

GEOGRAPHICAL HETEROGENEITY IN HOMEOWNERSHIP RATES:  
DOES THE DIFFERENTIAL BETWEEN RENT AND OWNERSHIP  
COST EXPLAIN LOCAL VARIATION IN HOMEOWNERSHIP RATES?

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## **Abstract**

This paper focuses on differentials between rental and owner costs as a primary determinant of local homeownership. In simultaneous equations to estimate the separate effects of owner cost and rent on homeownership rates, the control variables are various household and geographical factors (Census 2000 tract level dataset), in the samples of 48 contiguous states within the United States. The results show negative effects of rental and owner costs on homeownership rates. Ethnicity, income, age, property tax rate and loan usage rates, contribute to increased owner costs. Several factors had significant association with the rise in housing prices before 2006.

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## ACRONYMS

FHA Federal Housing Administration

PSID Panel Study of Income Dynamics

# **Geographical Heterogeneity in Homeownership Rates: Does the differential between rent and ownership cost explain local variation in homeownership rates?**

## **1. Introduction**

Homeownership is often discussed in the context of community development, in which higher residential stability and increased involvement of local population are claimed to provide externalities that help to alleviate social malaises. Summary papers on the effects of homeownership focus on its economic, social and psychological benefits. An extensive review by Haurin (2003) provides general overview of the relationship between homeownership and interest in the community, and the amount of social capital is strongly correlated with the higher percentage of local owner-occupants. Harkness and Newman (2002) show that the homeownership rate provides consistent positive effects on children's outcomes in poor communities. Sampson and others (1997) explain homeownership effects on community outcomes with the degree of collective efficacy that is originated in residential stability that supports community ties and interest. Brown, Perkins and Brown (2003) use subjective valuation of social environment and show that homeownership, as well as the years of residence and population heterogeneity, strongly explains the degree of individual attachment to the community, while fear of crime and community incivility greatly harm one's attachment values.

The policy responses, as well as the rise of social capital as a common term in public policy discussions, have been pursued actively through the last decades through a wide array of programs in housing markets. Tax benefits, mortgage support and lending insurance, specifically for the first-time buyers and minorities have been largely increased in magnitude especially after the latter half of 1980s (Carliner, 1998; Bond and Williams, 2007; Jaffee and Quigley, 2007). Studies focusing on low-and middle-income households, minorities and immigrants mention that the overall outcome of the programs seems appealing at least in terms of the general increase in homeownership rates (Bostic and Lee, 2008; Olsen, 2007). The increasing burden of home mortgage had also been discussed in the same perspective, especially compared with the consumer credit debt (Masnick, Di and Bersky, 2006).

Partly attributed to the strong economic growth that was believed to be contributing to increasing housing prices, the homeownership rate in the United States had reached 69.5 percent in 2004, about a five percent increase from the average in 1965-94 (64.3%, Chambers et al., 2007). The magnitude of this increase is almost the same across all age groups and regions (Chambers, Garriga and Schlagenhauf, 2009). More recently, the ongoing financial crisis involving public housing agencies and rapidly declining housing prices, and even homeownership rates, is undermining the public perceptions about the effectiveness of policies designed to increase homeownership, but the overall effectiveness of the prior set of programs should be discussed with the changes in housing market behaviors and the benefits that should be different across area and demographics.



## **1.1 Increasing homeownership rate and the persistent gap across groups**

The persistent heterogeneities in homeownership rates among different racial, income, age cohorts, and geographical areas made the general effects of the housing market interventions on specific subpopulations unclear. Meanwhile, they operate largely in different local conditions resulting in different household incentives to purchase homes. Below is a summary of the three focal points on which extensive comparative studies have explained the differences in homeownership rates across groups.

First is the continuing racial gap in homeownership rates, particularly among African Americans living in central cities. Ethnic separation in residential areas is often a financial segregation, while race-based discrimination, though mainly attributed to the income gaps with the other groups, has been reported in mortgage rates and market practices (Eggers, 2001; Leigh and Huff, 2007). Since the low-income minority population has been the main target of non-prime lending, the current effects of public policies are not easy to approach, due to the large scale foreclosures of the residents who had been the beneficiaries of the policies.

A second focus in the homeownership literature is the effects of immigrants on housing market behavior, mainly in urban centers and ethnically diverse quarters including relatively large Hispanic and Asian populations. These new immigrants are highly concentrated in metropolitan areas, tend to have lower homeownership but on average purchase more expensive housing units than the native born population (Drew, 2002; Coulson, 2002).

The third focus in homeownership literature is the behavior of first-time low-income buyers who are often ethnic minorities and immigrants. Disproportionate increases in housing prices compared to income (Gallin, 2006) have made it difficult for the group to purchase homes without financial intervention, while the increase in low-income homeownership in the last two decades is ascribed to rising income and education (Bostic and Lee, 2008). They also report that the gain from homeownership is higher as the household income is lower if they are free from the current failed appreciation and foreclosure. The social and economic benefits that this population would enjoy from rising homeownership, if they could achieve stable residence in a better environment, will still be enough to offset the costs.

## **1.2 Sources of geographical heterogeneity**

While the previously cited studies have discussed the behaviors of different groups in terms of homeownership decision making, the housing market is primarily the bundle of housing units, neighborhood and its residents, and geography always takes a role in the market outcomes in any markets. The geographical nature of the housing market is why Federal initiatives, including the drastic increase in FHA loan amount and financial reform to allow non-prime lending<sup>1</sup>, have contributed to the increases in homeownership on all three sub-populations above, and the initiatives are for increasing homeownership

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<sup>1</sup> Jaffee and Quigley (2008) point out that though the total ratio of FHA loans has been continuously declining since late 1980s, the amount of FHA insured loans has been increased by about four times from 1985 to 2004. Hoffman, Bersky and Lee (2006) provide a summary for the recent Federal initiatives on homeownership.

as well as mediating the problems of low-income quarters (“ghettos and barrios”) for its negative social externalities.

The common subjects of geographical (neighborhood) effects on homeownership rates are aging population (Haurin and Rosenthal, 2007; Painter and Lee, 2009), crime (Cullen and Levitt, 1997), environmental quality of neighborhood (Hilber, 2005) and other socio-economic indicators partly as the outcome of local public policy. When a major part of the benefit from increasing homeownership is the reduction of residential segregation based on ethnicity, as well as geographical heterogeneity in homeownership. Focus on these characteristics may provide the observations of housing heterogeneity how to capture the reality in geographic segregation. Previous related literature tends to rely on individual household data, mostly The Panel Study of Income Dynamics (PSID), to analyze how each household with varied conditions seek for different demands for their residential choice.

While they are useful for detailed household analysis on residential choice, behaviors of individual households provide little details on the general determinants of price differentials across locations, with varied structures in terms of demography, geography and housing conditions and geographical heterogeneities in prices. Variations in ownership costs, rents, and occupant conditions across regions at a specific time will be treated as the result of residential mobility depending on local amenities, neighborhood qualities and work conditions. The expected results of financial deregulations since the late 1980s include migration of larger scale and longer distance in which households look

for better place to live, though each community has different risk measures on prices and environment, depending on Resident age cohort, race group, and immigrant status still play a large role for household migration decision (Hilber, 2005).

### **1.3 Research objectives**

Based on the idea that household and financial conditions are the primary factors for each household to enter into the housing market (Henderson and Ioannides, 1983), this paper tries to find the effects of the quality of communities and demographic composition that may contribute to the wider discussion on homeownership. The purpose of this paper is to analyze the demographic, geographical and socio-economic factors and how the local differentials between rental prices and ownership costs, including mortgage payments, contribute to homeownership decisions.

The dataset is taken from the US Census in 2000, the year when the interest rates for housing originations started to decline sharply and the first wave of non-prime lending has been transitioned into a more stable housing market development following the boom<sup>2</sup>. This is expected to reveal the characteristics of general housing market in the pre-boom period when non-prime and lower grade lending have had larger impact on housing market than the increase in real terms. A simultaneous equations approach using data of this period may capture the effects of local housing costs relative to community

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<sup>2</sup> The recognizable change of trends in housing loan performances around the year 2000 includes the larger percentages loan origination numbers for purchase, the higher loan-to-value (LTV) ratio (with rapid increase in general home prices), and the smaller percentages of lower-grade loans in terms of LTV, in the period from 2000 to 2003 compared to the previous five years (Chomsisengphet and Pennington-Cross, 2006).

characteristics, as well as the different interests and benefits that renter and owner groups see in residence in the same community.

The next chapter identifies variables, and a dataset is compiled as community aggregate characteristics from Census 2000 tract data in the 48 contiguous states in the United States. The third chapter discusses the concepts and estimation strategies. The results follow, and its interpretation focuses on the determinants of cost differential, and how their differences could result in heterogeneity in local homeownership rates for each demographic group. Lastly, the discussion includes how the 2000 condition may reveal the critical factors related to the ongoing turmoil on housing market.

## **2. Factors that contribute to geographical heterogeneity in local homeownership**

### **2.1 Rent vs. own: a summary of determinants of current homeownership rate**

Though the increase in homeownership rates in 1990s was accompanied by declining costs of homeownership in the United States, average rental prices in the period did not decline much with ownership costs (Garriga et al., 2006) and vacancy rates of rental units increased (Olsen, 2007). The relative stagnation in rental market is partly be attributed to the decline in new rental units with slower urban growth after the 1980s (Turk, 2004), causing spatial mismatch of demands in residential units, and exacerbated by large-scale housing developments in suburban and rural areas. Also, a large scale of migration of the Baby-Boom generation in retirement has accelerated the current trend of suburbanization (Dawkins, 2009). With increasing non-prime loan originations, declining interest rates for all income and ethnic groups, and declining rates of down payment percentages through the previous decade in the 1990s (Herbert and Belsky, 2006), the purchasing decision has become a better move compared with its counterpart, while in the same period the general housing market had been stable.

While larger applications in lower-grade lending had helped population groups that could not afford housing units previously, other barriers to homeownership should be recognized to understand their behaviors. First, the transition to homeowner usually

incurs higher transaction costs<sup>3</sup> and exposure to different types of risk (Sinai and Souleles, 2005). While general risk for renters was smaller due to the stagnant rental market, the costs of homeownership will largely depend on the location and its specific characteristics like property tax and resale possibilities. Knowledge of local market practices is another source of location specific factors related to the transition, especially for foreign immigrants (Coulson, 2002). Furthermore, a potential owner will expect lower transaction costs as longer they live in the unit. Geographical variation in transaction costs related to homeownership, as well as the demographic compositions of the location depending on the amenities and business structures, is then an important factor determining the choice of residents between rental and owner units.

The trend in local housing price is another important factor that a potential owner considers. Accelerated housing prices in 1990s made relocation more frequent, including activated acquisition of second houses (Di, McArdle and Masnick, 2001). During the period the marginal benefit of homeownership, compared to the alternative, was on average increasing in the first eight years after purchase (Di, Bersky and Liu, 2007) and the appreciation rate was mostly uniform across racial groups. The appreciation value of minority populations was smaller because they tend to pay smaller amount of down payments and have higher rate on their mortgages loans, but the home value appreciation allowed the low-income population to receive significantly larger financial gains relative to its high-income counterparts (Williams, Nesiba and McCornell, 2005).

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<sup>3</sup> A summary article on the transaction costs of homeowners and its potential effects on housing market behavior is Haurin and Gill (2002).

Owner-occupants also consider the resale value of their housing units, and the expected investment returns associated with homeownership will change the local price of homeownership. In the conceptual explanation by Henderson and Ioannides (1983), the investment value of housing is strongly dependent on its consumption value, so properties are more likely to be the subject of investment when they have higher amenity values (i.e. good environment and proximity to high-paid jobs). Under the assumption that all housing units are the subject of investment, both by individual and financial institutions, residents in the location with better environments are more likely to be renters since they need to pay premiums for owning the property that should exceed the investment value.

Meanwhile, a purchasing decision does not always imply migration to a better community, particularly for low-income and minority populations. Low-income and first time buyers tend to move to neighborhoods of worse quality than higher-income buyers, resulting in lower reported satisfaction rates associated with homeownership (Herbert and Belsky, 2006). When the current local rent is enough low to live in a better community than the ones with potential ownership in other places, staying in rental units will be a reasonable choice for the household.

Since geographical heterogeneity in the homeownership rate depends heavily on the factors that compose household structures in each of the communities, each factor is comprehensively assessed to identify the variables and estimate them in later chapters.



### **2.1.1 Individual and Household Structure**

Household structure determines the potential benefits associated with the family becoming a homeowner. Marriage and aging household head with children are important factors that a household considers in purchasing a home. Declining headship rates during the past decades, as well as increasing single motherhood accompanied lower local homeownership rates (Haurin and Rosenthal, 2007). On average the American households has become smaller, with more heterogeneous income and educational attainment (Gyourko and Linneman, 1996). Meanwhile, the negative impacts of these changes have been alleviated by increasing availability of loans through the financial reforms in 1990s.

Although the decline in headship rates and household sizes has been common for all ethnic subgroups, its effects on homeownership rates have been different. Studies in ethnic differences in homeownership show that the minority population groups, especially blacks, are more dependent on the financial conditions (especially interest rates applied) than others with respect to homeownership rates (Van Zandt, 2007). Also, the income increase in minority populations in the past two decades was not an important factor of increasing minority homeownership compared with other factors like financial markets and regulations (Bostic and Surette; 2001). Current research on the persistent homeownership gaps across different race and income groups, such as Coulson (1999) and Flippen (2001), show that higher heterogeneity in local ethnic composition leads to lower homeownership.

### **2.1.2 Asset constraints and household portfolio choice**

Housing properties are considered as a component of permanent income for a household, especially as declining interest rates in the last decade made homeownership more attractive. The current behavior of local housing markets significantly affects homeownership choice, although the effects of housing prices on migration are not certain. Frabbin and Yamashita (2003) focus on housing assets with bonds and stocks, including some geographical comparisons in property market conditions. Homeowners have different risk structure than renters in terms of their asset formation. Sinai and Souleles (2005) show that the rent fluctuations, as well as the potential time horizon that each household seeks in each property, are strong factors that explain the probability of being a homeowner. Income variability and perception of risk is important for low- and medium- income households (Robst et al. 1999).

Homeownership as a financial asset largely depends on household characteristics. Cohort study of income and assets reveals that the pre-retirement population tends to invest in housing market as a choice in their portfolio (Hoynes and McFadden, 1994), and data on loan structures show a U-curve on age cohorts for the usage rate and amount of loan and the housing property value with its apex at age group of 55-64 (Carasso and McKeanan, 2007; Chambers et al. 2009). Meanwhile, each racial group experiences different appreciation rates for their housing properties, mostly by location effect (Flippen, 2004, Krivo and Kaufman, 2004, Cobb-Clark and Hildenbrand, 2006). Discriminatory down

payments and mortgage rates are also still a source of disadvantages for low-income households because they contribute to lower return from homeownership (Firestone et al., 2007), leaving central-city African Americans experiencing higher default rates (Berkovec et al., 1996). Also, the increase in total household debt (including non-housing) since 1980s, though it has been mostly equally experienced in all income groups, hit the lower income groups particularly hard, as shown by a significant increase in the rate of debt hardship households (Wagmiller, 2003; Masnick, Di and Bersky, 2006).

On the other hand, transitory income has some mixed effects on homeownership rates. Increasing transitory income greatly affects the transition to homeownership (Dawkins, 2005; Gallin, 2006; Davidoff, 2006), although Olsen (2007) points out that the lowest income population has negative incentives due to rent subsidies.

### **2.1.3 Geographical factors**

The third major factor of homeownership is location choice, and variation in local amenities is the primary source of geographical heterogeneity. Literature on migration behavior shows that local amenities such as average winter temperature, safety, local school qualities, public transportations and neighborhood demographics (ex. Necheba and Strauss, 1998; Cullen and Levitt, 1999; Bayoh, Irwin and Harb, 2006), affect not only the current but the expected future price of the local housing units.

Meanwhile, the general equilibrium perspective of local land use suggests that the productivity of the location affects local wage level then determines the living cost (Deller, 2009). General housing cost is empirically shown as a motive for moving from urban area to more inexpensive areas (Withers et al., 2008), while suburbanization has promoted spatial mismatch between work and residence, especially for minority populations in urban centers. Urban centers are more favored places for first time low income buyers.

Residential choice driven through employment prospects leads to the variety of homeownership with population groups of similar education, occupation and lifetime income when other factors are controlled (Ferguson et al, 2006). The actual practices of potential sellers and owners of housing units would discriminate against the "not favored" population, and zoning policies enacted in many favorable residential quarters has made the spatial discrimination severe.

When an urban homeowner thinks he is not likely to get a job in suburban place due to potential discrimination, he would not move to suburban area to rent a property to seek a job there. Raphael, Stoll and Holzer (2000) summarizes the previous articles on spatial mismatch and employment discrimination and finds evidence that businesses located in predominantly white suburban areas, tend to hire fewer black workers than their counterparts in urban areas, possibly with both population and employee dominance of white population in suburban areas.

Meanwhile, local amenities include demographic factors such as homogeneity of population, availability of good educational opportunities and reduced probability of crime victimization. The externalities of this social amenity will usually be higher where higher productivity leads to higher income and lower unemployment rates, for example, hedonic price analysis on the effects of school boundary Goodman and Thibodeau, 1998. Similarly, Kiel and Zabel (1996) show that housing prices are relatively cheaper in border area between minority concentrated and other locations.

Aside from the geographical factors such as weather and transport costs, community social amenities could be critical determinants that change local population composition in terms of economic status, resulting in different homeownership rates and rental values. While owning a house in a good environment is costly, high amenities will also make renters pay higher costs making renting higher cost in the long run than owning houses.

#### **2.1.4 Knowledge of local housing markets and practices**

Becoming a homeowner requires specific knowledge. Studies of migration behavior suggest that the population moving into the community visit to the community, as a common practice, to obtain the knowledge about the local community. So in a area with a higher fraction of renters, living in their rental property longer and paying a decent amount of rent, have larger implicit demand for the housing property sold in the community due to their familiarity with local characteristics including the behavior of housing markets and tax policies specific to the local area. The lower rate of

homeownership for Hispanic and Asian immigrants can be attributed to their lack of knowledge about housing policies and practices of real estate markets (Alba and Logan 1992, Coulson 1999).

These factors will be expected to change the outcome of tenure choice, conceptualized in models like Henderson and Ioannides (1983) and Brueckner (1997). Hoff and Sen (2007) expand the previous models to specifically explain how renter/owner segregation occurs within communities. These equilibrium analyses allow to compare benefits of utilization with various sources of cost, including future risks, and the concept is applicable for all asset investment decision problems.

### 3. Community-level homeownership rate with community characteristics

Homeownership rates are mostly heterogenous in terms of geography and demographic characteristics. Following the general equilibrium perspective of land use (ex. Roback, 1982), average rent of each Census tract captures the use (amenity) value of the land, while demographic characteristics and property values affect the differences between rent and ownership cost. Aside from the geographically specific market distortions such as zoning restrictions, discriminatory behaviors and structural heterogeneity in local market information, an individual household chooses to own a property when the decision is beneficial: the maintenance and financial costs of homeownership is less than the rental price of a unit with identical attributes.

The average prices that owners or renters will pay for each location are;

$$p_{O_i} = p_{O_i}(y_{O_i}, X_i, Z_i) \quad (1)$$

and

$$p_{R_i} = p_{R_i}(y_{R_i}, X_i, Z_i) \quad (2)$$

where  $p_{O_i}$  is the average cost of homeownership in tract i and  $p_{R_i}$  the average rental price of the property. Y shows the supply of housing units specifically for rent or purchase, likely to be fixed in amount and characteristics in the short run.  $X_i$  is the

average individual household characteristics of tract  $i$ , including the number of household income, occupation, educational attainment, and the length that they have been living in the location. The  $Z_i$  include spatial characteristics of the location  $i$ , including many aspects of unobservable local characteristics that are not included in the hedonic pricing model.

A question here is the degree to which the housing market is separated between renters and occupiers, but this problem will not seriously undermine the current framework since each market tends to be affected by different factors. The location choice of a household more likely depend on the geography itself rather than the price and characteristics of housing property. Finding the best area will be much harder than finding the best house, especially for individuals with higher investments in human capital, with strong preferences about their life courses other than their residential amenities. Meanwhile, ethnic minorities, families with children, and population closer to retirement age sometimes have strong preference for the social attributes that restrain their choices about the location. For both cases rentership will appear as a temporary choice in which the household decision is based on the limited aspects of the location (e.g. proximity to the industrial center), while geographical amenities such as crime rate and school quality take minor but significant roles. But the amenities that the home itself gives (e.g. home value, temperature) will not take a role for the location decision of the renter, while they are the primary factors for homeowners, especially for retiree households.



The homeownership rate in tract  $i$ , as a function of cost-rent difference  $\hat{P}_{O_i} - \hat{P}_{R_i}$ , is presented as

$$prob_{O_i} = prob_{O_i}(\hat{P}_{O_i} - \hat{P}_{R_i}, y_{O_i}, y_{R_i}, X_i, Z_i) \quad (3)$$

where the cost-rent difference is expected to be a significant factor of homeownership. The heterogeneity in homeownership rate is determined by community and household characteristics and the prices determined in (1) and (2). Particular emphasis will be put on the racial heterogeneity where a number of studies suggest evidence about its traits and potential consequences. Since the cost-to-rent ratio will be highly endogenous in terms of local characteristics, the estimation of this equation needs to include exploration of which could be treated as endogenous.

## 4. Data and variables

To analyze the geographical variations in community and housing market contexts, the tract-level dataset is used for 49 contiguous states (including Washington D.C.) in the United States. All variables are taken by or compiled using housing and population datasets in Census 2000 Summary File 3. Due to the limitation in comprehensive housing market data covering all places and locations in detail, this paper does not include any time-series analysis that could capture the changes in location-specific contexts, though several variables will capture the historical aspects of the community. Thus conclusions about the tradeoffs between rent prices and owner-occupied housing prices can be characterized as short to medium-run. In the long run, housing supply is more elastic.

The potential response bias, especially caused by the imperfect knowledge of property values, will be significantly alleviated when the primary variables are set for monthly values of payments, including mortgage payments and property taxes. Since they are intact to recall and misconception biases, the effects of potential bias by using these variables will be restrained at similar level as other socio-economic characteristics. The value of owner-occupant housing is used as an explanatory variable for monthly owner cost.

Table 1 provides an overview of the variables used in the following estimations. For each of the different groups the occupant characteristics are captured with its ethnicity, size of household, number of rooms and move-in year. Age distribution and average mortgage

conditions specifically included in the owner's market estimations capture financial conditions of owner-occupants in their lifecycle. Housing characteristics are presented by type of structure, median number of rooms for each property and average built year. Vacancy rates for each market will capture a part of local market behavior.

A variety of community characteristics are included to see the contexts of each location that could affect the housing market as potential amenities, controlled by housing market conditions. Average or median level of education, income, age structure, heterogeneities in race and income, and duration of residence are the variables treated independently of the property-specific variables included above. Economic structures include variation in occupational categories, and unemployment rates and mean household income will capture the financial conditions of local residents. Population and its density, Census-defined urban/rural indicators, average commuting time, percentage of population working within county, and usage rate of public transportation to commute are used to include geographical contexts of each tract.

Table 2 shows the summary statistics for the tract-level datasets. Observations with one or more missing variables are omitted from the original dataset, leaving 58,202 tracts in 2,983 counties<sup>4</sup>. Many numerical variables are top-or bottom-coded in the original dataset, and the tracts with smaller numbers of sample data are far out of 1% significance in several variables, though they are not omitted due to the large number of normal samples and the availability of other variables that the observations hold.

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<sup>4</sup> Most missing variables are from rural tracts, caused by the lack of either renter or homeowner dataset that led to missing denominators for several variables.

**Table 1: Variables used for estimation**

**Renters market**

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Median monthly rent paid by renters in the tract is paying (rent50)  
Percentage of each specific ethnic subpopulation living in the rental property:  
(rblack, rnativeam, rasian, rothers and rhispanic)  
Vacancy rate for the property specifically for rent (vacrent)  
Housing unit structure: percentages of each type of housing units for rent  
single unit attached (rattach), structure with 2-4 units (runit2\_4), 5-50 units (runit5\_50),  
more than 50 units (runit50\_) and other type of units including vans and mobile homes  
(runitothers)  
Average size of household occupying rental units (rsize)  
Median number of rooms for rental units (medrentroom)  
Average year of the rental unit built (rentyear)  
Average year in which the current occupant moved in (rentmoved)  
Percentage of the renters falling into each age group: 15-24, 25-34, 35-44, 45-54, 55-59,  
60-64, 65-74, 75-84 and 85+ (group of 45-54 as control)

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**Owners market**

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Homeownership rate: percentage of owner-occupants (pcowner)  
Median monthly maintenance cost that homeowner, including mortgage (medocost\_mor)  
Median monthly mortgage payment (medomor)  
Percentages of each specific ethnic subpopulation living in the rental property:  
(oblack, onativeam, oasian, oothers and ohispanic)  
Vacancy rate for the property specifically for sale (vacsale)  
Housing unit structure:  
percentages of each type of housing units for owner-occupant  
single unit attached (oattach), structure with 2-4 units (ounit2\_4), 5-50 units (ounit5\_50),  
more than 50 units (ounit50\_) and other type of units including vans and mobile homes  
(ounitothers)  
Average size of household in owner-occupying units (rsize)  
Median number of rooms for owner-occupant unit (medownroom)  
Average year of the rental unit built (ownyear)  
Average year in which the current occupant moved in (ownmoved)  
Percentage of the homeowners falling into each age group: 15-24, 25-34, 35-44, 45-54,  
55-59, 60-64, 65-74, 75-84 and 85+ (age group 45-54 as control)  
Median value of owner-occupant housing units in thousands (value50k)  
Of all owner-occupants:  
Median real estate tax: annual payments in thousands (medtaxk)  
Mortgage usage rate (pcmort)  
Usage rate of secondary mortgages and home equity loans (pc2mort)  
Monthly ownership costs as percentage of income (costpinc)

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## Table 1 (cont.)

### Community characteristics

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Ratio of monthly median ownership cost to median rent (costrent)  
100% sample population in thousands (pop)  
Population density (popden)  
Urban cluster area by Census definition (urbcluster)  
Urban area by Census definition (urban)  
Ethnic variation in the local household, including both renters and owners (ethnicvar<sup>5</sup>)  
percentage of population under age of 17 (depend\_k)  
percentage of population over 65 (elder)  
percentage of foreign-born population (foreign)  
percentage of population working within county (workcounty)  
average travel time to work (meantravel)  
usage rate of public transportation to work (pubtran)  
percentage of population enrolled in post-secondary educational institution (colenroll)  
average year of education for the population 25+ years (meaneduyear)  
unemployment rate (unemp)  
average household income (meanhhinc)  
gini coefficient (gini)  
percentage of workers in each occupational category:  
management (manag), construction (const), manufacturing (prod), sales (sales), farming  
(farm) and service (service)  
duration in residence:  
percentage of population moved to the community before 1969 (pre1969), during 1970s  
(movein70s) , during 1980s (movein80s) and after 1990 (control)

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<sup>5</sup>Obtained by cardinal equation;  $\text{ethnicvar} = 1 - \sqrt{\sum_{i=1}^I p_i^2}$  where  $p_i$  is the proportion of each ethnic group within the community.

**Table 2: Summary Statistics<sup>6</sup> (N = 58202)****Characteristics of Rental Units**

Variable	Mean	Std. Dev.	Min	Max
rent50	545.1369	265.0456	99	2001
rblack	0.1443	0.2376	0	1
rnative	0.0107	0.0470	0	1
rasian	0.0280	0.0627	0	1
rothers	0.0619	0.0835	0	1
rhispanic	0.0855	0.1324	0	1
vacrent	0.0999	0.0800	0	0.899083
rattach	0.0588	0.0937	0	1
runit2_4	0.1967	0.1715	0	1
runit5_50	0.2192	0.2058	0	1
runit50_	0.0758	0.1339	0	1
runitothers	0.0751	0.1328	0	1
rsize	2.4007	0.6153	0.58	10.11
medrentroom	4.4018	0.8327	1.1	9.1
rentyear	1966.28	14.31	1939	2000
rentmoved	1997.49	1.58	1969	2000
renter_24	0.1082	0.0848	0	1
renter_34	0.2622	0.0988	0	1
renter_44	0.2364	0.0926	0	1
renter_54	0.1578	0.0769	0	1
renter_59	0.0484	0.0426	0	1
renter_64	0.0369	0.0357	0	1
renter_74	0.0649	0.0540	0	1
renter_84	0.0594	0.0620	0	1
renter85_	0.0257	0.0432	0	1

<sup>6</sup> Several variables are generated using average values and suffer from top- or bottom-coding problem.

**Table 2 (cont.)****Characteristics of owner-occupant units**

Variable	Mean	Std. Dev.	Min	Max
pcowner	67.9934	20.9769	0.33847	99.70127
rent50	545.1369	265.0456	99	2001
medocost_mor	1105.8300	491.7895	150	4001
oblack	0.1046	0.2182	0	1
onative	0.0068	0.0407	0	1
oasian	0.0246	0.0610	0	1
oothers	0.0212	0.0338	0	0.611348
ohispanic	0.0542	0.1063	0	1
vacsale	0.0353	0.0400	0	0.995603
oattach	0.0602	0.1264	0	1
ounit2_4	0.0285	0.0784	0	0.856522
ounit5_50	0.0286	0.0709	0	0.935593
ounit50_	0.0067	0.0321	0	0.775763
ounitothers	0.0858	0.1319	0	0.988466
osize	2.6841	0.4206	0.42	9.25
medownroom	6.1140	0.8358	1.2	9.1
ownyear	1965.59	16.07	1939	2000
ownmoved	1988.97	4.94	1969	2000
owner_24	0.0139	0.0199	0	1
owner_34	0.1155	0.0599	0	1
owner_44	0.2197	0.0686	0	1
owner_54	0.2265	0.0610	0	1
owner_59	0.0892	0.0346	0	1
owner_64	0.0750	0.0324	0	0.784615
owner_74	0.1385	0.0578	0	1
owner_84	0.0964	0.0558	0	1
owner85_	0.0252	0.0244	0	0.875
value50k	138.4959	110.4670	9.999	1000.001
medtaxk	1.5803	1.3058	0	10.001
pcmort	67.9281	14.6160	2.7972	100
pc2mort	15.0749	7.9839	0	100
costpinc	11.6549	3.7218	0	50.1

**Table 2 (cont.)****Tract-level demographic variables**

Variable	Mean	Std. Dev.	Min	Max
costrent	2.1571	0.7162	0.243112	40.41414
pop	4.3961	2.0674	0.111	36.146
popden	1.6911	3.5752	4.28E-05	78.00512
urbanclu	0.1045	0.2742	0	1
urban	0.6574	0.4558	0	1
ruralfarm	0.0118	0.0323	0	0.442105
ethnicvar	0.2950	0.2032	0	0.804876
depend_k	0.2564	0.0607	0	0.72
elder	0.1335	0.0702	0	0.900515
foreign	0.0880	0.1107	0	0.814516
workcounty	0.7361	0.2001	0.027933	1
meantravel	25.4085	5.3400	15	51.81429
pubtran	0.0468	0.1006	0	0.822027
colenroll	0.0623	0.0701	0	0.990364
meaneduyear	13.0306	1.1588	9.512469	17.88429
unemp	0.0584	0.0456	0	0.897197
meanhhik	53.3646	19.9678	10.35003	164.0276
gini	0.3757	0.0519	0.10187	0.616855
manag	0.3276	0.1328	0	0.946108
const	0.0957	0.0451	0	1
prod	0.1507	0.0809	0	0.59
farm	0.0077	0.0171	0	0.372254
service	0.1537	0.0605	0	0.552474
pre1969	0.0804	0.0577	0	0.637011
movein70s	0.0933	0.0481	0	0.50468
movein80s	0.1631	0.0588	0	0.49818



## **5. Results**

The purpose of the following estimations is to capture how price differentials between rent and ownership cost are varied across the Census tracts, and how they could be explained with the demographic and geographical factors considered in the earlier chapters. Effects of household and geographical variables are discussed first for each separated market, following the observation on the interaction of prices in different market.

### **5.1 Determinants of rental and owner costs: occupier and property attributes**

Table 3 presents OLS estimations for rent and ownership cost separately. This setting estimates the coefficients in an assumption of completely separate markets between rental and owner units. Occupant and property characteristics are included only in the equation to be identified, while community variables and county-level dummies are the same in both equations. In sum, this result shows that costs in both markets are mostly explained by the occupant and property characteristics. Region and geography specific characteristics may not be the exogenously critical factor on homeownership when the homeownership rate is included in cost estimation equations<sup>7</sup> (Coulson, 2002). Below are the preliminary implications of the results for each variable. Subsequent estimations assume simultaneous determination of rent and owner cost.

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<sup>7</sup> Endogeneity on original homeownership rate will be specifically questioned in later estimations.

Proportions of occupier race have some significant implications. An area with 1% African American renters (*rblack*) has lower rent by \$0.41, while the race effect of ownership cost increases by \$0.65, possibly reflecting reported higher mortgage usage rates of the current owner group. On the contrary, increasing in Asian population (*rasian*) by 1% raises tract rent by about \$1.2 but lowers the ownership cost by \$0.57. Hispanic population (*rhispanic*) tends to pay both lower rent and ownership costs, and other groups (*rothers*--- a proportion of which is Pacific islanders), have similar cost gaps as African Americans. These results are consistent with the literature examining the effects of federal loan applications (Berkovec, 1996). The race effects of rent to cost differentials will further be analyzed in later estimations.

Local vacancy rates of both rental (*vacrent*) and sales (*vacsale*) units have unexpectedly positive coefficients, possibly indicating that higher vacancy rates at a time will be seen as the result of higher demands with more frequent transactions rather than inactiveness of the local market. On the other hand, occupied unit types, on which the control variable is the percentage of detached property, largely show negative coefficients on rental properties, while on owner units the larger structure types (e.g. apartments) have strongly positive coefficients. This partly reflects the mostly urban settings of largest unit structures (e.g. buildings of 50 or more units) where land rents are higher.

Unit size (*rentsize* and *ownsize*) and number of rooms (*rentroom* and *ownroom*) are both positive, and the effect of size is more than twice as strong in owner units as compared to rental ones, indicating the difference in the amenity demands between these two types of

owners. Also positive are both the year built and the year the occupier moved into the property, consistent with the positive effects of the vacancy rates.

An interestingly consistent result is found on the effects of ownership age distribution on local median costs, and this shows that age structure of homeowners certainly affects the behavior of the local housing market. Median rent takes inverse U-curve on age, and the magnitudes are mostly within the range of \$0.8-\$2 by 1% increase of each age cohort, peaking with age 45-54. Meanwhile, the strong positive coefficient of age 85 and more (\$5.6 by 1% increase) is not consistent with the behaviors of other age cohorts, and also against the results of research on elderly renters<sup>8</sup>. Though further estimations are provided in later estimations, this effect will be explained partly by the residential settings of these age groups, including many elderly who occupy senior residences functioning as nursing homes where rents include various service fees<sup>9</sup>.

A larger proportion of young owners (age less than 24) has a negative significant coefficient, \$0.66, indicating that in this age cohort the parental ownership status significantly affects their homeownership (Dawkins, 2009). The coefficients turn positive as age of owners increases with higher mortgage burdens. It again turns negative with the cohort of 60-64, though positive with age group of 75 and over. Percentages of mortgage

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<sup>8</sup> A survey by Carasso (2007) shows that elder homeowners tend to have very low level of housing loan burdens while the net values of their housing units are also smaller than younger cohorts. Painter and Lee's (2009) estimation provides that elder transition from owner to renter is neither driven by cost factors nor increases their cost burdens.

<sup>9</sup> Census 2000 does not include the institutionalized population as renters, but the rental units with nursing services have been emerging in these decades and may include rental units. Investments in elder housing units have been increased with REITs from the late 1990s, comparable to the behaviors of general housing market (Eichholtz et al., 2007).

usage rate, which will be highly correlated with income, race and education, have negative effects on local ownership costs.

**Table 3: Estimation for tract-level median rent with the characteristics of rental and owner properties and geographical characteristics**

Italic: not significant at 5%.

rent50	Coef.	Std. Err.	medocost_mor	Coef.	Std. Err.
rblack	-41.381	3.983	oblack	65.402	4.352
rnative	-123.293	14.285	onative	-183.315	17.443
rasian	119.884	11.042	oasian	-57.791	13.402
rothers	-55.590	12.526	<i>oothers</i>	44.946	32.836
rhispanic	-94.714	9.119	ohispanic	-68.635	11.948
vacrent	50.502	7.044	vacsale	104.154	15.179
rattach	-26.682	6.156	oattach	-57.638	5.935
runit2_4	-83.803	4.508	ounit2_4	154.452	10.344
runit5_50	-86.061	4.578	ounit5_50	97.692	9.837
<i>runit50_</i>	5.527	6.294	ounit50_	212.311	18.911
runitothers	-145.755	6.095	ounitothers	124.728	6.074
rsize	10.524	1.208	osize	22.243	2.329
medrentroom	74.399	1.100	medownroom	44.308	1.330
rentyear	2.507	0.058	ownyear	0.940	0.066
rentmoved	16.323	0.396	ownmoved	3.938	0.259
renter_24	-72.712	9.705	owner_24	-66.445	30.319
renter_34	-66.286	7.652	<i>owner_34</i>	0.389	14.142
<i>renter_44</i>	-14.704	7.942	owner_44	35.539	13.582
<i>renter_59</i>	-17.108	12.560	<i>owner_59</i>	28.188	18.364
renter_64	-87.549	14.683	owner_64	-45.323	19.327
renter_74	-194.331	11.365	owner_74	-51.627	15.541
renter_84	-67.015	11.514	owner_84	45.793	17.493
renter85_	566.336	14.672	<i>owner85_</i>	14.563	27.968
value50k	0.265	0.012	value50k	2.118	0.013
<i>pmort</i>	1.947	6.128	pmort	-34.878	7.305
medtaxk	-4.935	1.116	medtaxk	110.312	1.221
powner	-173.811	6.504	powner	-86.260	7.033
pop	-1.075	0.275	pop	-1.474	0.297
popden	1.024	0.270	popden	1.903	0.297
urbanclu	-28.147	2.788	urbanclu	0.595	3.403
urb	75.057	2.965	urban	-2.228	3.197
ruralfarm	-288.626	27.014	ruralfarm	76.594	28.900
ethnicvar	8.567	4.453	ethnicvar	-37.773	4.820
depend_k	-286.807	14.659	depend_k	-185.742	16.795
elder	76.268	14.207	elder	-88.286	16.387
foreign	138.646	10.349	foreign	151.385	11.329
workcounty	-40.630	5.192	workcounty	-13.839	5.652
meantravel	-0.479	0.195	meantravel	0.172	0.213
pubtran	11.826	13.309	pubtran	-23.124	14.605
colenroll	25.801	11.017	colenroll	11.522	11.399
meaneduyear	9.923	1.603	meaneduyear	-11.730	1.750
unemp	69.620	15.802	unemp	-13.932	17.236

**Table 3 (cont.)**

meanhhik	3.584	0.094	meanhhik	4.189	0.110
gini	-668.968	17.874	gini	315.822	19.189
manag	58.217	13.891	manag	-5.537	15.188
const	-30.868	20.656	const	-123.580	22.519
prod	89.967	16.242	prod	-105.081	17.771
farm	101.145	44.927	farm	-212.243	48.618
service	11.071	16.478	service	-132.958	18.035
pre1969	37.602	14.118	pre1969	193.671	19.795
movein70s	-51.196	13.138	movein70s	-156.867	17.090
movein80s	-90.654	10.855	movein80s	-108.438	12.863
_cons	-37208.650	790.100	const	-9367.652	535.8823
F(2982, 55167) = 4.800			F(2982, 55167) = 3.602		
F( 41, 55178) = 1639.38			F( 52, 55167) = 7032.45		
Prob > F = 0.0000			Prob > F = 0.0000		
R-squared = 0.8369			R-squared = 0.9439		
Adj R-squared = 0.8280			Adj R-squared = 0.9408		

### 5.1.2 Geographical effects

In Table 3 the sign of local homeownership rate (powner) is negative and gives stronger effects on rental prices, indicating that tracts of higher ownership costs tend to have lower demands and lower mobility in population. It also pulls down owner costs with a lower magnitude. Meanwhile, geography effects, taking rural nonfarm tracts as a control, show that median rental price is higher in urban but not rural farming areas, while ownership cost indicates some premium in rural farming area. This point will be explored further in subsequent estimations in which the effects of homeownership rates are compared across different geographical settings.

While the proportions of each minority group have specific effects on property costs, degree of ethnic variation (ethnicvar) gives a negligible but significant effect. It increases median rents but decreases ownership costs, possibly with the disamenity in highly heterogenous population area. The percentage of dependent age groups and elderly population decreases ownership costs, while the elder population effect increases median rent by some significance (1% increase in population of age 65 or more increase rent by \$2.4). This possibly accompanies with highly valued amenities of the area that attract both working age and elder populations that include both renters and owners.

In terms of proximity to work, the percentage of workers commuting within the county decreases both rent and owner costs, and mean travel time increases ownership costs. Percentage of commuters using public transportation increases rent by some power (\$0.34 for a 1% increase) but decreases ownership costs. All these results show the

outcome of urban sprawl in the last decades driven by significant negative preferences for the disamenities of locations closer to workplaces, often in urban centers.

College enrollment rates (colenroll) and average years of education (meaneduyear) both have strong rent coefficients, while on homeowner costs neither is significant in magnitudes. Local unemployment rates (unemp) are also an increasing factor for local rent, may similarly be caused by the possibilities of getting employment.

While average income (meanhhik) shows coefficients of similar degree (\$4.77 increase in rent and \$4.19 in owner cost with a 1% increase in average income), the Gini coefficient (gini) gives far stronger results both in ownership costs and rent (0.1 increase in Gini leads to \$6.9 decrease in rent but \$3.1 increase in owner cost). While local heterogeneity in income affects positively on ownership cost by the heterogeneity in property value and characteristics, a negative effect on rent shows that income heterogeneity is a strong negative disamenity of the location for renter. This is possibly because renters tend to be in lower income groups within the tract, and in these areas the rental markets are inactive where only low income renters are occupying the units.

Occupation of the local population gives clear distinctions between rent and owner cost. Controlled by percentage of sales industry workers, all coefficients of owner cost equation are nonsignificant or strongly negative, while mostly positive in rent equations. This indicates that sales industry can be considered as amenity, while for the renters who



may have stronger interest in local employment the other industries could activate the local rental markets.

Lastly, the effects of residential mobility (controlled by the percentage of population moved in during 1990s) are similar in both equations but stronger in owner cost function. The proportion of residents with more than 30 years tenure (movein1969) increases the rent and owner cost, indicating that the retirement migrations are less frequent due to possibly high level of amenities of the location. Meanwhile, the proportion of more recent arrivals (movein70s and movein80s) has negative values. For both rental and sales markets, these periods were when the urban sprawl and new developments of suburban residences were prominent, providing cheaper housing than the decades before, while owner costs are cheaper for the residents due to the lower mortgage usage rates and the lower total debts with longer residence periods than the movers in 1990s.

## **5.2 Simultaneous equation result: rent and owner cost interaction**

Using the same specification in Table 3, Table 4 shows simultaneous equation result on median monthly rent and median ownership cost at tract level. The coefficients of each equation do not change much both in sign and magnitude, indicating that these two markets are primarily independent in each location. The rent effect on ownership cost is weak but reasonable. A \$100 increase in monthly rent reduces ownership cost by \$10, while a \$100 increase in monthly ownership cost decreases rent by \$34.6.

**Table 4: Simultaneous equation result on rent and ownership cost***Italic: not significant at 5%.*

rent50	Coef.	Std. Err.	medocost_mor	Coef.	Std. Err.
medocost_mor	-0.346	0.021	rent50	-0.101	0.009
rblack	-44.598	3.725	oblack	27.249	3.739
rnative	-105.545	12.449	onative	-132.247	13.879
rasian	161.077	11.534	<i>oasian</i>	14.444	12.001
rothers	-20.536	12.476	oothers	147.870	28.536
rhispanic	-45.946	7.942	ohispanic	-21.806	9.215
vacrent	-35.652	7.002	vacsale	105.717	14.284
rattach	22.951	5.857	oattach	-44.335	4.582
runit2_4	-37.414	4.276	ounit2_4	103.411	8.932
runit5_50	-69.783	4.334	ounit5_50	60.594	9.000
runit50_	19.085	6.278	ounit50_	222.447	17.938
runitothers	-112.336	6.253	ounitothers	96.280	5.525
rsize	19.423	1.241	osize	17.361	2.137
medrentroom	61.219	1.105	medownroom	37.748	1.146
rentyear	2.419	0.055	ownyear	1.334	0.058
rentmoved	13.644	0.418	ownmoved	3.140	0.247
renter_24	-154.722	10.023	owner_24	-168.495	28.564
renter_34	-85.263	7.953	owner_34	-92.912	13.108
<i>renter_44</i>	-5.410	8.281	<i>owner_44</i>	-2.682	12.806
<i>renter_59</i>	-7.403	13.138	owner_59	38.981	17.495
renter_64	-98.339	15.312	<i>owner_64</i>	-19.904	18.295
renter_74	-203.014	11.855	<i>owner_74</i>	-23.135	14.538
renter_84	-99.857	11.904	owner_84	86.971	16.473
renter85_	495.044	15.447	owner85_	75.965	26.435
value50k	1.338	0.049	value50k	2.393	0.010
pmort	155.146	6.530	pmort	120.231	6.490
medtaxk	42.029	1.985	medtaxk	89.400	0.698
powner	-254.787	7.202	powner	-183.842	6.624
pop	-2.330	0.292	pop	-2.553	0.289
popden	0.797	0.275	popden	3.033	0.272
urbanclu	42.175	3.081	urbanclu	10.768	3.076
urban	81.252	2.721	urban	23.856	2.788
ruralfarm	-364.147	24.104	ruralfarm	-19.229	23.620
ethnicvar	52.057	4.326	ethnicvar	27.738	4.141
depend_k	-326.938	15.323	depend_k	-103.051	16.314
elder	199.484	14.704	elder	32.976	16.334
foreign	418.353	11.164	foreign	307.326	10.232
workcounty	26.941	3.263	workcounty	15.797	3.269
meantravel	6.635	0.187	meantravel	5.618	0.164
<i>pubtran</i>	1.547	11.288	<i>pubtran</i>	-36.275	11.780
colenroll	123.354	12.317	colenroll	95.144	11.270
meaneduyear	-3.723	1.623	meaneduyear	-22.739	1.582
unemp	148.681	17.116	unemp	58.565	17.124
meanhhik	6.372	0.163	meanhhik	5.795	0.115
gini	-662.838	20.240	gini	134.472	21.025
manag	-105.238	14.676	manag	-56.112	14.665

**Table 4 (cont.)**

const	-169.403	21.922	const	-186.689	21.440
prod	-263.567	16.067	prod	-317.684	14.870
farm	-111.319	41.186	farm	-381.736	40.078
<i>service</i>	-12.976	17.186	service	-172.881	16.735
pre1969	274.815	14.374	pre1969	399.347	18.562
<i>movein70s</i>	-24.923	15.048	movein70s	-86.259	16.713
<i>movein80s</i>	-4.993	11.942	movein80s	-39.965	12.662
_cons	-31704.750	833.551	_cons	-8580.103	511.924

Equation	Obs	Parms	RMSE	R-sq	chi2	P
rent50	58202	53	129.2469	0.7622	197562.55	0.0000
medocost_mor	58202	53	127.6995	0.9326	804154.3	0

Instrumental Variables: proportions of rental or sale units (vacrent, vacsale), median size (rentsize, ownsize) and moved in years (rentmoved and ownmoved).

The larger effects of owner cost on rent could be explained through several observations. First, in an area of high ownership demands with better location amenities and higher rent, the percentage of owners with down payments tends to be higher so the average owner costs for the locations will correspondingly be cheaper. As in Table 3, most location amenities are shared indifferently between the residents of rental and owner-occupied properties, and the homeowners in high rent areas pay rather cheaper average monthly owner costs than ones in lower rent areas, provided the other characteristics are identical. This observation is consistent with the reported characteristics of first-time low-income owners in 1990s who tend to rely heavily on mortgage loans with lower down payments.

Regressions in Table 5 give mixed findings to support this viewpoint. The dependent variables are usage rate of primary and secondary mortgages, and cost-to-income percentage of homeowners, explained by the same specification with ownership costs. Local median rent is not significant for the mortgage usage rates<sup>10</sup>, and has only negligible effects on the cost-to-income ratio of current owner-occupants (\$100 increase in median rent increases cost-to-income ratio only by 0.09%), showing that local rent will not change the choice of potential owners to live in the location.

A second explanation is that rental markets are relatively tight where owner residents are stable and remain in the area long enough to refinance most debts related to housing. The

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<sup>10</sup> The sign and significance of estimated parameters for primary and secondary mortgage usage rates are broadly similar. The variable for secondary mortgages (pc2mort) is therefore dropped from further analysis.

longer residence indicates lower average mortgage related cost, shown in the negative sign, although the amenities of the areas are valued both with renters and owners living there longer. The potential sources for tight rental market through owners' decision include non-market controls on rental market such as zoning policies, and the owner residents of such communities may have incentives to initiate restrictions to maintain the quality of communities.

The strongly negative coefficients of homeownership rates on owner costs (Table 3 and 4) partly support this view, while the Tables also indicate that higher homeownership rates actually reduce local rent. This could not be merely as a result of geographical separation between rental and owner areas due to urban sprawl. Tables 3 and 4 shows that both rent and owner costs are significantly smaller where percentage of populations moving in 1970s and 80s are larger, while the percentage of pre-1969 residents increases both. Both rent and owner costs rise with newer property and shorter tenure.

**Table 5: Estimation of mortgage usage rates and percentage of owner cost to the owner's income**

Italic: not significant at 5%.

	pcmort		pc2mort		costpinc	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
rent50	<i>0.00001</i>	0.00024	<i>-0.00003</i>	0.00019	0.00090	0.00011
oblack	7.067	0.251	1.281	0.205	1.162	0.120
onative	-34.659	1.006	-13.059	0.820	<i>0.632</i>	0.480
oasian	-7.413	0.701	-5.386	0.571	<i>-0.428</i>	0.334
oothers	12.107	1.911	<i>1.468</i>	1.557	<i>0.725</i>	0.911
ohispanic	-6.447	0.685	-2.769	0.558	<i>-0.212</i>	0.327
vacsale	-7.858	0.881	-7.075	0.718	<i>0.114</i>	0.420
oattach	-2.237	0.346	-3.022	0.282	0.344	0.165
ounit2_4	2.609	0.603	<i>-0.694</i>	0.491	4.568	0.288
ounit5_50	1.244	0.573	3.198	0.467	1.114	0.273
ounit50_	3.907	1.102	2.426	0.898	<i>-0.801</i>	0.525
ounitothers	<i>-0.556</i>	0.354	2.178	0.288	-1.204	0.169
osize	1.330	0.135	0.698	0.110	<i>0.030</i>	0.064
medownroom	<i>-0.010</i>	0.077	1.033	0.063	<i>0.048</i>	0.037
ownyear	0.073	0.004	0.021	0.003	<i>-0.003</i>	0.002
ownmoved	0.316	0.015	-0.044	0.012	<i>-0.009</i>	0.007
owner_24	-24.938	1.764	-16.908	1.437	<i>1.103</i>	0.841
owner_34	3.928	0.822	-2.314	0.670	<i>-0.223</i>	0.392
owner_44	3.338	0.790	<i>-0.351</i>	0.644	0.974	0.377
owner_59	-9.915	1.069	-3.410	0.871	<i>-0.797</i>	0.510
owner_64	-23.214	1.122	-7.768	0.914	3.254	0.535
owner_74	-38.876	0.890	-14.006	0.725	1.281	0.424
owner_84	-51.533	0.995	-16.172	0.811	4.123	0.474
owner85_	-56.159	1.612	-14.326	1.314	11.937	0.769
value50k	-0.008	0.001	-0.002	0.001	-0.002	0.000
medtaxk	0.529	0.071	<i>0.074</i>	0.058	0.651	0.034
powner	2.385	0.409	<i>0.295</i>	0.333	2.413	0.195
pop	0.055	0.017	0.039	0.014	-0.083	0.008
popden	0.084	0.017	<i>0.015</i>	0.014	0.068	0.008
urbanclu	4.595	0.198	1.699	0.161	0.185	0.094
urban	4.700	0.186	1.464	0.152	<i>0.181</i>	0.089
ruralfarm	5.455	1.684	-6.143	1.373	<i>1.507</i>	0.803
ethnicvar	1.481	0.273	-1.308	0.222	<i>-0.577</i>	0.130
depend_k	-4.925	0.977	-4.351	0.796	<i>0.153</i>	0.466
elder	-10.277	0.957	-7.089	0.780	-3.486	0.457
workcounty	-0.620	0.329	<i>-0.303</i>	0.268	<i>-0.201</i>	0.157
meantravel	-0.072	0.012	<i>-0.003</i>	0.010	<i>0.011</i>	0.006
pubtran	<i>1.050</i>	0.851	-1.640	0.694	-2.051	0.406
colenroll	-4.497	0.665	-3.047	0.542	-1.612	0.317
meaneduyear	0.810	0.102	0.293	0.083	-0.297	0.049
unemp	-3.579	1.000	<i>-1.306</i>	0.815	<i>-0.733</i>	0.477

**Table 5 (cont.)**

meanhhik	-0.040	0.007	<i>0.008</i>	0.005	-0.043	0.003
gini	-17.080	1.145	<i>0.958</i>	0.933	6.235	0.546
manag	-10.258	0.881	-6.277	0.718	1.042	0.420
const	-13.568	1.303	-5.892	1.062	<i>0.135</i>	0.621
prod	-15.853	1.029	-10.141	0.838	<i>-0.045</i>	0.491
farm	-48.923	2.806	-17.238	2.287	<i>0.417</i>	1.338
service	-12.397	1.041	-6.209	0.848	1.247	0.496
pre1969	-38.236	1.140	-9.753	0.929	-3.871	0.544
movein70s	3.487	0.995	6.388	0.811	-4.960	0.474
movein80s	2.241	0.749	5.016	0.610	-1.599	0.357
const	-683.945	31.189	62.300	25.419	35.920	14.872
county-level control F =		7.907		7.64		1.063
F( 51, 55168) =		1535.08		250.91		86.36
R-squared =		0.7844		0.52		0.2439
Adj R-squared =		0.7725		0.4936		0.2023

Table 6 is the OLS result explored the effect of owners' characteristics on median rent, giving some support for the hypothesis above. Proportions of owner's age shows strong U-curve on median rent, indicating that rents are higher where larger fractions of owners are away from the prime age group of home purchasers. Owner's moving-in year has negative coefficients, while earlier moving-in years of general population also has negative effects. Although multicollinearity could influence the accuracy of age effects, the age structure, especially of elderly population, may have strong effects on the local rent determination. This shows that newly developed locations for housing units have relatively lower median rent than that in older places.

On the other hand, the spatial mismatch hypothesis explains that high-demand rental units nearby will reduce the values of owner-occupied housing units (Hilber, 2005). Higher local rent implies that the location is attractive for potential renters and may tend to have shorter renewal periods for rental contracts, causing turnover in the local population. This observation also implies that local rental units, including urban public apartments and boarding houses for students and temporary workers, will be a source of disamenity for local homeowners. While they are living in the same community and sharing geographical amenities of the location, the renters and homeowners tend to have different household, demographic and socio-economic characteristics.



**Table 6: Owner characteristics on rent determination**

Italic: not significant at 5%.

rent50	Coef.	Std. Err.
oblack	88.661	6.678
onative	80.567	25.850
oasian	-80.644	14.272
oothers	165.780	31.138
ohispanic	52.072	12.610
<i>vacsale</i>	3.344	14.597
oattach	68.494	6.145
ounit2_4	64.842	10.365
ounit5_50	40.598	9.326
ounit50_	-63.699	17.727
ounitothers	52.108	6.578
<i>osize</i>	3.760	2.224
medownroom	-16.254	1.269
ownyear	-1.305	0.071
ownmoved	-1.890	0.242
owner_24	88.403	28.174
owner_34	34.296	13.160
owner_44	33.028	12.657
<i>owner_59</i>	-6.698	17.066
<i>owner_64</i>	6.935	17.913
<i>owner_74</i>	-19.665	14.301
<i>owner_84</i>	-12.403	15.994
owner85_	45.694	25.820
value50k	0.248	0.012
medtax	-0.004	0.001
powner	-153.953	7.527

F( 66, 55153) = 1245.14

Prob &gt; F = 0.0000

R-squared = 0.8333

Adj R-squared = 0.8241

Other variables used in Table 3 are omitted for notation but still included in estimation.

### **5.3 Simultaneous determination process on homeownership rate, rent and ownership cost**

Table 7 is the result of simultaneous equation estimations in which homeownership rates, median rents and median ownership costs are endogenous for each equation.

Homeownership rate (pcowner) is included as exogenous variables for the other two equations, shown as a local market condition. In the market, homeownership rate is more likely to be exogenous where the community is more stable and the owner market is less active, while it is highly endogenous where the population is less stable both in renter and owner markets.

The effects of rent, owner cost and homeownership rate are all negative with each other, and this shows that the demographic and geographical factors play a greater role in increasing homeownership rates than housing prices, since a higher local ownership rate will reduce rent and ownership cost, though the higher homeownership rates will be the result of more affordable market conditions through the decades. The influence of homeownership rate on rent and owner cost equations (around \$5 for a 1% increase in ownership rate), can generally interpreted as market tightness within the area, show that in higher owner areas the available units are in high demand for their amenities controlled by other variables.

The coefficients of the homeownership rate equation are the same in previous research (e.g. Coulson, 2002). It shares signs with the ownership cost equations with respect to an location. For example, urban cluster tracts (urbanclu) have both lower owner cost and

lower ownership rate, reducing each by \$24 and 9.55% when the tract is 100% urban cluster. Meanwhile, the effects of rent and ownership cost on homeownership rates are stable. A \$100 increase in median ownership costs reduces local ownership costs by about 2% in the specification, while it reduces median rent by \$38. The effects of increase in median rent by \$100 decrease homeownership by 1%, about a half of the effect that ownership cost gives.

**Table 7: Estimation on determinants of homeownership rate**

*Italic: not significant at 5%.*

Proxy variables in rent and owner cost equations are the same in Table 4.

pcowner	Coef.	Std. Err.	rent50	Coef.	Std. Err.	medocost_mor	Coef.	Std. Err.
medocost_mor	-0.020	0.000	rent50	-0.386	0.020	medocost_mor	-0.386	0.020
rent50	-0.011	0.001	medocost_mor	-5.008	0.071	pcowner	-5.338	0.064
pop	0.340	0.021	pcowner	-1.397	0.292	pop	-1.112	0.288
popden	-0.076	0.020	pop	0.564	0.275	popden	2.517	0.271
urbancclu	-9.556	0.221	popden	17.033	3.077	urbancclu	-24.962	3.065
urban	-10.742	0.191	urbancclu	51.889	2.713	urban	-17.389	2.770
ruralfarm	-41.993	1.765	urban	-460.652	24.091	ruralfarm	-169.753	23.594
ethnicvar	-2.395	0.292	ruralfarm	43.897	4.315	ethnicvar	16.489	4.125
depend_k	45.600	1.029	ethnicvar	-204.685	15.289	depend_k	69.854	16.163
elder	67.833	0.883	depend_k	365.437	14.645	elder	275.756	16.098
foreign	-11.845	0.627	elder	376.173	11.108	foreign	240.282	10.125
workcounty	4.006	0.245	foreign	36.191	3.262	workcounty	28.937	3.266
meantravel	0.450	0.012	workcounty	7.572	0.186	meantravel	6.814	0.164
pubtran	-22.772	0.824	meantravel	-56.444	11.278	pubtran	-118.476	11.724
colenroll	15.516	0.811	pubtran	161.551	12.290	colenroll	144.117	11.237
meaneduyear	-1.937	0.115	colenroll	-8.238	1.621	meaneduyear	-27.867	1.578
unemp	-15.866	1.254	meaneduyear	103.101	17.102	unemp	-5.159	17.085
meanhhik	0.934	0.007	unemp	8.545	0.161	meanhhik	8.770	0.113
gini	-80.848	1.491	meanhhik	-850.006	20.168	gini	-167.058	20.909
manag	-8.081	1.091	gini	-122.600	14.670	manag	-81.535	14.647
const	34.469	1.547	manag	-77.696	21.881	const	-46.859	21.370
prod	-6.740	1.089	const	-271.984	16.021	prod	-318.367	14.841
farm	25.700	2.983	prod	-46.444	41.137	farm	-261.577	40.032
service	-18.668	1.233	farm	-59.687	17.162	service	-228.889	16.704
pre1969	29.039	0.885	service	340.020	14.322	pre1969	473.210	18.236
movein70s	39.691	1.024	pre1969	75.331	15.007	movein70s	63.876	16.552

**Table 7 (cont.)**

Equation	Obs	Parms	RMSE	R-sq	chi2	P
movein80s	39.606	0.843				
movein80s			94.522	11.922	106.474	12.580
rblack			-43.118	3.675	26.222	3.611
rnative			-104.098	12.278	-123.074	13.405
rasian			153.252	11.441	10.952	11.660
rothers			-15.629	12.409	142.003	27.790
rhispanic			-45.329	7.874	-20.219	8.946
vacrent			-36.597	6.966	97.774	13.907
rattach			23.699	5.810	-39.354	4.447
runit2_4			-36.253	4.252	98.028	8.678
runit5_50			-68.246	4.312	57.472	8.767
runit50_			20.138	6.246	206.324	17.471
runitothers			-108.219	6.207	91.252	5.359
rsize			19.246	1.235	16.684	2.080
medrentroom			59.511	1.099	34.518	1.111
rentyear			2.352	0.055	1.218	0.056
rentmoved			13.207	0.416	2.878	0.241
renter_24			-155.727	9.978	-157.273	27.847
renter_34			-84.140	7.920	-86.252	12.778
renter_44			-4.877	8.248	-0.738	12.485
renter_59			-6.937	13.085	36.222	17.060
renter_64			-95.758	15.251	-18.165	17.839
renter_74			-199.949	11.807	-20.740	14.171
renter_84			-99.033	11.853	82.938	16.052
renter85_			480.391	15.374	73.163	25.770
value50k			1.298	0.048	2.216	0.010
medtaxk			40.796	1.953	82.807	0.675
pcmort			1.502	0.064	1.113	0.063
_cons	67.240	1.864	-30539.34	829.398	-7611.744	498.397
pcowner	58202	27	9.735	0.785	218614.8	0.000
rent50	58202	53	133.338	0.747	199632.7	0.000
medocost_mor	58202	53	133.469	0.926	810184.5	0.000

## **6. Discussions of occupier and geographical attributes**

Chapter 2 reviewed the literature on primary factors associated with the general homeownership rates. The estimation results show that the homeownership rate is more of a function determined by demographic and geographical factors than the rental and owner costs, and discussion of each of the factors is pertinent to analyze the determination processes of local rent, owner cost and homeownership rates. The discussion below is for each of the variables considered in Chapter 2 on the summary of effects and potential changes that will be caused by significant quantitative changes of specific conditions.

### **6.1 Composition of minority population and its heterogeneity**

The proportion of minority population within a tract is a primary determinant of local ownership cost compared to rent. Controlled for owner and community characteristics, a larger percentage of ethnic minority groups positively affect ownership cost. The coefficients of black, others and Hispanic groups are larger in relative terms in the ownership cost equation, while for Asian and Native American populations the rent equations have higher estimated coefficients. This demonstrates that the locations with higher minority population, especially of lower income groups, may experience higher transition cost for homeownership and may have significant default risks in adverse financial conditions.

When other conditions are identical, an additional 1% black population adds about \$0.8 per month to homeownership costs for each household (Table 7). In similar way, an additional 1% of Hispanic households costs \$0.25 per month, while for Asian households homeownership becomes a cheaper by about \$14 per household month.

Higher numbers in each ethnic group also increases local ethnic variety (*ethnicvar*), which has a higher coefficient in the rent equation than in the owner cost estimation. The difference in coefficients between markets may be coming from mortgage premiums due to the lack of financial resources among specific ethnic groups, while the smaller effects of ethnic variation in owner the cost equation may be associated to the general disamenity in higher heterogeneity. Percentage of foreign-born population (*foreign*) gives stable positive coefficients on both costs but negative coefficients on homeownership rates (1% increase in foreign-born citizens reduces homeownership by about 0.1-0.2%), as reported in other research.

## **6.2 Income and property tax rates**

Income effects are stable in all endogenous estimations above, supporting the argument of amenity theory, in which wage income is a primarily determined by local amenities (controlled by other variables) and controls household residential choice. In Tables 4 and 7 income effect on ownership cost is about twice of that on rent, consistent with the ratio of average median owner cost to median rent across tracts. This contrasts Table 3, where

renters and owners have income effects of the same level on prices (\$4 per month by an increase in \$1000).

Income heterogeneity (gini) is a strong negative factor on monthly median rent, while the effect on ownership cost is only marginal. Increasing the local Gini coefficient by 0.1 leads to a decline in median rent by about \$85 and homeownership rate by about 8%. This is not very consistent with the effects of unemployment rates (highly positive only in rent, negative for ownership rate and cost). While a higher Gini (including homeowners) implies higher proportion of low income residents, areas where the economy is relatively unstable have higher demand for rental property, controlled by other factors. This result is more likely associated with financial affordability than the effect of heterogeneity.

Median tax payments have positive effects both on rent and owner cost. Annual property tax payments (medtaxk) affect monthly rent and owner cost by \$41 and \$83 per \$1,000/year. Higher property tax payments (comparable to mean income) also increase the local rent by about \$490 per year, so in the areas of higher property tax rates rental occupation becomes a better alternative. For example, an extra \$80 caused by a \$1000 increase in annual property tax payment decreases local homeownership rate by about 1.0%<sup>11</sup>, granted that other conditions are the same.

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<sup>11</sup>  $-(82.8-40.8*0.871) *0.02+(40.8-82.8*0.614)*0.011$ , calculated from Table 7.



### **6.3 Community stability**

The proportion of residents who moved in prior to 1969 has notable effects on rent, ownership costs and homeownership rates, increasing each respectively by \$3.4, \$4.7, and 0.29% for each 1% increase of residents in this category. Though an increase in longer-term residents may reduce costs of ownership (due to refinancing periods), the higher coefficients indicate that residents of those communities are paying for amenities with extra costs. As well as the positive effects of more recent but still long-term residents (movein70s and movein80s), the results indicate that residential stability is a strong influence on local amenity, as suggested by social capital theorists. It is not true that the higher amenity values are correlated with large homeownership rates (since the effects of local homeownership rate on prices are generally negative). Also, the coefficients of occupier moved year (rentmoved and ownmoved) and built years (rentyear and ownyear) are significantly positive (\$1-3 per year), especially the year in which current renters were moved in (by around 13.8 per annum), indicating that active market conditions will reduce homeownership by increasing costs for both groups.

In the homeownership rate equation, the coefficients of movers in the 1970s and 1980s (about 0.39% increase for a 1% increase in each group) are slightly higher than for those who moved before 1969 (about 0.29%) and very different from those in the rent and ownership cost equations. This reflects that the locations having higher proportion of movers in the later periods are newly developed areas with relatively low historical or cultural values, while these places tend to be exclusively residential and relatively distant

from traditional city centers. The effects of mortgage rate are possibly absorbed in the age variables and not significant in the movers' effects on each of the dependent variables.

## **6.4 Household structure**

Age structure of the household takes the same curve in both specifications, indicating that in general terms the transition to homeownership for each age cohort does not affect local housing prices. Age groups around 40 to 50 pay the highest rent and owner costs in any of the results above, and the magnitudes are generally similar. The results demonstrate that age structure of renters is also an important factor in the local housing market, though this result does not reveal how the housing cost, which also progresses with age, affects household transition to homeownership.

A notable exception is the behavior of elder residents. The percentage of residents over 65 (elder) increases all housing costs and homeownership rates substantially (\$2.8-\$3.5 in costs, and 0.68% by 1% increase in population), while the effect has some recognizable differences in each market. For age cohorts of 60-84, the transition to homeowners reduces local housing costs by \$1 to \$2 with a 1% increase in any of the residents in these age groups, while age groups over 85 the costs are greatly higher in rentership, by around \$5 with 1% increase.

In general, a larger percentage of elder population correlates with higher rent and owner costs, while research on housing markets (Carasso, 2007) finds that the properties of elder owners have smaller values (and also smaller owner costs). The fact that elder populations tend to live in areas with higher housing costs may be applied to the rental market in which elder renters would have similar preferences as owners so tend to pay higher rents.

## **6.5 Mortgage condition**

The mortgage usage rate (pcmort) only marginally affects on median rent by increasing rent and owner cost by \$1-1.5 per month with a 1% increase in the loan application rate. While in the rental market this number is significant, in the owner cost equation the mortgage condition does not perform well. With the results in Table 5 in which the primary and secondary loan application rates are not well explained by owner characteristics, this result implies that the loan conditions itself are not a significant factor for local housing market behavior, especially when it is compared to the other two value-related variables (value50 and medtaxk) that show strong relations with median owner cost and rent.

A conclusion from the estimations above is that loan application rates are highly dependent on characteristics other than owner attributes, with local factors including housing costs and other factors. This means that in more liberated housing markets housing loans are more likely to be used for increasing options for location choice than

for improving housing conditions (transition to homeownership) within the locations when the other attributes are identical.

## 7. Summary and conclusion

This paper tries to address the question on geographical distribution in homeownership rate through the cost differential between ownership and rentership. Several findings are specifically obtained as results of large-scale estimation using Census tract data.

Geographical variation in homeownership rates, median rent and ownership costs could mostly be explained by various demographic, geographic and socio-economic variables. While local rent also negatively affects the local homeownership rate, its effect is about a half of that caused by owner cost and it is approximately the ratio between average rent and owner cost (Table 7). This observation indicates that when controlled by other factors, ownership decisions are primarily a domain of location choice in which potential homeowners sorted by the margin of prices between rental and ownership costs.

The behavior of each of these variables is largely consistent with previous research based on individual households, especially age, ethnicity, and income. Overall community factors including population density, Gini coefficient and travel time to work have some significant effects too, while on the category of resident occupation its effects are not clear. The estimations do not include perceived owner risk, but the fact that loan structure does not affect housing prices or homeownership rates much shows that they are not a significant factor in the location choice of household. Meanwhile, percentage of foreign born residents has large effects on rental prices and homeownership rates, typically

consistent with past research, indicating that knowledge of market practices takes a significant role for housing prices.

## **7.1 Discussion: implications for current housing market conditions**

Resident characteristics are the primary factors that determine both owner and rental costs at a given time, while location, at least at the Census tract level, determines who would take home loans and how much they might borrow. The weak loan-related variables suggest that the resident and location characteristics will be the primary drivers for the current housing crisis across locations. The plethora of studies on geographical heterogeneity of housing market since 2007 mainly focus on the macroeconomic conditions, but not many estimate the changes in residents and location characteristics, especially that of the past two decades, and its consequences in the near future.

In the early part of the decade, housing prices in the United States have rapidly increased to more than twice the level of that in late 1990s, while rents changed very little (only 4% from 1996 to 2006) throughout the period (Shiller, 2007; Mikhed and Zemčík, 2007). Studies of housing price change indicate that housing prices are strongly cointegrated before 2006, and the areas experiencing sharp increases in prices in the period also experienced sharp decrease since 2007. Total residential investments, which mostly consist of development of new housing or residential areas, have followed the same pattern (Case and Quigley, 2009).

These trends are not consistent with the estimated results in this paper, since the reported increase in house prices (including increase in loan burdens) should reduce local rent and ownership rate considerably. Though expectations of rising house prices, as well as its downward stickiness, are largely be attributed to the general cointegration since 2000, the real local factors such as household structures, increasing incomes and financial deregulations have surely been contributed to the trend (Case and Quigley, 2009). The local income effect in this period is partly shown in the negative effects of the unemployment rate in homeownership rate and owner prices, while proportion of the local population over sixty-five has taken a significant role in increasing costs of the housing market. Studies of FHA loans (Ambrose and Pennington-Cross, 2000; Jaffee and Quigley, 2007) show that loan initiatives are concentrated in the tracts of low- and middle- income and minority populations, and these occupier characteristics are consistent with the geographical trend in housing prices.

Due to the stagnant rental market through the period of rising homeownership, the reduction in loan burdens has contributed to the increasing homeownership through reducing owner costs. Rising elder populations have increased the homeownership as well as costs. A 1% increase in the ratio of elder population in a tract population will increase homeownership by 0.58%<sup>12</sup>, excluding the renter or owner specific effects on each of the costs.

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<sup>12</sup>  $(67.8-(365*0.011+275*0.02))*0.01$ .

## **7.2 Possibilities for research development**

This is the first research to explore location level housing prices and their distribution across the United States, focusing on the effects of local factors on price differentials in tenure choice. The methods used here may have potential to extend to the analysis of local trends in prices and other factors if data are available through different periods. However, the current deficiencies of the dataset harm the accuracy of the specific results in this paper. First, many variables are top- or bottom-coded, so the coefficients provided in the estimations may be biased even at the aggregated level. Also, large-scale research cannot provide the actual measures of specific local variables, and sample choices (like PSID) may not reduce this problem, unless the aggregate local factor is well integrated into the individual-level dataset. Second, this paper focuses only on local aggregate measures and does not look at the exact behavior of each demographic group of different correlation sets with other variables. Specific treatment is required to view more closely estimate how different groups react to the relative change in housing costs. Lastly, the variables used here do not employ socioeconomic variables that are widely used in other research, including marital status, which may somewhat undermine the interpretability of results here. More accurate measure of residential stability, as well as more attention to the geographical use value of housing units, could improve upon the approach.



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