Location Choice vis-à-vis Transportation: The Case of Apartment Dwellers

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To be Presented at the 85th Annual Meeting of the Transportation and Under Consideration for Publication by *Transportation Research Record*

Abstract

An understanding of residential location choice is fundamental to behavioral models of land use and, ultimately, travel demand. Detailed data and predictive models are lacking. The paper examines the choices of apartment dwellers and explores their reasons for moving, priorities when choosing a residential location, and tradeoffs involved. In addition to summary statistics of the data, linear regressions, binary logit, and ordered probit models were utilized to investigate variations in rent and apartment size, stated preferences of housing, location, transportation, and access. Binary logit and ordered probit models reveal similar results concerning people's preferences for accessibility. For instance, families and other multi-person households tend to place less value on commute times and freeway access and choose apartment improvements over travel savings. Interestingly, women are more likely to state that they place a higher importance on commute time and freeway access; but, when asked to choose between travel times and apartment size, they are more likely to choose the larger apartment. Other models suggest that being within walking distance of a commercial center increases average rent by $24 per month. Increases in distances to the central business district (CBD) and mean neighborhood commute times reflect lower monthly rents, about $20 per mile from the CBD and $24 per added minute of commute (one-way). Apartments in the urban area tend to be, on average, 75 square feet smaller,

ceteris paribus (including population density, which has an added effect). These results and many others provide several valuable insights regarding the location choice of those residing in apartments.

Keywords: Location choice, logit models, apartment choice, accessibility

1 Introduction

The past 40 years have seen significant urban shifts in land use and travel behaviors. Rising income and vehicle ownership have made it possible for many families to purchase apartments in suburban areas and travel longer distances, resulting in minimal transit use and decentralization of metropolitan areas. Such shifts make integrated models of land use and transportation very relevant for prediction of future travel patterns. Residential location choice models can inform such models.

This paper focuses on apartment dwellers in order to obtain a clearer picture of the underlying factors for choosing for their residential choices, vis-à-vis many factors. According to the Census of Population Survey (CPS), renters comprised 62.7% of movers during 2002 and 2003. (Schachter 2004) Though they represent the majority of movers, they only represent 33.8% of U.S. households. And they are a demographic group that has not previously been studied in much detail. This research developed a survey instrument that asked randomly selected apartment residents in Austin, Texas about their reasons for choosing to live in an apartment and for moving, the importance they place on certain housing and location attributes, their travel patterns, their opinions and values, and basic demographic information. The remainder of the paper positions the study within the context of prior work, describes the methodologies employed, and discusses summary statistics of data collected as well as empirical results of linear regression and discrete choice models. Key results and extensions are discussed in the conclusions, providing a platform for future research.

2 Literature Review

The standard framework for residential location choice models hypothesizes a sequence of decisions that begins with a decision to move and ends with a chosen home and location. (Grigg 1982, Weisbrod et al. 1980, Guiliano 1988, Ben-Akiva and Bowman 1998) Studies have examined various aspects of residential location choice, such as residential mobility (Speare et al. 1975), market search (Clark 1982), dwelling type (Boehm 1982, Tu and Goldfinch 1996, Cho 1997), and location choice (Gabriel and Rosenthal 1989, Wadell 1996). These models seek to identify the determinants of household mobility as well as choice of apartment and location.

Although there are many residential location choice models, most do not identify reasons to move. The US Bureau of Census recognized this gap and recently published a couple Current Population Reports titled “Why People Move” (2001) and “Geographic Mobility” (2004), containing cross-tabulations and raw distributions. These studies included a high number of reason-to-move responses in “other” categories, suggesting that there are some unexpected yet important reasons for moving. The studies did not quantify correlations between multiple demographic factors and response nor did they identify the type of housing structure or tenure choice.

A few residential location choice studies did include reasons for moving. Murie's 1974 study in England explored the reasons for household move and related them to tenure, housing structure, and several demographic factors, but the data is out-dated and the housing and tenure options are very different from the dominant types of current housing. Filion et al. (1999) extensively investigated the determinants of residential location choice within Kitchener, Canada. They reported households' reasons for moving but did not relate these to housing structure or demographics. To the authors' knowledge, no recent study exists that isolates apartment dwellers and explores their reasons for moving.

Another important aspect of residential location choice involves the housing search process, particularly the relative importance of various attributes. Filion et al. (1999) presented some raw statistics. However, their study did not explore explanatory variables that underlie the varying importance of such attributes. The 2004 American Community Survey (ACS) also examined household priorities when deciding where to live. Although Belden et al. (2004) linked gender and race in the ACS, they presented little analysis and did not relate such priorities to dwelling type.

The third aspect of residential location presented in this paper concerns the tradeoffs that households make when choosing an apartment. A household's choice to move and where to move is a complex and costly decision. "When people buy or rent housing, they are obtaining a bundle of goods that includes interior living space; housing services such as schools and parks; and externalities like neighborhood image, noise, and smog." (NCHRP Report 423A 1999, p.96) For virtually every household, a residence cannot be found in which all of these housing and location attributes are optimized; and size, cost, accessibility, or other features may be compromised. Weisbrod et al. (1980) examined the tradeoffs between transportation and other factors for recent movers in Minnesota. Although they did calibrate a tenure choice model, they did not quantify tradeoffs for apartment dwellers nor link demographic characteristics to these. Belden et al. (2004) explored tradeoffs between commute time and lot size while linking gender and race. However, they discussed only raw statistics.

Overall, the research presented in this paper is unique in that it focuses on apartment dwellers and addresses their reasons to move, their valuation of various factors while searching for a new apartment, and the tradeoffs associated in apartment choice and location.

3 Methodology

Survey design and data collection were undertaken by graduate students at the University of Texas at Austin during the spring semester of 2005 as part of a collective effort between researchers and students in a graduate course. The survey was designed as a self-completion survey and was intended for door-to-door as well as Internet distribution. Several revisions and a pilot test were executed in order to develop a comprehensive survey, which can be found in Bina (2005).

3.1 Sampling

The sampling frame for the survey was all apartment dwellers within the Austin area[1]. The 2000 Census estimates 138,757 renter-occupied multi-unit attached housing. A list of 558 apartment complexes (representing 115,344 apartments) was obtained from Austin Investor Interests and the University of Texas at Austin Division of Housing and Food Service datasheet. Thus, the sampling list obtained seems to be fairly comprehensive (containing 83% of all such units) and is hopefully, unbiased.

Due to resource limitations, a stratified cluster sampling approach was used to select apartment complexes. The stratification recognized four regions of roughly equal populations (200,000 persons). It also recognized complex size since complexes of similar size may be alike in terms of amenities, which can be important to renters and yet hard to quantify. Thus, sampled complexes were chosen randomly with equal numbers of "small" (80 or fewer rentable units), "medium" (81 to 250 rentable units), and "large" (greater than 250 rentable units) complexes. (The average complex size is roughly 200 apartments.) Six complexes (two of each "size") were selected for each of the four regions. However, since data collectors were required to receive only 40 completed surveys and some fulfilled the quota before sampling every complex, only 17 complexes were actually surveyed. Supplementary data was obtained to describe each observation's location. Capital Area Metropolitan Planning Organization (CAMPO) data provided information on zonal areas, population, number of households, and employment at the Traffic Serial Zone (TSZ) level; and Census tract information on housing characteristics was matched to the TSZ.

3.2 Survey method

After running a pre-test of the survey instrument using 10 demographically diverse apartment dwellers, the survey was distributed "door-to-door" on Saturdays and Sundays during late February and early March of 2005. The survey was delivered directly to the first adult answering the door and collected from respondents around 30 minutes later. The reasons for choosing this survey method are several: This method permitted faster distribution and response times, as well as higher response rates (Richardson et al 1995). It also permitted better data quality by allowing respondents to get their questions answered directly. Candy bars and maps were offered as incentives, and cards advertising the website URL were posted at unopened doors.

3.3 Response rates

A total of around 1600 apartments were visited; out of these, 28% answered the door. Only 450 doors were opened, perhaps because no one was home, lived, or wished to answer the door at the others. This is largely a quality neutral loss, though certain travel, location choice or other relevant characteristics may be associated with those living in the non-response apartments. The surveys were conducted on weekend days only, when most people, regardless of employment type, may be assumed to have the same chance of being at home.

Of the 450 who answered the door, 260 chose to return a survey, suggesting a response rate of 58%. However, only 240 of those surveys were fully completed. So the real response rate was in fact 53%. Generally, women were more likely to answer the doors than men, and younger persons were more likely to answer the door than older persons. Among the women who answered their doors, more than half agreed to fill out the survey, while slightly less than half of the men agreed. Elderly persons appeared much more reluctant to take the survey than younger people. Also of some interest is the fact that both men and women were more responsive when a person of the opposite gender was asking, even in cases where there were two students of different gender interviewing at the same time (with one standing in the background). In such cases, the female interviewer tended to achieve higher response rates, confirming previous response rate studies.

3.4 Weights

Several of the 240 “completed” surveys required some data imputation (as discussed below). Weights to correct for age, gender, and household income were created using most recent 5% Public-Use Microdata Sample (PUMS) for Austin metro area renters in apartment buildings (not including those in institutionalized group housing units or those under the age of 18). The sample weights were created for 18 groups of people, as characterized by 3 age groups (18-35, 36-55, 56+ years of age), 3 household income groups ($0-$24,999, $25,000-$49,999, $50,000+), and gender.

3.5 Imputed data values

Where feasible, missing data was imputed. For example, rents were determined by comparing apartment units with others obtained from the same apartment complex. In many cases these were virtually identical. When rent values varied across a complex, comparisons based on rent per square foot as a function of bedrooms and bathrooms provided a clear indication of the appropriate rent category.

Square footage was imputed similarly, recognizing the number of rooms and rent levels within each apartment complex. However, since the variation of square footage within each apartment is much greater than rent variations (possibly due to the respondents’ ignorance of exact square footage, as compared to rent), some values could not be imputed with sufficient certainty and remained missing.

Missing values for respondent age were imputed using ordinary least squares (OLS) regression techniques. A two-sample t-test suggested that age values were missing at random across observations. Stochastic regression imputation was used[2].

As with many surveys, many household income responses were missing. Since this variable was reported categorically (i.e., as “grouped data”), a multi-threshold variation of the tobit model was used in LimDep software in order to provide an underlying continuous model for income prediction. These continuous values were then used for missing values, while category mid-points were used for all reporting households.

4 Data Analysis and Results

The following discussion presents sample characteristics and results of behavioral regression models. Table 1 provides several summary statistics that characterize apartment dwellers in the sample.

Many practitioners and researchers are interested in why a household chooses a particular dwelling type. The survey asked the respondents to indicate their main reason for choosing to live in an apartment. 44% indicated affordability, 18% needed a short-term residence, 15% appreciated the size, relative to their needs, 13% wanted low maintenance, and 9.5% chose “other” as a response. Based on these responses, one might hypothesize that lower income and smaller households tend to live in apartments. 2000 Census PUMS data for the Austin metro area confirms this hypothesis, indicating that the average household income of those living in apartments is $35,996 – or less than half that of non-apartment dwellers ($74,163). Moreover, the average household size for those residing in apartments is 2.08 persons, whereas an average of 2.63 persons live in other types of dwelling units.

4.1 Reasons for Moving

Simply knowing why people move can be very helpful in developing residential choice models. The survey asked respondents to indicate their primary reason for moving to their current apartment. Table 2 compares these results to those of the 2003 U.S. CPS, which sampled over 40,000 recently relocated households across the U.S.

The comparisons suggest that Austin's apartment dwellers differ from recent U.S. movers in several ways. The greatest difference between the two is the high percentage of apartment dwellers surveyed that moved for an easier commute. This may be attributed to Austin's heavy congestion and limited freeway corridors. The next greatest difference relates to those moving for a new job/job transfer: 4.77% more apartment dwellers stated this as their primary reason for moving. A new job or job transfer often signals a long-distance move; and the Census results support this by indicating that the most common single reason for an intercounty or international move is a new job or job transfer. (Schachter 2004) Long-distance movers may be more inclined to choose an apartment, in order to become more familiar with the area before buying a home. A third difference is the higher percentage of apartment dwellers seeking less expensive housing, which is intuitive since apartments are generally a less expensive housing option. Finally, a higher percentage of apartment dwellers moved to begin college studies, which also is intuitive, since many college students rent apartments and Austin has a relatively high population of college students (13.7% vs. 8.32% in the US).

4.2 Priorities during Housing Search

Once a household has chosen to move, the process of searching for a new apartment/location begins. During this search, a household has priorities for key features. So respondents were asked to rank the importance of several housing and location attributes. Table 3 lists these attributes, along with the "mean" ranks for the corrected (population weighted) sample.

Predictably, price is the important attribute to apartment dwellers. Of course, price is a key criterion in virtually any choice, for most people. Moreover, lower income households tend to rent (as discussed earlier), and therefore may be more concerned with this attribute. Commute time is the next most important attribute, which, as explained earlier, may be credited to Austin's traffic congestion. Commute time is just one of several access attributes that were included in the survey. By summing the weights of all variables, access attributes carry less importance than non-access attributes (40% vs. 60%).

Surprisingly, the quality of and distance to local public schools attributes were rated least important. Perhaps this is because apartment dwelling households tend to contain fewer children. The 2000 Census suggests that 20.4% of U.S. households living in an apartment have children, as compared to 30.3% among non-apartment households. Ordered probit models were created to analyze the underlying factors that influence these scores. And the presence of children was a statistically significant variable in some cases.

5 Model results

Weighted least squares (WLS), binary logit, or ordered probit regression models were used to analyze response to the various types of survey questions posed. The results are as follows:

5.1 Linear regression analyses of rent and square footage

Linear regression models (Table 4), weighted by population correction factors, were used to examine how rent and square footage relate to various demographic and location variables. This is valuable information in determining where to build and zone for multifamily apartment complexes (as well as how to price such units). The results also provide a sense of the tradeoffs that households make in terms of cost (rent) and benefits (e.g., interior square footage). As shown in Table 4, all variables that were expected to have an impact were included in the initial specifications. The final model specifications emerged from a systematic procedure of eliminating statistically insignificant variables, combined with intuitive considerations. Final adjusted R^2 values exceeded 0.5, suggesting a reasonable fit – but also the fact that many other variables are at play here.

5.1.1 Rent model

The average rent in the dataset was $693 per month. Each added bedroom's estimated value is $119, and each bathroom $109. While an added bedroom may be more useful to many households and offer more space than a bathroom, bathrooms are expensive to build and service. Having a commercial center within walking distance adds around $24 per month in rent. And brand new apartments are expected to command $44 more per month.

Non-Caucasian households tend to pay $52 less per month, while those with children tend to pay around $47 less per child. Those with higher levels of education tend to pay more (e.g., $110/month by those with a Master's degree). Such attributes may be proxying for location effects not captured by other model variables. These other variables include proximity to the CBD, which is valued quite favorably: Every mile less in travel distance to the CBD contributes an average of $20 in monthly rent. A similar trend is visible in the mean-travel-time-to-work variable: For every minute less of commute time, rents rise by $24/month.

Rents also tend to rise with population density, ceteris paribus: Another 3,000 people per square mile (or 4.7 persons per acre) is associated with rents that are $55 per month higher. However, increased transit stop density counters this effect: Another 50 bus stops per square mile averages $67 less in monthly rent. This may due to the fact that the use of bus transportation is more widespread among lower income households. It also may relate to a greater presence of commercially used, busy streets, where bus stops are common, but noise, congestion, and other issues limit desirability for residential use. Many of these same features are at play in apartment size estimation, as discussed next.

5.1.2 Square footage

The WLS model of apartment size suggests that another bedroom adds around 152 square feet, and an extra bathroom 179 square feet. Since bedrooms tend to be quite a bit larger than bathrooms, this result is most likely an indication that the overall size of an apartment is influenced by the number of bathrooms. In other words, the model specifications does not suggest that bathrooms have an average size of 179 square feet; but, rather, having more than one bedroom may be an indicator of a “luxury” apartment, offering more space throughout the unit.

Households with children appear to use less space, dropping about 22 square feet per child, which is not an intuitive result. One would expect families with children to require more space. However, it could be an indication that families with many children have tighter budgets and thus they are forced to select smaller apartments, everything else constant. This is consistent with the results of WLS models of rent, in section 5.1.1, which suggests that families with children pay less in rent than childless households. Since children add more expenses to the family, such households cannot necessarily afford as expensive (and large) an apartment as households without children. This conclusion is further reinforced when one looks at higher-income households. They tend, ceteris paribus to choose more spacious apartments (0.77 square feet more per $1,000 in annual income). Respondents with master’s degrees or higher levels of education tend to live in apartments that average an additional 94 square feet.

As expected, smaller apartments are found in Austin’s “urban areas” (70 square feet less than in non-urban areas, as defined by CAMPO). Higher population densities are associated with smaller apartments, as expected: Another 3,000 persons per square mile is associated with 130 less square feet. Interestingly, after controlling for these two types of variables, size is estimated to fall with distance from the CBD (at a rate of 37 square feet per mile). This may indicate that those willing to pay to live more centrally also want larger units. Access and size both come at a price, however, as discussed earlier.

5.2 Logit results for binary choice experiments

The six stated preference questions were developed in order to appreciate which apartment respondents prefer. All six scenarios presented a choice between an improved apartment or neighborhood feature and a transportation improvement. The scenarios and their weighted choice percentages are as follows:

- Scenario 1: 200 extra SF (47%) vs. freeway proximity reducing commute time by half (53%).
- Scenario 2: An apartment with friend or relatives nearby (55%) vs. an apartment near a light rail station that can take the respondent to work or school (45%).
- Scenario 3: A suburban apartment with plenty of parking (66%)vs. a downtown apartment with one parking space (and additional parking spaces costing $60 per month) (34%).
- Scenario 4: An apartment close to a shopping center (41%) vs. a larger kitchen/living room (59%).
- Scenario 5: An apartment close to a bus stop (46%) vs. one offering a park view (54%).
- Scenario 6: A brand new apartment and complex (77%) vs. an older apartment that is 5 miles closer to a shopping center (23%).

Table 5 shows the model results for the six scenarios. In every comparison, Apartment 2 is the base choice, meaning that the parameter estimates represent the additional utility of Apartment 1, as compared to Apartment 2. As before, elimination of statistically insignificant variables and intuitive considerations have been used to obtain the final specifications. A p-value of 0.20 was generally accepted as the upper limit of statistical significance. However, the relatively small sample sizes make it difficult to obtain statistical significance on all variables of interest.

This section describes preferences by demographic groups, as revealed by the model results.

5.2.1 Household size and income

Larger households and married couples tend to prefer larger apartments and more parking, as one might expect, while single-person households are more likely to opt for a shorter commute time and a downtown location. Larger households also tend to value apartment enhancements over access improvements. Hence, they are more likely to choose better appliances and a newer apartment than reduced shopping travel time (Scenario 6). Those with children are more likely to opt for a nearby park (where their children can play, ostensibly) than transit access. Those with many workers, however, are attracted by the light rail option. Higher-income households tend to value a park view over bus stop proximity, and a newer complex over nearby shopping, perhaps because travel costs (including parking) are of less importance to them.

5.2.2 Ethnicity and gender

Ethnicity parameters emerge as statistically significant in four scenarios, but only when grouped (as Caucasian and non-Caucasian). In general, the results suggest that non-Caucasian households are more interested in shorter travel times (to shopping and workplaces) than in better apartment features. This may indicate that these demographic groups depend more on public transportation or other non-SOV modes, or it may be they are more time-constrained in their activities.

Women appear to prefer larger apartments, over reduced commute times, relative to male respondents. That may be due to shorter commute times, on average, for women (their average commute times are roughly the same: 21.82 minutes for men vs. 20.47 minutes for women). Sermons and Koppelman’s (2001) work suggests that women spend less time commuting due to their greater participation in household activities.

5.2.3 Education and employment

Education and employment status also affect respondent priorities. Scenarios 3 and 4 suggest that more highly educated persons are more likely to choose reduced travel times (to shopping) and a downtown location, possibly because they tend to work longer hours and/or have higher values of time, ceteris paribus. Full-time workers also are more attracted to travel time savings, in their commutes. And retired persons tend to be more impressed by shopping access (than by newer apartments).

5.2.4 Apartment location

In all six scenarios, supplementary data regarding current apartment location indicate that urban area apartment dwellers are more likely to choose shorter commute times, better public transportation facilities and proximity to shopping centers. Such households may be more accustomed to using (and dependent on) public transit. The distance-to-CBD parameter suggests that households located further from the CBD are more likely to opt for better public transportation (bus and rail) options. This could be an indication that public transportation in the suburbs does not meet the requirements of the citizens in those areas.

5.3 Ordered probit analysis of the importance of access

Ordered probit models were used to explore priorities during the housing search process. Since the variables of primary interest concern accessibility and its impact on location choice, explanatory variables like commute time, distance/travel time to shopping, access to major freeways, and access to public transportation were studied. Final model specifications are shown in Table 6, and these provide some interesting results.

Those who view commute time as more important tend to be female, non-Caucasian, highly educated (master's degree or higher), and have no children. Among these, the presence of children is the most practically significant, causing more than a one-point gain in terms of importance (which is scored from 1 to 5). A graduate degree is almost as significant, in this same sense.

Those who view shopping access as more important tend to be older, Hispanic or Latino, having fewer workers in the household, and living with family members (but not with a spouse and children). Transit access is rated as more important by students, non-Caucasians, and those with fewer vehicles, lower levels of education, and lower household income. Freeway access is rated higher by females, Hispanics, Latinos and African -Americans, those of lower educational attainment, and those without children at home. Those living with family and/or a significant other are also more likely to rate freeway access highly.

These various attributes, and preferences, offer one a sense of the consumer market for different locations.

5.4 Some potential applications of results

The results of these models tell a bigger story than simply who is more attracted to what and what they are willing to pay. For example, the logit results suggest that if a developer and/or community wishes to attract well-educated, high-earning full-time workers, it might best focus on building nice apartments close to downtown, while improving access to public transportation. In order to attract families with children, however, they should build large apartment complexes in the suburbs with access to recreation facilities and shopping.

Another possible goal of communities is greater ethnic and racial integration. Since non-Caucasian respondents appear to value public transit access, improvements in bus and/or additions of light rail service in neighborhoods dominated by Caucasian households may serve such objectives. Rents should probably be kept moderate in enough units to ensure affordability for a variety of household types.

The model of rent arguably indicates substantial differences in willingness to pay. For example, a white single person, with a graduate degree and an annual income of $80,000 is estimated to pay $1216 per month for a single-bedroom, single-bathroom, new apartment, with a commercial center nearby, one mile from the CBD, and a mean commute time of 10 minutes (and densities of 3000 persons and 17 bus stops per square mile). In notable contrast, a non-Caucasian with three children, a bachelor's degree or less, and an annual income of $30,000 is willing to pay only $874 per month for the very same apartment. Of course, an apartment of this type may not be available at that price, suggesting that certain demographic groups will be priced out of this market. Such distinctions support that notion that market forces can (and do) result in substantial clustering of households, by income education transportation needs, and other factors.

Finally, in order to deal with issues of congestion, transit-oriented designs that cater to a variety of preferences may be of interest. By locating an apartment complex in the suburbs around a light or commuter rail station, and by offering several apartment sizes and price ranges, one may meet the needs and suit the preferences of many households – including families with children, those desiring more than one parking space, and, at the same time, single persons of relatively low income but who would value the transit access and relatively affordable accommodation.

The previous examples are just some of the applications one might devise from the results of this work. The data set and various models are hoped to be a valuable source for more informed policymaking, land development practices, and transportation system design.

6 Conclusions and Extensions

This work provides new insights into location and dwelling choices by those living in apartments in the Austin area. One particularly valuable aspect of the research lies in the data set itself. The focus is on apartment dwellers (rather than home owners), and questions range from reasons for moving, to rent and apartment attributes, to tradeoffs between pairs of key access-dwelling qualities, and to ratings of individual attributes.

One finds that apartment dwellers may have very different reasons for moving than home owners and others; for example, a new job (or job transfer) is far more common. Rent and apartment size models reveal several tradeoffs that households make: for example, another bedroom adds approximately $119 to monthly rent and newness $44, while access to commercial centers adds around $24. Rents fall by about $20 per month for each additional mile away from the CBD, and by $24 for each added commute-time minute. A higher bus stop density also is associated with lower rents. Urban area apartments run about 75 square feet smaller than others, ceteris paribus, and those in more densely populated neighborhoods run smaller (about 28 square feet smaller for every added person-per-acre).

Binary logit models of stated preferences suggest that multi-person households, married couples, and those with children tend to prefer larger and newer apartments as well as better recreation facilities and suburban locations, while single-person households are more likely to choose a shorter commute and more central locations. Additionally, the results suggest that women prefer more space to a percentage reduction in commute time, as compared to men. Women and non-Caucasian apartment dwellers tend to be more concerned with accessibility. Those living without children tend to more concerned about commute times and freeway access, everything else constant.

Finally, although this study offers significant insights, several extensions would be valuable. Ideally, more persons in more locations would be surveyed, producing greater variety in spatial as well as demographic characteristics. A random sample (rather than choice-based sample) of apartment dwellers would permit calibration of a location choice model, to more formally determine the neighborhood, price, and access factors (and tradeoffs) that are at play in apartment choice. With such data sets and models on hand, prediction of future land use patterns as well as the viability of new forms of residential design will be greatly enhanced.

Acknowledgments

Survey design and collection was completed by students in a graduate course. Without the help of Ahmed Qatan, Shadi Hakimi, Nick Lownes, and Shashank Gadda, the data set would not have been obtained. Undergraduates Robin Lynch and Daniel Villalobos also aided in the collection process, as well as Stacey Bricka. A special thanks to Ahmed Qatan for making the survey available on the Internet. We would also like to recognize the Southwest University Transportation Center (SWUTC) for funding this research project.

Endnotes

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[1] This sampling area is the 787xx Zip Code Tabulation Area (ZCTA), which has a population of 777,789.

[2] This technique uses a stochastic draw to impute the data, by adding a random term to a regression models estimate of age. Little and Rubin (1987) concluded that this method suffers less from bias than relying on the regression model's "best" or average guess. The two-sample test used data from records providing age information, and those without.

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Table 1. Characteristics of sample

Variables		Min.	Max.	Mean	Std. dev.	Number of observations
Apartment features (self-reported)	Number of bedrooms	1	4	1.61	0.65	235
	Number of bathrooms	1	4	1.46	0.56	234
	Rent (dollars per month)	150	1,500	673.33	263.54	240
	Interior size (square feet)	300	1,700	861.70	285.36	235
	Commute to work/school	3	100	19.59	14.34	222
	Travel time to grocery store	3	100	8.01	8.90	232
	Travel time to mall	3	100	15.86	12.86	238
Household information	Household size	1	4	2.08	1.03	240
	Number of workers in household	0	4	1.28	0.80	239
	Number of children	0	4	0.48	0.93	239
	Number of licensed drivers in household	0	4	1.52	0.79	238
	Number of vehicles	0	5	1.38	0.76	240
	Household income ($1000/year)	13	200	37.86	27.95	240
Respondent information	Married	0	1	0.28	0.45	237
	Age	18	83	32.83	12.80	240
	Male (indicator)	0	1	0.51	0.50	240
	Number of days per week typically driven	0	7	5.42	2.30	238
	Caucasian	0	1	0.48	0.50	239
	Hispanic/Latino	0	1	0.28	0.45	239
	African-American	0	1	0.10	0.31	239
	Asian	0	1	0.09	0.29	239
	Other ethnicity	0	1	0.04	0.20	239
	Non-Caucasian	0	1	0.52	0.50	239
	Living alone	0	1	0.37	0.48	240
	Living with friends	0	1	0.15	0.36	240
	Living with family	0	1	0.29	0.46	240
	Living with significant other	0	1	0.17	0.38	240
	Less than high school	0	1	0.05	0.23	238
	High school	0	1	0.37	0.48	238
	Associate's or technical degree	0	1	0.16	0.37	238
	Bachelor's degree	0	1	0.29	0.46	238
	Master's degree or higher	0	1	0.13	0.33	238
	Employed full-time	0	1	0.56	0.50	238
	Employed part-time	0	1	0.09	0.29	238
	Full-time student	0	1	0.19	0.40	238
	Homemaker	0	1	0.03	0.16	238
	Unemployed	0	1	0.08	0.27	238
	Retired	0	1	0.05	0.21	238
Supplementary data)	Urban (indicator)	0	1	0.74	0.44	240
	Distance to CBD	1	15	6.59	2.95	240
	Neighborhood mean travel time to work	17	27	22.90	2.88	240
	Neighborhood median household income	17,596	63,662	34,542	13,044	240
	Neighborhood median rent	581	911	714.62	86.18	240
	Cost for home-based work trips	4,477	6,998	4,992	697	240
	Cost for home-based non-work trips	4,671	7,718	5,291	825	240
	Population density (people/ square mile)	900	11,437	3,366.58	1,888.19	240
	Percent of non-Caucasian residents	0.12	0.64	0.35	0.16	240
	Employment per square mile	212	6,821	1,551.52	1,530.36	240
	Bus stops per square mile	11	150	71.26	36.63	240

Table 2. Primary reason for moving

Primary Reason for Moving (Sample Results)	Frequency	Percent*
Wanted new/better apartment	44	18.74%
Easier commute	40	17.03%
Other	36	15.33%
New job/job transfer	32	13.57%
Wanted/needed less expensive housing	24	10.33%
Planned to attend or graduate from college	15	6.33%
Marriage or divorce	14	6.16%
Wanted to rent	13	5.64%
Birth/adoption	9	3.73%
Change of climate	6	2.40%
Retiring	1	0.39%
Health reasons	1	0.36%

* corrected percentages weighted for Austin's apartment dwelling population

Primary Reason for Moving (Census Results)	Percent
New/better house/apartment	19.8%
Other family reason	12.6%
Other housing reason	11.0%
Wanted to own home/not rent	10.2%
New job/job transfer	8.8%
To establish own household	7.0%
Change in marital status	6.7%
Cheaper housing	6.5%
Better neighborhood/less crime	3.8%
Closer to work/easier commute	3.2%
Attend/leave college	2.5%
Other reason	2.5%
To look for work/lost job	1.9%
Other work reason	1.4%
Health reasons	1.4%
Change of climate	0.4%
Retired	0.3%

Table 3. Mean rank of importance of housing and location attributes

Housing/Location Attributes	Mean Rank (where 1 is very unimportant and 5 is very important)
Price	3.663
Commute time to work	3.277
Perception of crime rate	3.246
Attractive neighborhood appearance	3.166
Commute time to school	3.145
Access to major freeways	3.095
Noise	2.991
Distance/travel time to shopping	2.645
Social composition of the neighborhood	2.632
Neighborhood amenities / recreational facilities	2.621
Access to public transportation	2.571
Views	2.494
Closeness to friends or relatives	2.406
Quality of local public schools	2.243
Distance to local public schools	2.218

Table 4. Final linear regression models of rent and square footage

Variables		Monthly rent ($)		Square footage (sq. ft.)	
		β	*p-value*	*β*	*p-value*
	Constant	993.71	*0.00*	809.98	*0.00*
Apartment and neighborhood features (self-reported)	Number of bedrooms	118.90	*0.00*	152.52	*0.00*
	Number of bathrooms	109.28	*0.00*	179.17	*0.00*
	Commercial center within walking distance (0-4)	24.41	*0.13*		
	Relatively new apartment (0-4)	43.81	*0.00*		
	Travel time to mall (min.)			-2.60	*0.02*
Age and ethnicity	Age				
	Non-Caucasian	-52.67	*0.06*		
Education level	Lower education (base)	0	*N/A*	0	*N/A*
	Master's degree or higher	110.01	*0.00*	94.29	*0.02*
Household information	Number of children	-46.57	*0.00*	-22.55	*0.16*
	Household income (per $1000 annual salary)	0.81	*0.19*	0.77	*0.16*
Supplementary data	Urban Indicator			-70.06	*0.09*
	Distance to CBD (miles)	-19.50	*0.01*	-37.50	*0.00*
	Neighborhood mean travel time to work (minutes)	-24.31	*0.00*		
	Population density (people per square mile)	0.02	*0.03*	-0.04	*0.00*
	Number of bus stops per square mile	-2.52	*0.00*		
	Number of observations	209		229	
	Adjusted R^2	0.551		0.508	

Table 5. Final binary logit models of stated preference questions

Variables		**Scenario 1:** 200 extra sq. feet vs. shorter commute		**Scenario 2:** Friends/relatives nearby vs. light rail to work		**Scenario 3:** Suburban location vs. downtown with one parking spot (extra spot = $60)		**Scenario 4:** Closer to shopping vs. larger kitchen		**Scenario 5:** Close to bus stop vs. view of park		**Scenario 6:** Brand new complex vs. 5 miles to shopping center	
		β	***p***	***β***	***p***	***β***	***p***	***β***	***P***	***β***	***p***	***β***	***p***
	Constant	-0.64	*0.73*	3.66	*0.00*	1.60	*0.00*	-2.81	*0.00*	-2.31	*0.02*	4.69	*0.03*
Living situation	Number of workers			-0.55	*0.01*								
	Number of children									-0.25	*0.12*		
	Married	0.80	*0.02*			0.68	*0.09*	0.42	*0.16*				
	Living alone	-0.68	*0.04*	-0.78	*0.02*	-0.99	*0.00*					-0.59	*0.09*
Ethnicity and gender	Non-white					0.74	*0.02*	0.64	*0.02*	0.73	*0.01*	-0.64	*0.06*
	Male	-0.70	*0.02*			-0.61	*0.05*						
Education	Less than high school							-1.38	*-0.08*				
	Master's or higher					1.43	*0.01*						
Employment Status	Full-time	0.51	*0.09*										
	Retired											-1.52	*0.06*
Income	Household income(per $1000 annual salary)									-0.01	*0.01*	0.01	*0.08*
Supplemen-tary data	Urban indicator	-0.78	*0.13*	-1.47	*0.00*	-1.19	*0.00*	0.92	*0.01*	0.84	*0.04*	-0.93	*0.07*
	Distance to CBD	-0.18	*0.01*	-0.21	*0.00*					0.14	*0.05*		
	Neighborhood mean travel time to work	0.12	*0.07*									-0.11	*0.15*
	Population density									0.00	*0.02*		
	#Observations	231		235		233		233		236		235	
	Log likelihood	-143.08		-150.41		-127.54		-148.23		-146.21		-117.14	
	Adjusted rho square	0.073		0.050		0.181		0.057		0.074		0.256	
	Market shares (apt. 1 vs. apt. 2)	47% vs. 53%		55% vs. 45%		66% vs. 34%		41% vs. 59%		46% vs. 54%		77% vs. 23%	

Table 6. Final ordered probit models of importance of commute, distance/travel time to shopping, access to public transportation, and access to major freeway(s)

Variables		Commute time		Distance/ travel time to shopping		Access to public transportation		Access to major freeway(s)	
		β	*p*	*β*	*p*	*β*	*p*	*β*	*p*
	Constant	1.950	0.000	1.046	0.000	2.224	0.000	1.502	0.000
Household/ respondent information	Number of workers in household			-0.254	0.006	-0.260	0.017		
	Presence of at least one child in household	-0.941	0.000					-0.370	0.129
	Married and have at least one child			-0.698	0.043				
	Age			0.016	0.007				
	Male	-0.372	0.021					-0.277	0.072
	Number of vehicles available in household					-0.311	0.017		
	Household income (per $1000 annual salary)					-9.45E-03	0.001		
	Full-time student			-0.260	0.128	0.338	0.048		
	Hispanic/Latino			0.327	0.056			0.369	0.046
	African-American							1.048	0.000
	Non-Caucasian	0.569	0.000			0.399	0.006		
Living situation	Living alone					-0.695	0.000		
	Living with friends								
	Living with family			0.505	0.002			0.435	0.013
	Living with significant other			0.387	0.059			0.419	0.021
Highest level of education	Less than high school							0.263[1]	0.085
	High school								
	Associate's or technical degree								
	Bachelor's degree					-0.389[2]	0.019		
	Master's degree or higher	0.805	0.000						
Thresholds	μ (0)	0	N/A	0	N/A	0	N/A	0	N/A
	μ (1)	0.773	0.000	1.270	0.000	0.681	0.000	0.854	0.000
	μ (2)	2.193	0.000	2.517	0.000	1.655	0.000	2.260	0.000
	#Observations	221		224		214		228	
	Loglikelihood	-216.293		-263.968		-264.570		-244.230	
	Log Lik: constants only	-238.425		-283.049		-293.738		-260.351	
	Adjusted LRI	0.062		0.028		0.077		0.049	

[1] Represent a combination variable of less than high school or high school education level.
[2] Represent a combination variable of associate’s degree, bachelor’s degree, or master’s degree or higher education level.