhelmed if the area is zoned for TOD, which depresses prices by 11%.

Conclusion

In summary, the hedonic price literature confirms that the market shifts in favor of pedestrian- and transit-designed development indicated by survey data and demographic analyses are, indeed, being capitalized into real estate prices. As such, this literature provides a third, independent method of confirming and observing those market shifts. The literature also demonstrates that the amenity-based elements of transit-designed development play an important positive role in urban land markets, in addition to the accessibility benefits provided by transit. In fact, the newest literature suggests that the benefits of transit accessibility and TOD-based design are linked synergistically and may be, to a degree, mutually dependent. This tends to validate the distinctions others have made between transit-oriented and transit-adjacent development and suggests that planners, elected officials, transit agencies, and developers pay closer attention to the non-transit, amenity-based elements of land developments proximate to transit facilities.

Paradoxically, the literature of transit-related effects on real estate prices is both mature and yet still in its infancy. With more than 50 empirical studies in the last 35 years, there is a great deal of published research on the connections between transit and real estate. However, because much of that literature ignores the roles that urban form and development design play in real estate values (and transit ridership), its explanatory power is severely limited. Given that much of this literature was written during a period of burgeoning interest in land use-transportation interactions, in general, and in TOD, in particular, it is curious that hedonic research did not better reflect land use-transportation interactions. Only now are we beginning to see research that is beginning to unpack the market impacts of these interactions.

Perhaps the lag in the literature is the natural result of a limitation inherent to all revealed-preference methods, including hedonic price analysis: the need for transactional data. One cannot test market acceptance of pedestrian- /transit-oriented development using hedonic methods until there is enough of it actually constructed and on the market to provide statistically reliable samples. Now that these product types are becoming more available, one would hope that hedonic research would take advantage of the data to further explore what pedestrian- and transit-based design features mean for real estate markets. Some of the later studies outlined in this appendix are a good start in this direction.

When pedestrian- and transit-oriented development was first discussed as a response to contemporary transportation and urban development challenges, skeptics asked "Will anyone buy it?" The hedonic literature presented here shows that many people will, indeed, buy these types of development.