Owned Now Rented Later? The Effect of Housing Stock Transitions on Affordable Housing and Market Dynamics

by

Stuart S. Rosenthal

Maxwell Advisory Board Professor of Economics
Department of Economics, Syracuse University
Phone: 315-443-3809
ssrosent@maxwell.syr.edu

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Abstract

This paper shows that own-to-rent housing stock transitions provide a long run source of affordable housing while slowing recovery following a shock. Based on multiple linked surveys for the United States, there is a 2 percent net shift of existing SFD housing into rental status with each passing decade. Short term transitions can be larger and exceed 10 percent for recently built homes following the 2007 crash. Short run effects also partly reverse as markets rebound, depressing new construction. At the MSA level, roughly 25 fewer single family permits are filed for every 100 own-to-rent transitions of recently built homes.

JEL Codes: R21, R3, E32
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I. Introduction

The need to ensure adequate supplies of affordable housing for lower income households continues to dominate housing policy debate.[1] At the same time housing market volatility is now widely recognized as an important driver of the macro economy and a primary cause of the great recession. This paper highlights an understudied feature of housing markets that contributes to both of these concerns. Based on multiple cross-sections of U.S. census data along with the American Housing Survey (AHS) panel, I document and explain a robust tendency for existing housing stock to shift from owner-occupied to rental status as homes age, increasing the supply of housing accessible to lower income families. A conceptual model and supporting evidence further suggest that short term own-to-rent housing stock transitions can reverse as prices rebound following a negative demand shock and likely have slowed recovery of housing construction in metropolitan areas hit hard by the 2007 housing market crash.[2] Some context will help to clarify.

Between 1994 and 2019, US homeownership rates experienced an historic boom and bust, jumping from 64 percent in 1994 to 69 percent in 2006, and then crashing all the way back down to 63 percent in the second quarter of 2016, a level not seen since 1965 (see Figure 1a).[3] Although home prices have rebounded in most markets, and homeownership rates have begun to move back up (Figure 1a), housing construction remains depressed. This is evident in Figure 1b which plots home price indexes and housing permit levels for the U.S. from 2000 to 2019. It is also apparent in prominent recent boom-bust markets like Atlanta, Miami, Las Vegas and Phoenix for which plots are displayed in Figure 1c. For each

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[1] Concern about the supply of affordable housing cuts across the political spectrum although proposed strategies differ. The Trump administration has recently emphasized relaxation of local regulations and building restrictions as a way to increase the supply of affordable housing while proposing to cut back on transfer programs (see "Trump Administration to Take on Local Housing Barriers" in the Wall Street Journal, June 25, 2019). Other strategies have including longstanding programs that subsidize construction, as with the Low Income Housing Tax Credit (LIHTC) program, or voucher-type programs such as Section 8 housing. There is a large literature on low-income housing, including recent papers by Quigley (2000), Olsen (2003), Sinai and Waldfogel (2005), Baum-Snow and Marion (2009), Eriksen (2009), Eriksen and Rosenthal (2010), and Diamond and McQuade (2019), to name just a few.
[2] A huge literature has examined household decisions of whether to own versus rent their home, and related patterns of aggregate homeownership rates (see Gabriel and Rosenthal (2005, 2015) for recent examples and Haurin, Herbert and Rosenthal (2007) for a review). The focus in this paper on the housing stock as opposed to households is new.
[3] Source: Current Population Survey/Housing Vacancy Survey, Series H-111, U.S. Census Bureau, Washington, DC 20233 (https://www.census.gov/housing/hvs/data/histtabs.html).

of these metro areas, housing construction remains at historically low levels despite sharp increases in home prices since roughly 2011. Modeling housing stock transitions helps to explain these patterns.

In considering these and other relationships, the paper makes a sharp distinction between long and short run transitions of the housing stock. Long run transitions are especially sensitive to age-related depreciation of the housing stock. These types of transitions are part of the filtering process by which markets generate affordable housing, both because lower income families mostly rent, and also because rental units filter down to lower income households at an accelerated rate (see Rosenthal (2014) for evidence). Short run transitions are especially sensitive to demand shocks that could contribute to rising house prices and increasing anticipated returns to investment, or falling house prices and mortgage defaults. These sorts of transitions can be reversed if market conditions return to earlier states, contributing to short run volatility in the market.

To guide the empirical work, I adapt the model of Henderson and Ioannides (1983) on housing tenure choice. In the Henderson-Ioannides framework, households are increasingly likely to own their home as their investment (portfolio) demand for real estate rises above their consumption (shelter) motive for occupying a home. Assuming that investment demand increases more quickly with income than does shelter demand, the model predicts that higher income families will tend to own while lower income families will tend to rent. An additional implication not previously emphasized is that higher quality homes tend to be sorted into the owner-occupied sector while lower quality homes will be concentrated in the rental segment of the market. Many aging homes, therefore, slowly shift from owner-occupied to rental status. In contrast, demand shocks shift the housing investment and shelter demand functions and can prompt large short-term movements of homes between the owner-occupied and rental segments of the market, as with the crash following 2007.

As noted above, two primary datasets are used to explore the frequency and causes of housing stock transitions. The first is the 2000 five-percent PUMS file of the decennial census along with each year of the 2005-2018 one-percent PUMS files of the American Community Survey (ACS).[4] These data are used to document trends in housing stock transitions at the national, metropolitan and county levels over the 2000 to 2018 period. Because the ACS files are separate cross-sections, I rely on a vintage strategy to estimate counts of housing stock transitions for specific vintages (e.g. homes built in the 1990s). For a given vintage of the housing stock, absent demolitions or vacancies, a change in the homeownership rate implies a shift of homes from one segment of the market to the other. Especially for recent vintage homes that are unlikely to be subject to age-related demolitions, this makes it possible to use observed changes in homeownership rates along with knowledge of the size of the housing stock to estimate the number of homes that transition between sectors.

The second data source is the 1985-2013 American Housing Survey (AHS) panel which is approximately representative of urban areas in the United States. The AHS follows individual homes every two years over the 1985-2013 period. Overall, the panel includes information on over 100,000 different homes, many of which are present for only a portion of the entire 1985-2013 period. The AHS includes an extensive array of structural and neighborhood attributes in addition to detailed information on the current occupants of the home. Importantly, the AHS panel follows individual homes over time making it possible to observe individual tenure transitions directly. In addition, the AHS contains a richer set of structural and neighborhood attributes relative to the ACS. Together, these features enhance the ability to highlight underlying mechanisms that drive short and long run housing stock transitions.[5]

Estimates confirm that long-term transitions of housing stock occur from the owner-occupied to the rental sector and also in reverse direction. However, the former dominate and are sensitive to aging of the housing stock. With each passing decade, on average there is a net transition of roughly 2 percent of

[4] PUMS data for these files are available from the Census website (www.census.gov) and also in a more user-friendly form from the IPUMS website (www.ipums.org). ACS samples in 2002-2004 have more limited geographic and variable coverage than in later years and are not used for that reason.

[5] Although many papers have been written with the AHS, relatively few have drawn on the panel structure of the data. Previous work with the AHS panel on which this paper is partly based includes Hoyt and Rosenthal (1997), Harding, Sirmans and Rosenthal (2003; 2007), Rosenthal (2014), Harding and Rosenthal (2016) and Harding et al (2019). Of these, Rosenthal (2014) is closest in content to this paper. In that paper the AHS panel is used to follow homes over time in order to determine the rate at which homes filter down to families of lower income status.

the existing single family detached housing stock into the rental sector.[6] Other work (Rosenthal (2014)) shows that rental units filter down more quickly to lower income families as compared to owner-occupied units, 2.5 percent decline in occupant real income per year compared to just 0.5 percent for owner-occupied units. Own-to-rent transitions therefore have direct and indirect effects that increase low-income access to affordable housing.[7]

Findings also indicate that short run transitions of housing stock can be much larger in magnitude and are sensitive to changes in housing prices, with rising prices drawing rental units into the owner-occupied sector and falling prices having the opposite effect. Between 2000 and 2016, roughly 6 percent of homes built prior to 2000 and 11 percent of homes built in the 1990s shifted from owner-occupied to rental status. Owner-occupied homes for which the current household is modestly under water (with CLTV[8] between 100 and 120 percent) are also 1 to 2 percentage points more likely to transition into the rental sector, while homes that are deep under water (with CLTV greater than 120 percent) are 6 to 8 percentage points more likely to transition. Additional analysis reveals that these transitions occur primarily for housing types for which there is ample demand in the rental market. In instances where an underwater property is of high quality to a degree that limits demand in the rental sector, transitions to the rental sector largely do not occur. Moreover, these patterns are nearly identical pre- versus post-financial crisis which suggests that the mechanisms governing such transitions were similar in both periods.

Returning to Figures 1b and 1c, a natural question in the post-2007 context is whether recent own-to-rent transitions act as a buffer stock of *potential* future owner-occupied housing and delay recovery of new construction for that reason. To address this question, annual data on single family housing permits are regressed on the number of single family own-to-rent housing stock transitions since 2006 along with controls for local home price changes, vacant units, year fixed effects and geographic

[6] The pattern is qualitatively similar but not as regular for SFA and MF housing. I emphasize SFD patterns here because SFD stock accounts for over 70 percent of the typical MSA in the sample.
[7] See also Brueckner and Rosenthal (2009) and Rosenthal (2008) for related discussion of the market provision of lower income housing and the role of age-related depreciation and filtering.
[8] CLTV (current loan to value ratio) above 1 indicates that the homeowner owes the lender more than the home is worth and is at risk of defaulting on its mortgage.

fixed effects. At the metropolitan level, estimates indicate that roughly 8 fewer single family permits are filed for every 100 vacant single family homes on the market. Analogous effects occur for own-to-rent stock transitions. Grouping all vintage homes together, roughly 3 fewer single family permits are filed for every 100 own-to-rent transitions, and roughly 25 fewer permits for own-to-rent transitions of homes built between 2000 and 2004. Modestly larger effects are obtained at the county level. These and other patterns in the paper confirm that own-to-rent transitions partly reverse as markets recover and act as a buffer stock of owner-occupied housing that undercuts pressure for new construction.

The next section outlines the conceptual framework described above. Section III describes key features of the data. Section IV documents shifts in housing stock between the owner-occupied and rental sectors of the market. Section V evaluates the drivers of housing stock transitions in the long and short run. Section VI presents the housing permits model and Section VII concludes.

II. Model: Sorting housing stock by quality

Figure 2 reproduces the housing tenure choice model from Henderson and Ioannides (1983).[9] Households have investment and consumption demands for real estate, both of which increase with income. In Figure 2, housing quality is plotted on the vertical axis while household income is on the horizontal axis. As drawn, both sources of housing demand are assumed to increase with income but consumption demand rises at a slower rate. That is because of the anticipated effect of diminishing marginal returns from housing consumption. On the other hand, at very low levels of income investment demand is assumed to fall to zero while consumption demand remains positive reflecting the need for a minimum level of shelter. Together, these assumptions suggest that the investment demand function crosses the consumption demand function from below at income level I*.

Consider now a household with income above I* so that investment demand exceeds consumption demand. Such families can optimize their portfolio by purchasing housing equal to investment demand. In principle, any additional housing above the preferred level of consumption can be

[9] An empirical test of the model is in Ioannides and Rosenthal (1994).

rented out. For families with income below I* consumption demand exceeds investment demand. In this case, owning a level of housing that would meet the family's shelter demand would require overinvesting in real estate from a portfolio perspective. For these reasons, families with income sufficiently below I* are expected to rent.

The model above implies that high income families will tend to own while lower income households will rent. This stratification was emphasized by Henderson and Ioannides (1983). The model in Figure 2 also points to a further pattern that has not received attention: high quality homes, those for which $h > h^*$, will tend to be in the owner-occupied sector while homes with quality below h^* will tend to be rented out. Although intuitive, this structure provides considerable guidance when modeling long and short run transitions of housing stock between the owner-occupied and rental sectors of the market.

Note again that housing quality depends on the structural attributes of the home and also the attributes of the neighborhood in which the home is located. Changes in these attributes affect perceptions of quality and shift a home up or down along the vertical axis. Holding the housing demand functions constant, sufficient change in quality will cause a home to transition between market sectors. As an example, age-related depreciation of the home will reduce quality and push owner-occupied units towards the rental sector (e.g. Rosenthal, 2014), but falling neighborhood crime rates that improve neighborhood appeal will increase neighborhood income (e.g. Lee and Lin, 2017) and work in the opposite direction. These sorts of transitions that reflect enduring changes in the quality of a home or its neighborhood are characterized as long run in nature.

Suppose instead that the perceived risk associated with investing in real estate increases. This was the case following the 2007 crash when lenders adopted sharply tighter underwriting standards. Absent other events, the investment demand function in Figure 2 would rotate down but the consumption demand function would not shift since consumption demand is not so sensitive to portfolio considerations. In equilibrium, I* would move to the right and h^* would move up causing owner-occupied housing stock to shift into the rental sector. A similar effect would arise from falling home prices that also characterized the post-2007 crash. For a given level of income, falling home prices cause consumption demand to shift up but likely reduce investment demand, a combination that would also cause I* to move to the right and *h** to move up. Prominent features of the post-2007 crash, therefore, drew housing stock from owner-occupied status into the rental sector of the market, consistent with the decline in homeownership in Figure 1. These changes could reverse if market demand and household income return back to previous levels. For that reason, these sorts of transitions are described as short run in nature.[10]

III. Data and measurement

3.1 Census and ACS files

The first data source used in this paper draws on the individual PUMS files for the 5 percent 2000 decennial census and each year of the 1 percent 2005-2018 American Community Survey (ACS). These files are all cross-sections and provide millions of records on individual households. Although the surveys are mostly representative of the US population, sampling weights are also provided to improve the representativeness of the data. In the empirical work to follow, I used household weights in all instances where the census/ACS data were used to summarize patterns in the US and individual metropolitan areas.

The ACS data provide extensive information on individuals and households. These data also report core features of the homes in which individuals reside, including structure type (e.g. single family versus multi-family), number of bedrooms, number of rooms, decade the home was built, and metropolitan location. Each survey is therefore not only a sample of the population of households in the United States but also of the stock of homes in which families live.

In the work to follow, I distinguish between three housing types, including single family detached, single family attached, and multi-family. Mobile homes are omitted. In addition, I create separate measures for each type of home for 8 different vintages. This includes homes built prior to 1940, homes built in the 1940s, 1950s, 1960s, 1970s, 1980s, and 1990s, as well as homes built 2000 to 2004. In all, there are 24 different type-by-vintage homes identified in each survey year.

[10] Although not represented in Figure 2, rising unemployment following the 2007 crash would have amplified the effects described above by increasing the number of households with income below a given level, such as I*.

In most of the empirical work to follow, location in the Census/ACS data is identified at the metropolitan level using the met2013 measure in IPUMS. Depending on the models being estimated, this is used to identify up to 290 metropolitan areas across the US on a consistent geographic basis over the 2000 to 2018 period. For each MSA, separate counts of homes are calculated for each type-vintage home in each survey year. This produces a vast amount of detail and is possible because of the large size of the census/ACS files.

A multi-step procedure is used to estimate the number of housing stock transitions between the owner-occupied and rental sectors of the market for each type-vintage home in each MSA for each survey year. The first step establishes a reliable base estimate of the size of the stock of type-by-vintage homes in each location. To do so, I pool data from across all of the 2000 to 2018 Census/ACS surveys noted above, adjusting weights to allow for the number and size of the different surveys to ensure a representative sample. Using this pooled and very large sample, for each type-by-vintage category, I calculate separate measures of the total number of each housing type in each metropolitan area. The number of type-*k*, vintage-*v* homes in location-*m* is then denoted $N_{k,v,m}$ for all combinations of *k, v,* and *m*.[11]

The second step creates accurate measures of the homeownership rate for each type-*k*, vintage-*v* home in MSA-*m* for each survey year-*t*, denoted $R_{k,v,m,t}$ for all combinations of *k*, *v*, *m*, and *t*. For this measure, I divide the number of owner-occupied type-*kv* homes in survey-*t*, location-*m* by the number of all occupied type-*kv* homes in survey-*t*, location-*m* (equal to the sum of owner-occupied plus renter-occupied units). It is worth emphasizing that this calculation is survey specific and is not based on the pooled sample described above. I adopt this approach because the homeownership rate is a sample mean and less subject to measurement error for that reasons (relative to the size of the housing stock above). This implicitly assumes that sampling variation will have similar percentage effects on the number of

[11] In practice, separate measures for each of the $N_{k,v,m}$ ($k = 1, \dots 3$; $v = 1, \dots, 9$; $m = 1, \dots, 290$) were calculated for each survey year applying survey-year sampling weights as noted above. Those measures were then averaged across survey years to produce a single pooled survey estimate for each $N_{k,v,m}$. Because the 2000 census and ACS surveys are separate cross-sections, pooling the data yields a massive sample that helps to ensure reliable measures of $N_{k,v,m}$.

owner-occupied and rental units when calculating type-by-vintage homeownership rates for each year and location, which helps to ensure accurate measures for $R_{k,v,m,t}$.

Step three multiplies $N_{k,v,m}$ and $R_{k,v,m,t}$ to form counts of the number of owner-occupied type-*kv* homes in survey-*t*, location-*m*, given by $N_{own,k,v,m,t} = N_{k,v,m} \cdot R_{k,v,m,t}$. Step four measures the number of housing stock transitions between survey years by differencing $N_{own,k,v,m,t}$ across surveys.

3.2 American Housing Survey Panel

The second data source used in this study are the national core files of the 1985-2013 American Housing Survey (AHS) panel. Each survey contains an extensive array of questions about the house, neighborhood, and occupants. The survey is designed to be approximately representative of the United States and yields a panel that is unique among major surveys in that it follows homes not people over time. The survey is conducted every odd year (e.g. 1985, 1987 ...) and collects data from occupants of roughly 55,000 homes. The exact number of units surveyed varies across years (see the Codebook for the AHS, April 2011 for details). As would be expected, many homes are not present throughout the entire panel but not in manner that is likely to bias estimates.[12]

The AHS data also identify whether a home is currently renter-occupied or owner-occupied and also whether a home changes tenure in a successive survey. These features make it feasible to directly measure the tendency for individual homes to transition between sectors of the market.

IV. The frequency of housing stock transitions

This section documents the frequency of housing stock transitions between the owner-occupied and rental sectors of the market based primarily on the 2000-2018 census/ACS data. Because of the

[12] The AHS is designed and implemented by the Department for Housing and Urban Development (HUD). Conversations with HUD officials confirmed that the composition of the AHS sample is adjusted over time to help ensure that it remains roughly representative of the U.S. For a succinct comparison of the sample design and coverage of the American Housing Survey (AHS), the American Community Survey (ACS), and the Current Population Survey (CPS) see http://www.census.gov/housing/homeownershipfactsheet.html. Additional details of the AHS sample design are provided in the codebook manuals listed in the reference section of this paper.

nature of the data and vintage approach, it is important to recognize that the estimates to follow reflect net changes in the market, allowing for both own-to-rent and rent-to-own transitions. This differs from analysis later in the paper where the focus is on mechanisms. For that portion of the analysis, estimates are based primarily on the AHS panel that follows individual homes over time, making it possible to document the direction of a given transition. As noted earlier, mobile homes are omitted from both samples so that all of the estimates to follow are based on just SFD, SFA and MF housing.

As a starting point, it is helpful to recognize that SFD housing dominates the market in most urban areas in the U.S. For the sample used in this paper, on average across MSAs, SFD, SFA and MF housing types comprise 71.8%, 5.2%, and 23.0%, respectively, of the housing market, omitting mobile homes.[13] The large share of SFD housing indicates that the aggregate frequency of own-to-rent transitions in the U.S. is especially sensitive to the propensity for transitions in that sector.

Consider now Figure 3 which plots average homeownership rates across MSAs for SFD, SFA and MF housing for each 2000-2018 survey.[14] Separate plots are provided for each structure type in panels A, B and C, respectively, each on its own left vertical scale. Each figure also plots the aggregate homeownership rate for the three structure types on the right vertical axes. Several patterns stand out.

The first pattern is well known: homeownership rates are high for SFD housing, with rates averaging roughly 86 percent over the 2000-2018 period. SFA homeownership rates are more moderate, averaging roughly 56 percent, and low for MF housing at roughly 9 percent. Also not surprising is that homeownership rates fell for all three structure types following the 2007 crash. Less well known, is that

[13] Alternatively, aggregating across all MSAs and sample years, the U.S. level shares for SFD, SFA and MF housing are, respectively, 62.9%, 7.2%, and 29.9%, similar to values reported by the US Census at https://www.census.gov/hhes/www/housing/census/historic/units.html . The smaller SFD share here (and higher MF share) relative to that above reflects the large number of small MSAs with high shares of low-density housing.

[14] Analogous to the procedure described earlier, separate homeownership rates were calculated for each structure type for each MSA-year record for SFD, SFA and MF housing. These were then averaged across MSAs in a given year and plotted in Figure 3. The aggregate homeownership rate in the figure was obtained by taking a weighted average of the three structure-type homeownership rates in each year based on the pooled sample (across years and MSAs). Alternative structure type weights calculated at the MSA-year level yield very similar aggregate homeownership rates but are more subject to sampling error and were not favored for that reason.

the volatility of homeownership rates over the 2000 to 2018 period differs sharply for the different structure types. This is especially apparent in Figure 4 where changes in homeownership rates since 2000 are plotted on a common vertical scale for all three structure types. Observe that MF homeownership rates fell about 1 percentage point between 2007 and 2012, a large change relative to the MF base level of 9 percent, but small in absolute terms. SFD homeownership rates were largely flat 2000 to 2006, and then fell roughly 3.5 percentage points 2007 to 2014 before beginning to move up in 2015. In comparison, SFA homeownership rates jumped up almost 4 percentage points 2000 to 2007, fell 6 percentage points between 2007 and 2013, and then rose 2 percentage points by 2018.

The patterns in Figure 4 hint at a general principle that will be confirmed later in the paper: homes are more likely to transition between ownership and rental status when there is sufficient demand for the attributes of the home in the alternate sector. This is evident in the patterns for SFA housing relative to the other structure types. SFA is a hybrid structure that provides single family housing opportunities in a high density form that includes a degree of shared infrastructure and communal space. These features likely contribute to demand for SFA housing in both the owner-occupied and rental sectors of the market, consistent with its intermediate homeownership rate and greater tendency to transition between sectors during the recent boom and bust in housing markets.

Consider next Table 1 which reports MSA level regressions for which the dependent variable is the log number of owner-occupied units present in each survey year for each MSA. Controls include MSA fixed effects that capture the influence of time invariant metropolitan attributes that affect propensity for homeownership (e.g. MSA income, size, price level, etc.). Also included in the regressions are survey year dummy variables with year 2000 as the omitted category. Specified in this manner, the survey year coefficients approximate the percentage change in owner-occupied units since 2000 and are the primary focus. T-ratios based on robust standard errors clustered at the MSA level are in parentheses.

Column 1 summarizes the net tendency for the aggregate stock of pre-2000 housing to transition towards the rental sector as homes age from 2000 to 2018. The point estimates indicate little net change from rent to own between 2000 and 2007 when prices were rising sharply (e.g. as in Figure 1a). With the onset of the 2007 crash, however, net transitions into the rental sector became pronounced. Relative to 2000, roughly 6 percent of the housing stock shifted into the rental sector by 2015 (with a t-ratio of 20). A similar magnitude pattern is evident for pre-1940s homes (column 3), while the pattern is even more pronounced for 1990s vintage housing (column 2), with a net shift of roughly 11 percent.

Columns 4-9 report analogous estimates by structure type and reveal an important difference. For SFD 1990s vintage housing (column 4), during the boom years of 2000 to 2006, on net about 1.4 percent of the stock transitioned into rental status (with a t-ratio of 4.5). Over this same period, 7.5 percent of SFA homes and 21.1 percent of MF homes shifted into owner-occupied status (columns 6 and 8, respectively), presumably drawn in by sharply rising home prices. Following 2006, all three structure types shift towards the rental sector but the shift was most pronounced for SFA and MF housing. Among 1990s vintage housing (columns 4, 6 and 8) and between 2006 and 2015, roughly 4.5 percent, 17.9 percent, and 25.9 percent of SFD, SFA and MF housing, respectively, transitioned from own to rental status. Thus, while own-to-rent transitions in the post-crash period were extensive for all structure types, the patterns were most pronounced among higher density housing that is more traditionally represented in the rental sector of the market.

Figures 5a and 5b conclude this section by summarizing the net number of homes that transitioned from own to rent in the post-crash years after 2006 (in 1,000 units). This is done restricting the sample to units that were built before 2000, prior to the start of the boom in U.S. housing markets. Figure 5a plots the net number of own-to-rent transitions for all structure types grouped together and also by structure type. It is evident that the largest number of transitions occurred in the SFD sector but SFA and MF housing also experienced large numbers of transitions despite their much smaller market share. Aggregating across structure types, between 2006 and 2014, nea;rly three million housing units shifted on net into the rental sector. This represents roughly 10 percent of the rental housing stock in 2015 and underscores the importance of market driven housing stock transitions as a source of rental housing.

Figure 5b provides complementary evidence that highlights extensive heterogeneity in own-to-rent transitions across MSAs during the post-crash period. For each year from 2007 to 2018, Figure 5b reports separate box and whisker plots, each of which summarizes the distribution of net transitions across MSAs since 2006. To conserve space, patterns are presented only for all structure types grouped together.[15] Similar patterns are present by structure type in Figure A-1 of the appendix. Note also that Panel A of Figure 5b includes dots for outlier MSAs beyond the whiskers while Panel B omits the outliers to facilitate viewing of the main part of the distribution.

In both panels of Figure 5b, the distribution of own-to-rent transitions clearly shifts down over time, indicating more transitions. As of 2015, the median MSA had experienced a net shift of roughly 4,000 own-to-rent transitions. For the 75th percentile MSA (the bottom of the box) the corresponding number of transitions is about 10,000. Notice also that the number of outlier MSAs with especially large numbers of own-to-rent transitions, some in excess of 100,000, also increased sharply over time.[16] Thus, while the number of post-2007 own-to-rent transitions was very large, it is important to recognize that there was extensive heterogeneity in the frequency of such transitions across MSAs.

V. Mechanisms

The evidence thus far shows that own-to-rent housing stock transitions are extensive and also that the number of housing stock transitions differs considerably across structure types, MSAs and over time. This section seeks to explain why, highlighting both long and short run mechanisms.

5.1 Aging housing

As suggested earlier, as homes age, they typically deteriorate, lowering quality and causing some owner-occupied homes to shift into the rental sector. Figure 6 provides evidence on this point using the census/ACS data. In Panel A, homeownership rates averaged across MSAs are plotted for SFD homes for

[15] In each plot, the top and bottom of the box represents the interquartile range (IQR), or the 75th and 25th percentiles, respectively. The horizontal line dividing the box into two vertical segments is the median of the distribution. The stems extend to include all data points that are within 1.5 times the IQR of the nearer quartile. Thus, the upper whisker extends from the 75th percentile up to a value 1.5 times the IQR within the upper quartile, while the lower whisker extends downward from the 25th percentile. Values outside of these stems are outliers. For additional discussion see the stata journal at: http://www.stata-journal.com/sjpdf.html?articlenum=gr0039.
[16] Such areas include MSAs in California, Florida, Las Vegas, and Phoenix (e.g. Liu, Nowak and Rosenthal, 2016).

each survey year from 2000 to 2018.[17] In Panel B, analogous plots are given for all structure types combined (SFD, SFA and MF). In both panels, each MSA-year record is treated as a separate observation.

Three patterns are especially striking. First, most plots in both panels trend down prior to 2014. By itself that pattern is difficult to interpret since it reflects the influence of aging of homes within a given vintage as well as changes in market conditions over the 2000-2018 period. A sharper pattern is seen by looking vertically across vintages for the SFD plots in Panel A. For most sample years, homeownership rates are roughly 2 to 3 percentage points lower for each decade older vintage. In 2000, for example, rates are 94 percent for homes built in the 1990s, 91 percent for homes built in the 1980s, 88 percent for homes built in the 1970s, 86 percent for homes built in the 1960s, 84 percent for homes built in the 1950s, and 80 percent for homes built in the 1940s.[18] Also prominent, homes built between 2000 and 2004 display noticeably rising homeownership rates after 2013, a pattern that is especially clear in Panel B where all structure types are combined. This is indicative of reversal of prior own-to-rent transitions and will be discussed further later in the paper.

The plots in Figure 6 reflect the net effect of transitions from own to rent and rent to own. Table 2 provides related evidence for both own-to-rent and rent-to-own transitions based on the AHS panel. This is accomplished by following individual homes in the AHS for up to eight surveys or 2 to 16 years into the future. Future homeownership rates are then tabulated for homes that are currently owner-occupied and those that are currently renter-occupied. In the first two columns, structure types are grouped together (omitting mobile homes). Columns 3 and 4 report values for single family homes including both SFD and SFA given the smaller sample size in the AHS, and columns 5 and 6 report values for multi-family homes.

[17] Plots for SFA and MF housing are not reported to conserve space and given their lesser share of the market.
[18] Similar evidence is also present in the 1985-2013 AHS panel. Using AHS data, a regression was estimated for which the dependent variable is 1 if a currently owner-occupied home is rented 10 years in the future, restricting the sample to currently owner-occupied SFD homes. Controlling only for MSA-by-year fixed effects, results indicate that aging a home ten years increases the likelihood of transition to rental status by roughly 1.66 percentage points.

In column 1, observe that the 16-year ahead homeownership rate for homes currently owner-occupied is 90.2 percent. The relative tendency for currently owner-occupied homes to transition to the rental sector, however, is much more pronounced among multi-family units than for single family homes: the 16-year ahead homeownership rate for single family dwellings is 92.3 percent (column 3) compared to 68.6 percent for multi-family (column 5). Analogous summary measures based on currently renter-occupied homes are also informative. For all structure types combined (column 2), the 16-year ahead homeownership rate is 20.1 percent. Among single family homes (column 4) the corresponding number is 56.1 percent but among multi-family units (column 6) the corresponding rate is just 9.1 percent.

The patterns in Figure 6 and Table 2 provide compelling evidence that housing stock shifts in both directions, but that own-to-rent transitions are more common. This has direct and indirect effects on the supply of affordable housing. The direct effect arises from net movement of housing stock into the rental sector where housing is more accessible to lower income families with limited ability to secure a mortgage. That effect is reinforced by a faster rate of downward filtering once homes enter the rental sector of the market as documented elsewhere (e.g. Rosenthal (2014).[19] Nevertheless, the role of own-to-rent transitions as a market source of affordable housing has tended to be overlooked.

The next section provides a more fully specified set of models designed to evaluate additional mechanisms that drive these patterns.

5.2 The joint effects of housing quality and market conditions

5.2.1 Model design

Table 3 presents estimates from a more fully specified model that includes extensive controls for housing quality and market conditions that together drive short and long run transitions of the housing

[19] I also estimated the effect of age-related depreciation on tenure transitions using an adaptation of standard repeat sales specifications in a manner analogous to extensions in Rosenthal (2014). The model substitutes house age for calendar time, and changes in a home's tenure status for changes in home price. Estimates confirm the tendency for owner-occupied units to transition towards the rental stock as they age, with age-related patterns plateauing at about age 50. Analogous patterns were evident for rental homes transitioning towards owner-occupied status but at a lesser rate, consistent with the patterns described above. Results are not presented to conserve space.

stock. Building off of the sample design in Table 2, eight regressions are presented based on the AHS panel. In each case the sample is restricted to homes that are currently owner-occupied. The dependent variable in column 1 is set to 1 if the home is still owner-occupied 2 years in the future and 0 if rented. In column 2 the dependent variable is 1 if the home is owner-occupied 4 years in the future and 0 otherwise, and similarly for the other columns for 6 to 16 years into the future. Specified in this fashion, these regressions measure the tendency for indicators of housing quality and market conditions to cause owner-occupied homes to transition to rental status.

Each of the models in Table 3 includes five sets of controls that serve different functions. The first group includes a wide range of structural attributes of the home that mostly do not change over time. This includes structure type (e.g. SFD, SFA and MF), size and other durable features of the home. Because these attributes do not change over time, they have enduring effects on perceptions of housing quality.

A second group of controls include attributes of the immediate neighborhood, defined in the data as being on the same city block. This includes indicators of neighborhood quality, such as the presence of bars on the windows of nearby homes, garbage on the street, and other attributes. These attributes can change over time, both for better or for worse, causing a home to shift up or down the vertical quality axis in Figure 2.

Two other groups of controls in Table 3 proxy for unobserved quality attributes of the home and neighborhood, as well as broader metropolitan level market conditions. The first is captured by controls for current occupant characteristics such as income and the owner's assessment of house value. Such measures are clearly correlated with unobserved quality of a home's structure and neighborhood and help to determine where along the vertical quality axis in Figure 2 a given home is likely to be positioned. The second set of controls are a vector of MSA-by-year fixed effects. These capture changes in market conditions at the MSA level that cause the demand curves in Figure 2 to shift up and down.

The remaining group of controls are a set of dummy variables for whether the current mortgage loan-to-value ratio (CLTV) for the current occupant in the home is 80 to 90 percent, 90 to 100 percent, 100 to 120 percent, and over 100 percent, with CLTV less than 80 percent as the omitted category. These measures help to proxy for mortgage default risk and are sensitive to an occupant's decisions, as with the level of down payment, and market conditions such as falling home prices. The role of CLTV in the estimation is discussed later in the discussion. For now, it is sufficient to note that these controls are used to help to identify additional and less obvious features of the model in Figure 2.

5.2.2 *Housing and neighborhood quality*

Consider now the overall pattern of coefficients in Table 3 that control for house quality. Looking down the rows in the table, the estimates are consistent with findings from the earlier tables and related priors. As a rule, indicators of housing quality such as SFD status, house size (based on rooms and bathrooms), and the absence of neighborhood disamenities (e.g. indicators of crime, abandoned buildings, and junk on the street) have positive effects on the tendency for the home to remain owner-occupied. Moreover, those effects tend to become larger over time. In part, this is because it takes time for homes to sort and potentially transition between sectors since house occupants must move for a home to change tenure. Because there are too many controls in Table 3 to discuss in detail, three controls that help to illustrate key principles are highlighted in Figure 7. These include house age, bars on the windows of neighboring homes, and owner's assessment of house value.

Panel A of Figure 7 plots the coefficients on house age and their 95 percent confidence bands across each of the eight regressions. It is worth noting that these estimates are conditioned on many other controls that capture much of the influence of housing quality. For that reason, the house age effect in Panel A is expected to be small in comparison to the unconditional effect in Figure 6 while growing over time. The pattern in Panel A affirms that prior. The house age effect grows from nearly zero two years into the future to 0.22 percentage points ten years ahead, much smaller than the roughly two percentage point ten-year effect for SFD homes in Figure 6.

Panel B of Figure 7 plots the coefficients on a dummy variable that indicates whether there are homes on the block that have bars on their windows. The presence of such bars is indicative of security concerns and is likely correlated with higher local crime rates. Two years ahead, the presence of bars on the windows of neighboring homes increases the likelihood that the home in question transitions to the rental sector by roughly 0.75 percentage points. That effect grows to 1.89 percentage points 14 years in the future and then moderates slightly in the following two years.

Panel C of Figure 7 plots the coefficients on log of house value in the current year. This variable is intended to capture the effect of unobserved quality attributes not correlated with the other model controls. As expected, higher house value has little effect on tenure transitions in the near term but an increasingly positive and highly significant effect on the likelihood that the home remains owner-occupied further out in the future. For the 16-year ahead estimate, doubling house value increases the likelihood that the home will still be owner-occupied by 1.35 percent.

These and other estimates in Table 3 confirm that structural and neighborhood attributes that enhance perceptions of housing quality increase the tendency for a home to remain owner-occupied.

5.3 Robustness and extensions

5.3.1 Mortgage default risk

The controls discussed thus far proxy for the quality of the home and neighborhood and also local market conditions (e.g. the MSA by year fixed effects), all of which affect whether a home sorts into the owner-occupied or rental sector of the market. Current loan to value ratio (CLT) plays a different role that helps to highlight other features of the model in Figure 2.

An extensive literature has confirmed that when CLTV exceeds 100 percent, the homeowner is at risk of defaulting on the mortgage should the family move out of the home (see Foote, Gerardi and Willen (2008), for example). Indeed, following the 2007 crash in home prices, CLTV jumped up above 1 for many families, prompting a massive wave of mortgage defaults. Nevertheless, conditional on the model controls, including house value, a departing homeowner's CLTV should not affect financing for subsequent buyers of the home, and for that reason, should have limited effect on whether the home is owned or rented in the future. Not all of the CLTV coefficients in Table 3 support that view, however.

Figure 8 plots the CLTV coefficients from Table 3 with years into the future along the horizontal axis. The omitted category includes homes with CLTV below 80 percent and is the reference group. Notice that the coefficients on the CLTV dummies for 80 to 90 percent and 90 to 100 percent are close to zero for each regression, from 2 to 16 years out into the future. This is consistent with the argument above. The pattern is different, however, for homes with CLTV above 100 percent.

Observe that for homes with CLTV between 100 to 120 percent, transitions into the rental sector occur at a rate roughly 1 to 2 percentage points higher than for the reference group for most of the period from 4 to 16 years in the future. For homes that are deep under water, with CLTV above 120 percent, the pattern is especially dramatic. Two years into the future, such homes are roughly 1 percentage point more likely to transition to rental status. That effect grows to roughly 5 percentage points over most of the period from 6 to 16 years in the future. For these coefficients, the 95 percent confidence band is also plotted in Figure 8. Although the estimates are less precise further into the future because of small sample size, there is clear evidence of a persistent and even growing tendency for transition into the rental sector.

One possible explanation for the pattern above is that current homeowners at risk of default curtail home maintenance. This has been documented by Harding et al (2019), Lambie-Hanson (2015), Gerardi et al (2015), and Haughwout et al (2013). Such behavior would lower a home's quality, causing it to shift down the vertical axis in Figure 2, and could prompt a transition to rental status. Two extensions of the model in Table 3, however, suggest a different explanation may be driving the pattern.

The first considers whether owner-occupied homes in the sample that are deep under water have attributes that are in high demand in the rental sector. To the extent that is the case, a possible mortgage default may simply be a catalyst that prompts turnover of occupancy and subsequent transition into the rental sector for homes that were already close to the own-to-rent margin. The second extension examines whether there might have been a fundamental change in market structure following the 2007 crash in ways not directly captured by the demand-side model in Figure 2. Blackstone and other large institutional investors, for example, began to buy up large numbers of distressed properties following the crash with the intention of renting them out, and in some instances even securitizing investments in rental stock. If these sorts of developments lowered the cost of providing rental housing, that could have drawn some homes to the rental sector that would have formerly remained owner-occupied. Both of these possibilities are considered below.

5.3.2 Rental demand

This first extension considers the extent to which there may be sufficient rental demand for a home presently in the owner-occupied sector to affect its potential to transition to rental status. This is done using a two-step procedure. The first step establishes whether there is notable demand for the home in the rental sector. The second step stratifies the sample on the basis of inferred rental demand and then re-estimates the models in Table 3.

To implement the first step, all home-year observations in the AHS are pooled together across all survey years. Using this sample, a linear probability model is estimated for which the dependent variable is 1 if the home is currently owner-occupied and 0 if rented. Controls include all of the measures from Table 3 including MSA-by-year fixed effects. The only controls not included are those that are specific to a given tenure, as with house value and CLTV which are only reported when the home is owner-occupied. Estimates from the model are reported in Table A-1 of the appendix and are used to predict the probability of homeownership for each home-year observation in the sample, P_i. For homes for which P_i is high, demand in the rental sector is inferred to be low. For homes for which P_i is low the reverse is true. To execute the second step, the sample of owner-occupied units used for Table 3 is then split into two groups based on homes above and below a critical value for $\overline{P}$ that satisfies the description just provided.

Table 4 provides summary measures for the sample distribution of P_i that guides the selection of the critical level of $\overline{P}$. Panel A reports the distribution of predicted homeownership probability stratified by actual owner-occupancy status (reading down the columns). Panel B reports the actual homeownership rate for different predicted probabilities of owner-occupancy (reading across rows). Based on the patterns in the table, few rental units have values of P above 0.9 (in Panel A), and only a small share of homes with values for P above 0.9 are rented (in Panel B). Additional summary measures in the Table A-2 of the appendix indicate that owner-occupied homes with *P* below 0.9 have structural and neighborhood traits that are relatively similar to rental units as compared to owner-occupied homes with *P* above 0.9.[20] For these reasons, the critical value for *P* used to stratify the sample is set at 0.9.

Table 5, Panels A and B, present estimates of the stratified sample models. Panel A presents estimates for owner-occupied homes with *P* below 0.9 while Panel B presents estimates for owner-occupied homes with *P* above 0.9. As before, eight models are presented in each table for homeownership status 2 to 16 years into the future. All of the models are specified as in Table 3.

The CLTV coefficients in the two tables are plotted in Figure 9. Panel A plots estimates for homes "unlikely" to be owner-occupied for which *P* is below 0.9. Panel B plots estimates for homes that are "likely" to be owner-occupied, with *P* above 0.9. The patterns are informative. In Panel A, the pattern is quite similar to that in Figure 8. In Panel B, however, the estimates display little tendency for underwater homes to transition into the rental sector of the market, and by comparison to Panel A, especially so for homes that are deep underwater. These results support the view that for an own-to-rent transition to be more than temporary there must be sufficient rental demand for the structural and neighborhood attributes of the home in the rental sector of the market.

5.3.3 Pre- versus post-financial crisis

Is it possible that the changes in market structure following the 2007 crash could also be contributing to the patterns in Table 5? To consider this question, Table 5 was re-estimated splitting the samples into survey years from 1985 through 1999, and survey years from 2003 through 2013. Estimates from these samples are presented in Table 6. Because of the shortened time horizon models are presented only for 2, 4, 6 and 8 years ahead.

[20] Owner-occupied homes with *P* below 0.9 are older, smaller, less likely to be single family detached, less likely to have a garage, more likely to be on a block with bars on the windows, junk on the street, and abandoned buildings present, and more likely to be in the central city. These homes are also occupied by lower income individuals who are younger and less likely to be married.

The estimates in Table 6 yield qualitative and quantitative patterns that are similar for the pre- and post-2000 periods. In both periods, among homes that are likely to be owner-occupied ($P > 0.9$), CLTV values have little impact on transitions into the rental sector even when the home is deep underwater. However, among homes that are unlikely to be owner-occupied ($P < 0.9$), homes with high CLTV values (CLTV > 1) are notably more likely to transition to rental status. These patterns suggest that despite the dramatic scale of the 2007 financial crisis, and at least some shifts in market structure (e.g. the arrival of large institutional investors into the rental market), the demand side principles embodied in the model in Figure 2 appear to be robust and offer similar guidance when evaluating housing stock transitions pre- and post-financial crisis.

VI. Post-2007 recovery and own-to-rent transitions

The preceding sections document that housing stock tenure transitions are common and respond to both long and short run drivers. This section examines the extent to which own-to-rent housing stock transitions depress housing construction following a negative shock.

A longstanding stylized fact of the U.S. economy is that new home construction takes place primarily in the owner-occupied sector.[21] This suggests that any reversal of recent own-to-rent transitions could undercut demand for new home building and slow recovery in the construction market following a downturn. The extent to which this occurs will depend on the degree of reversal which in turn depends on whether homes that recently shifted to rental status retain viable markets in the owner-occupied sector. Table 7 presents results from a series of regressions that provide evidence on these points.

The regressions in Table 7 highlight the influence of own-to-rent stock transitions on post-2006 housing construction. In all cases, the dependent variable is the number of single family housing permits measured on an annual basis from 2006 to 2018. Columns one through three are based on measures at the MSA level as earlier in the paper while the remaining three columns measure activity at the county level.

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[21] Calculations based on the 2000 IPUMS census data, for example, indicate that among homes built in the 1990s, 77 percent of all homes (excluding mobile homes) and 94 percent of SFD homes were owner-occupied.

For each respective level of geography, controls include the percent change in home prices since 2006, the number of single family vacant homes in a given survey year, the number of net single family own-to-rent stock transitions since 2006 for each survey year, location fixed effects, and year fixed effects. Data for these measures were obtained from HUD, FHFA and IPUMs.[22] It is intuitive that as geography narrows, developers should be less likely to build homes where vacant homes and recent own-to-rent stock transitions are present. For that reason, the patterns in Table 7 are expected to be more pronounced at the county level which provides a helpful check. It is also worth noting that county level information is restricted for public-access census data after 1950 to ensure confidentiality. This limits the number of counties identified in IPUMs and for which vacancy rates can be reliably computed using the census data. For that reason, the number of counties included in the county-level sample in Table 7 is just 461, many fewer than the total number of counties in the United States.[23]

In column 1, at the MSA level, the primary variable of interest is the number of single family own-to-rent transitions since 2006 for pre-2005 vintage homes. In column 2, that variable is decomposed into similarly formed measures for single family housing stock built between 2000 and 2004 and homes built prior to 2000. In column 3, this later measure is further decomposed into homes built in the 1980s and 90s, in the 1960s and 70s, in the 1940s and 50s, and prior to 1940. These same specifications are

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[22] County level single family housing permits were obtained from HUD at: https://socds.huduser.gov/permits/index.html . County level repeat sales home price indexes for all transactions were obtained from FHFA at: https://www.fhfa.gov/PolicyProgramsResearch/Research/Pages/wp1601.aspx. Details on the HPI index are available at Bogin et al (2016, 2019). County level single family vacancy rates were calculated using data from the same census data used earlier in the paper. Separate files were downloaded from the IPUMs website at www.ipums.org for household level measures to compute the vacancy information. Using the individual level data from earlier in the paper, a cross walk was created that matched weighted county measures to met2013 geography. Those weights were used to aggregate the HPI index, vacant housing, and permits in Table 7 to met2013 geography for the first three columns. Single family own-to-rent transitions at the met2013 level were obtained using the measures reported earlier in the paper. All of those earlier models were rerun at the county level to produce analogous measures for the county-level regressions in Table 7.

[23] See http://blog.popdata.org/ipums-faqs-missing-u-s-counties/ for further discussion on restrictions to county identification in the data and how IPUMs used PUMA and other geographic units to fill in where feasible. Also, 591 counties are identified in the IPUMs data based on county fips codes (see https://usa.ipums.org/usa-action/variables/COUNTYFIP#description_section). The number used in the regressions is smaller because not all counties are represented in the other data used in the regressions.

repeated at the county level in the last three columns of the table. Specifying the models in this manner helps to reveal vintage effects.

Results in Table 7 support the arguments above and elsewhere in the paper. Notice first that in all of the regressions, house price growth has a positive and significant effect on permits as would be expected with upward sloping supply. Vacant housing also always discourages new construction. At the MSA level, for every 100 vacant single family homes there are roughly 7.9 fewer single family permits issued that year. At the county level the corresponding effect is larger, roughly 12.6 fewer permits.

The effect of own-to-rent transitions also adheres to priors. Looking across the three columns for each level of geography, it is evident that single family own-to-rent transitions depress new construction and especially so for transitions of recently built homes. This is most easily seen in the more fully specified models in columns 3 and 6. For 2000-2004 vintage homes, 100 own-to-rent transitions since 2006 reduce single family permits by roughly 24 at the MSA level (column 3) and 31 at the county level (column 6). These effects attenuate sharply with age of the housing stock, falling to 3.1 and 7.6, respectively, at the MSA and county levels for homes built in the 1980s and 90s, and smaller still for older vintages.

Recently built homes are typically of higher quality and are more likely to retain a viable market in the owner-occupied sector for that reason. This increases the likelihood that such homes will return to owner-occupancy status if an own-to-rent transition is prompted by a negative demand shock, as with the 2007 crash. Older homes however are more likely to have depreciated down the vertical axis in Figure 2 and are less likely to return to own-occupancy following a shift into the rental sector. For these reasons, post-2006 own-to-rent housing stock transitions, and especially those associated with recently built homes, appear to be acting in part as a buffer stock of potential owner-occupied housing that is slowing the rate of recovery in the construction sector.

VII. Conclusions

Evidence presented in this paper indicates that on net, roughly 2 percent of existing single family detached housing stock transitions into the rental sector with each passing decade as homes age. Along with evidence elsewhere that rental homes filter down to lower income families at an accelerated rate, this suggests that own-to-rent housing stock transitions are an important long run source of housing for lower income families.

Additional evidence shows that short run housing stock transitions in response to shocks to market demand can be much larger: among recently built homes, own-to-rent transitions exceeded 10 percent of the stock following the 2007 market crash. These sorts of transitions can reverse as local markets recover and appear to act in part as a buffer stock of potential owner-occupied housing, depressing subsequent new home construction. At the metropolitan level, in the post-2006 period, roughly 3 fewer single family permits for new construction were filed for every 100 post-crash own-to-rent transitions. Among homes built between 2000 and 2004, the effect is larger, roughly 25 fewer permits for every 100 post-crash own-to-rent transitions. These patterns help to explain why post-2007 construction activity has yet to recover in many cities even though home prices have largely rebounded.

A general principle, and one that is confirmed in the data, is that housing stock transitions require that demand for a home's attributes must be sufficiently present in the alternate sector. While intuitive, this principle governs the potential for own-to-rent transitions to persist in the long run or to reverse with shifts in market conditions. That and other arguments in the paper appear to be robust to pre- and post-2007 market environments, and confirm that housing stock transitions are an important source of affordable housing while also affecting market dynamics following a shock.

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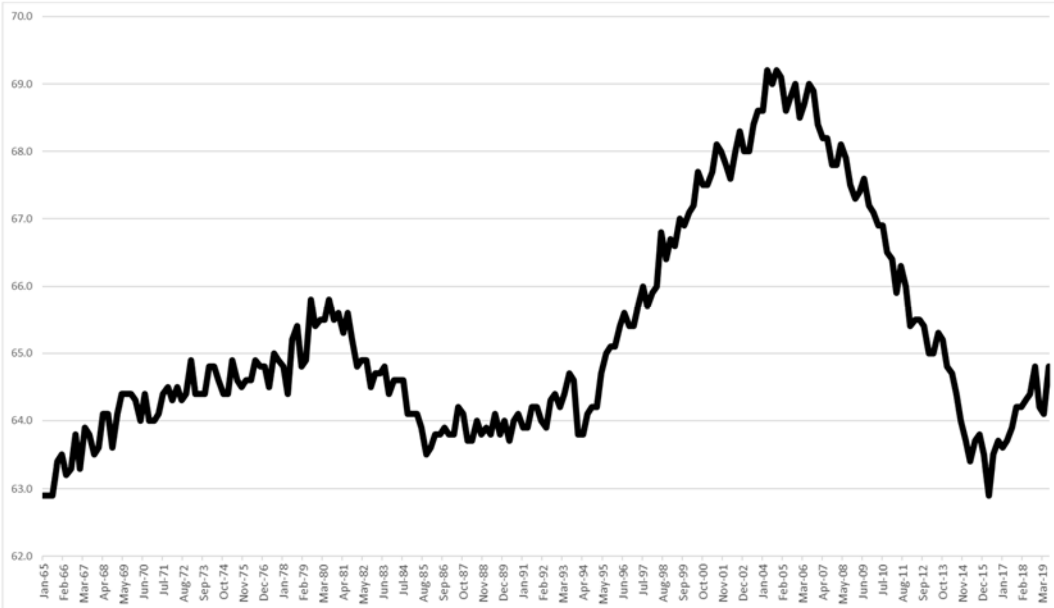
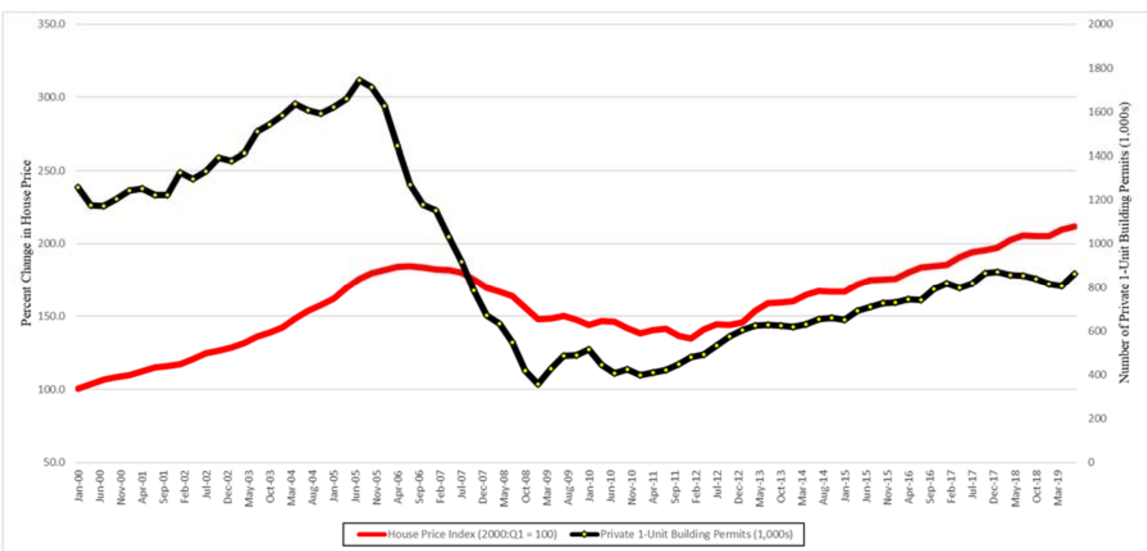
Figure 1a: US Homeownership Rate 1965:Q1 - 2019:Q3[a]



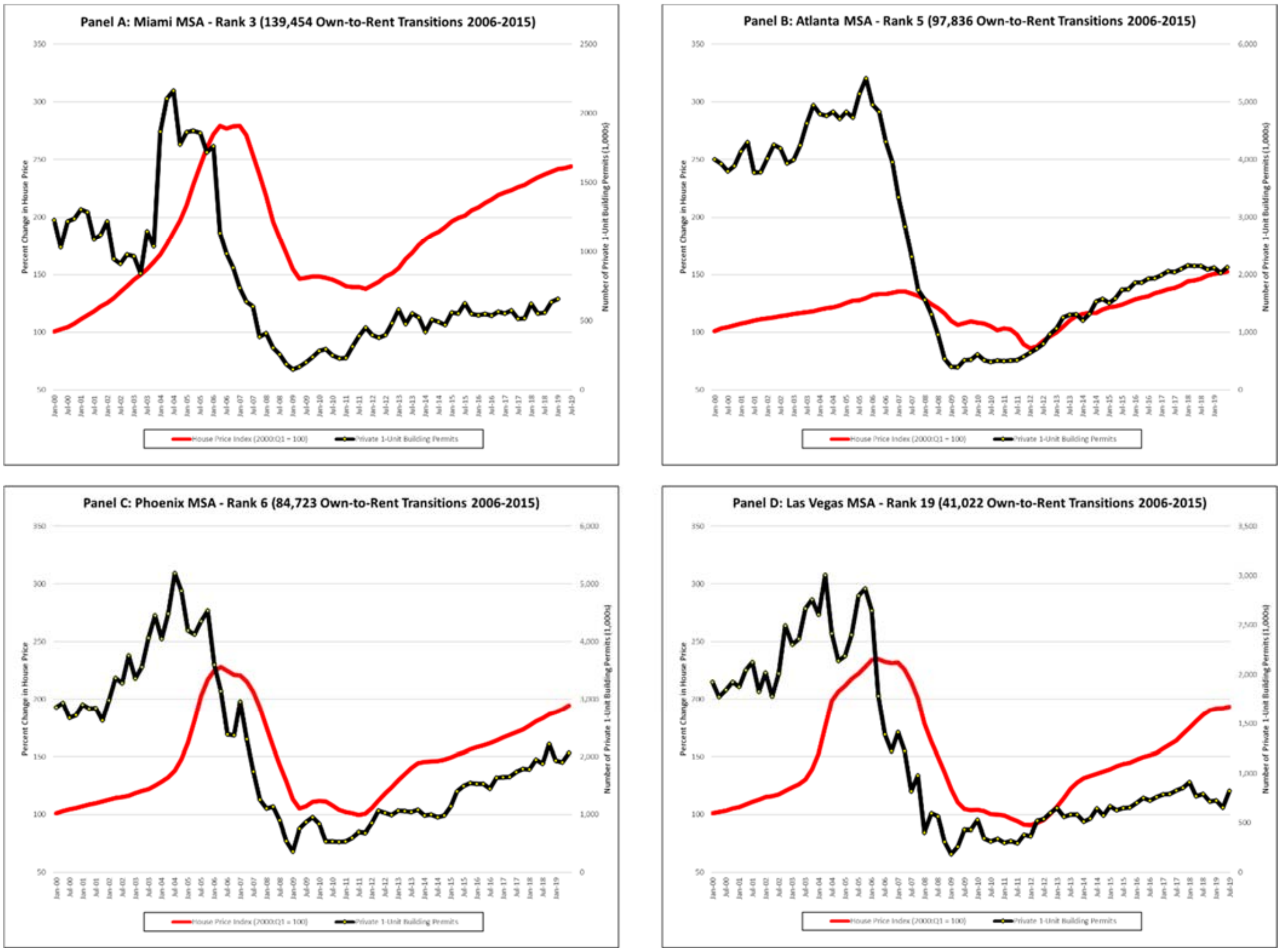
[a] Data were obtained from https://www.huduser.gov/portal/ushmc/hi_HOR.html .

Figure 1b: Single Family Residential Construction and Home Prices in the United States 2000:Q1 – 2019:Q2[a]



[a] Data on building permits were obtained from the US. Bureau of the Census, New Private Housing Units Authorized by Building Permits: 1-Unit Structures and downloaded from the FRED data portal at Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/ . The HPI indexes are from FHFA all transactions index.

Figure 1c: Single Family Housing Construction and Home Prices in Select Metropolitan Areas 2000:Q1 – 2019:Q2[a]



[a] Data on building permits were obtained from the US. Bureau of the Census, New Private Housing Units Authorized by Building Permits: 1-Unit Structures and downloaded from the FRED data portal at Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/ . The HPI indexes are from FHFA all transactions index. Number in parenthese in each panel title are the net number of homes that were owner-occupied in 2006 that transitioned to the rental sector by 2015.

Figure 2: Division of Housing Stock into Owner-Occupied and Rental

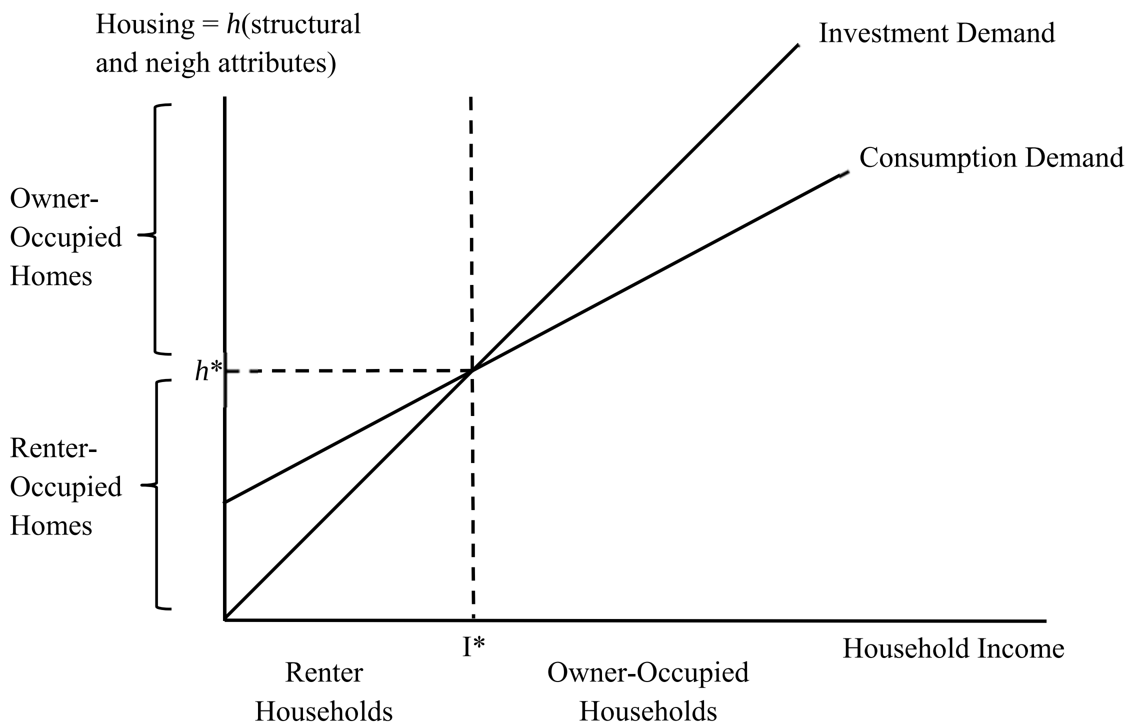
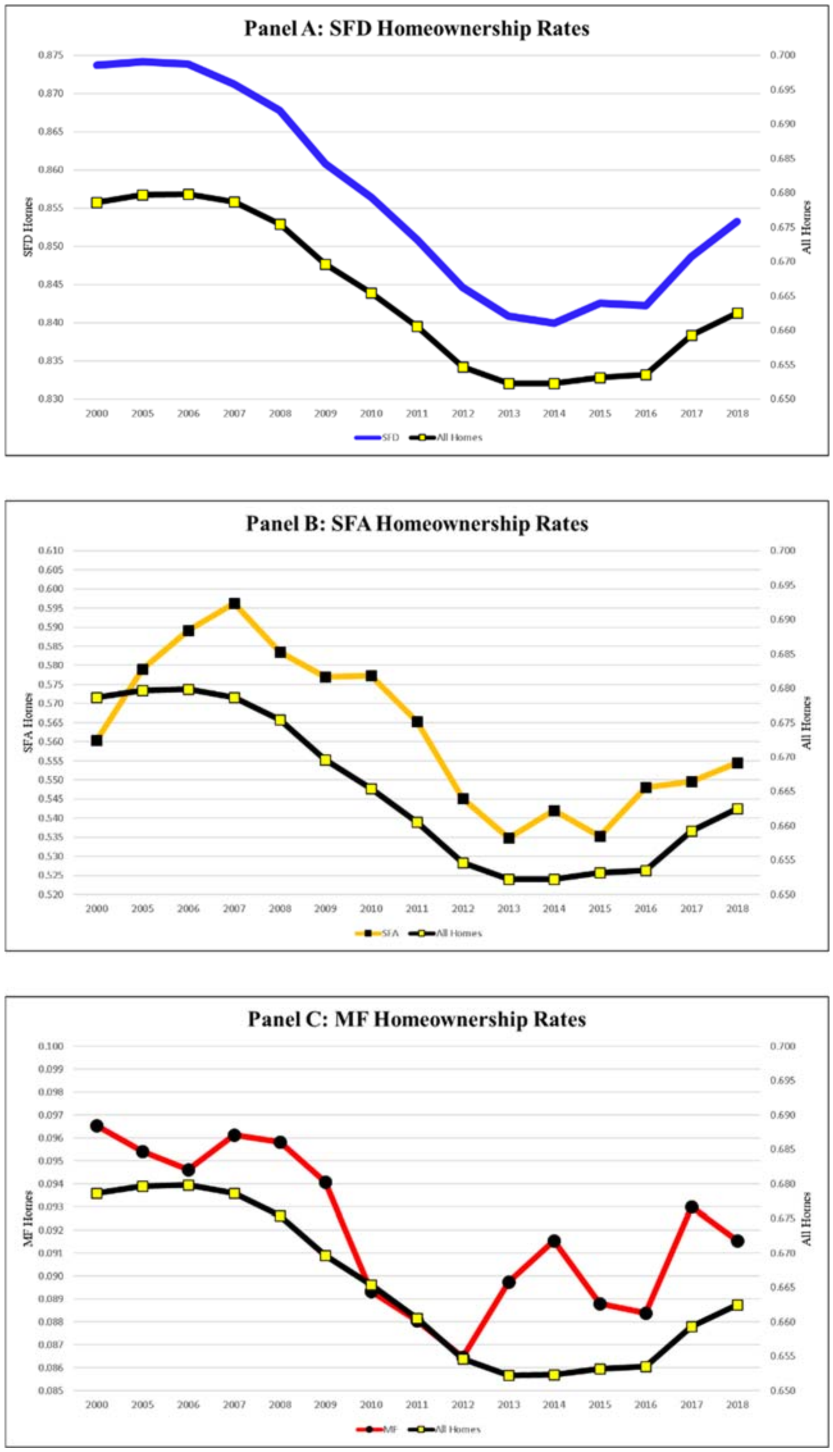
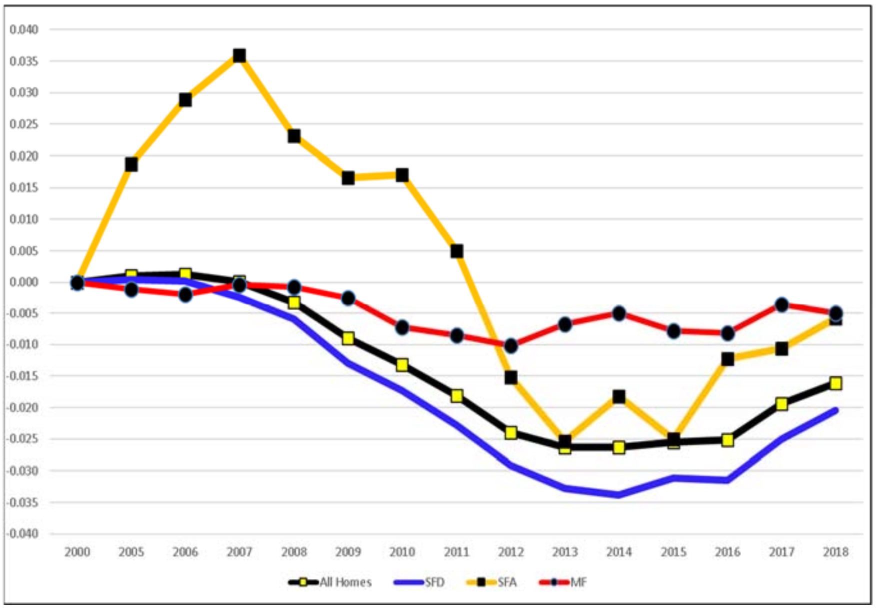


Figure 3: Metropolitan Homeownership Rates
by Structure Type Based on Census and ACS Data[a]



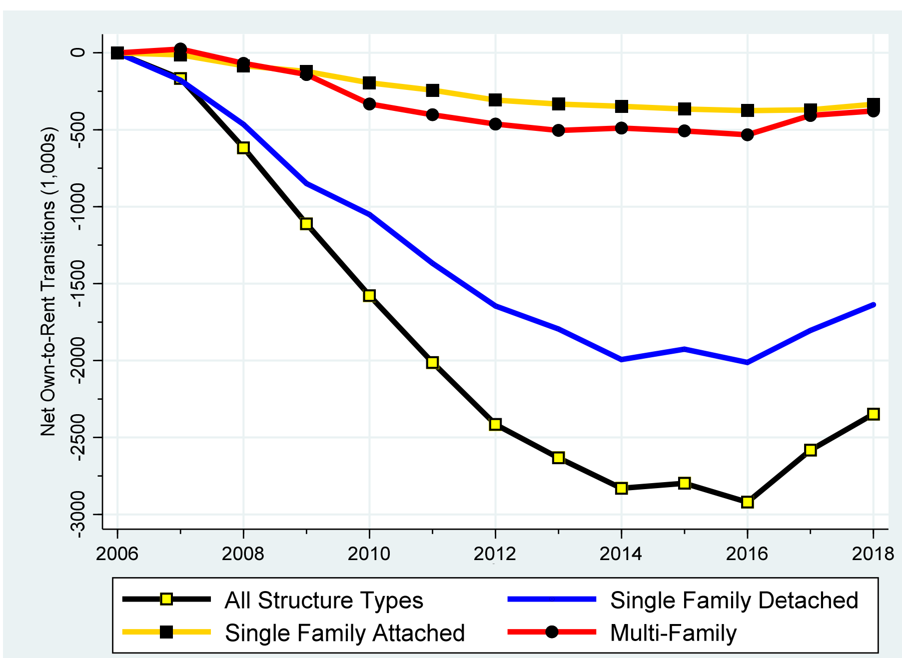
[a] Values are average homeownership rates across metropolitan areas in each year Data are from the Census and ACS as described in the text and obtained from www.ipums.org.

Figure 4: Metropolitan Level Change in Homeownership Rates Since 2000 in Percentage Points Based on Census and ACS Data



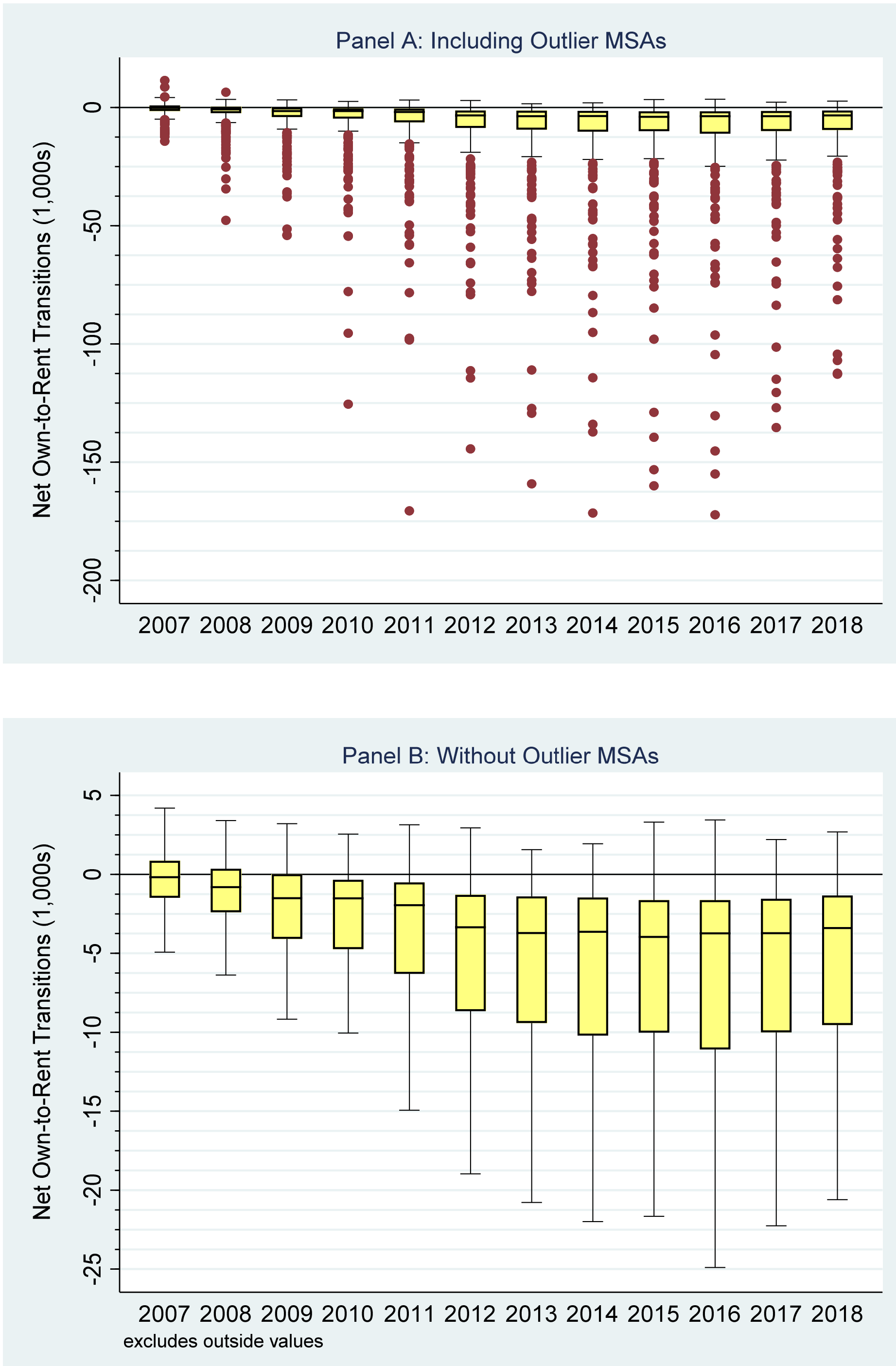
[a] Values are based on differences from Figure 3. Data are from the Census and ACS as described in the text and obtained from www.ipums.org.

Figure 5a: Net Own-to-Rent Transitions of Pre-2000 Vintage Homes Since 2006 Based on Census and ACS Data



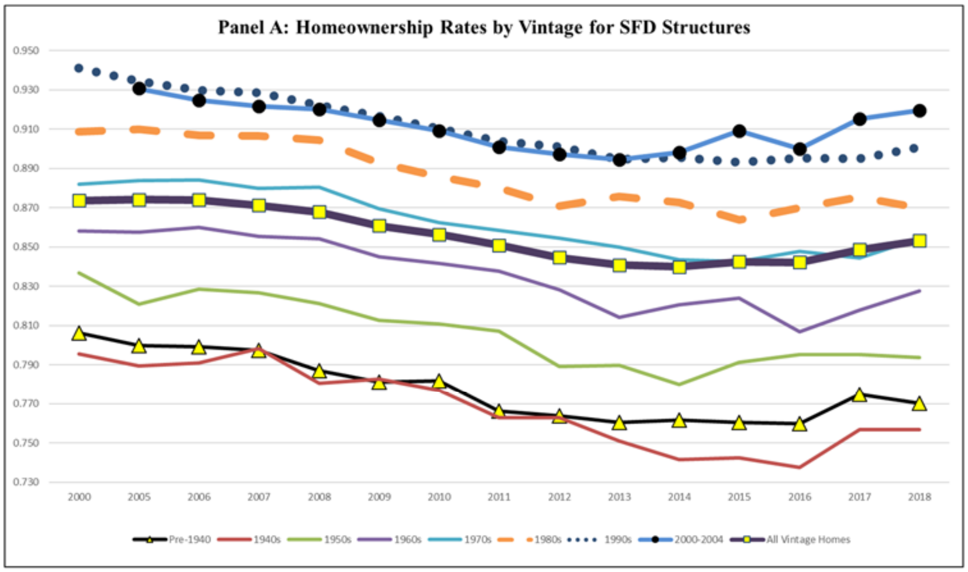
[a] Values are based on the Census and ACS data as described in the text and obtained from www.ipums.org.

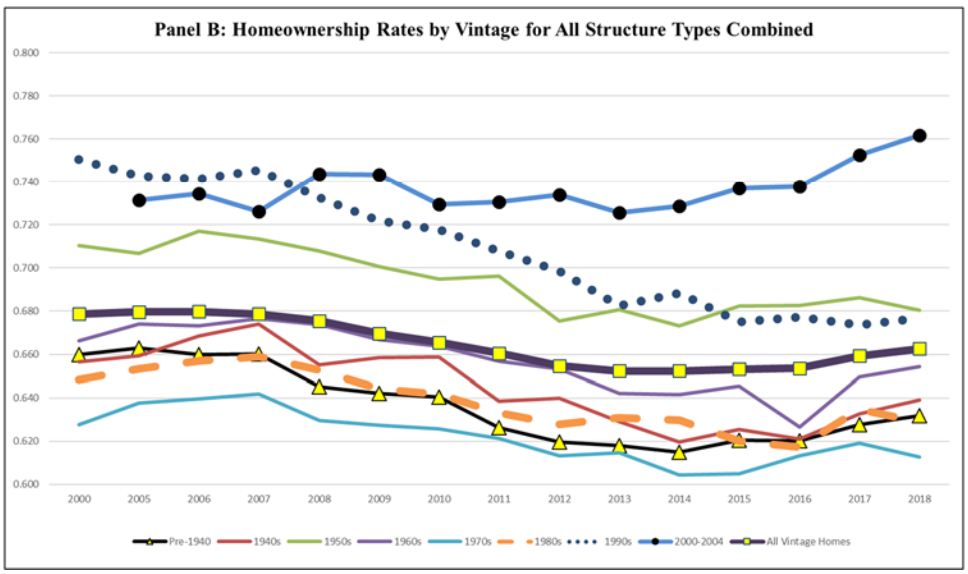
Figure 5b: Distribution Across MSAs of
Net Own-to-Rent Transitions of Pre-2000 Vintage Homes
Since 2006 Based on Census and ACS Data



[a] Values are based on the Census and ACS data as described in the text and obtained from www.ipums.org.

Figure 6: Metropolitan Average SFD and Aggregate Homeownership Rates by Vintage Based on Census and ACS Data





[a] SFD values in Panel A are average vintage-specific homeownership rates across metropolitan areas in each year. Similar measures were calculated for SFA and MF housing but are not reported to conserve space. Panel B measures are based on a weighted average of the three structure-type vintage-specific homeownership rates as described in the text. Data are from the Census and ACS as also described in the text and obtained from www.ipums.org.

Figure 7: Select Tenure Transition Coefficients from Table 3
(Dependent variable equals 1 if own in year t+K and 0 if rent)

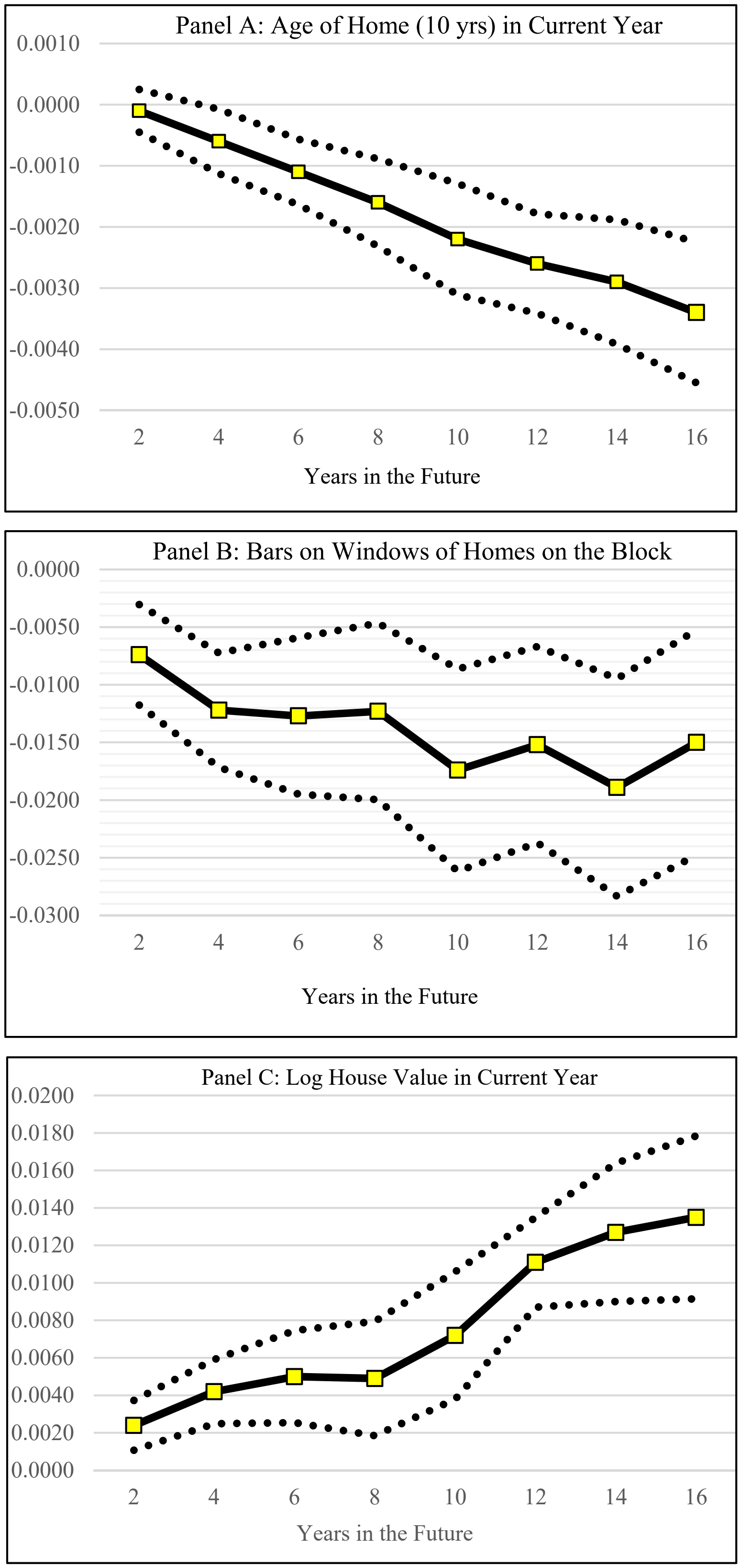


Figure 8: CLTV Tenure Transition Coefficients from Table 3
(Dependent variable equals 1 if own in year t+K and 0 if rent)

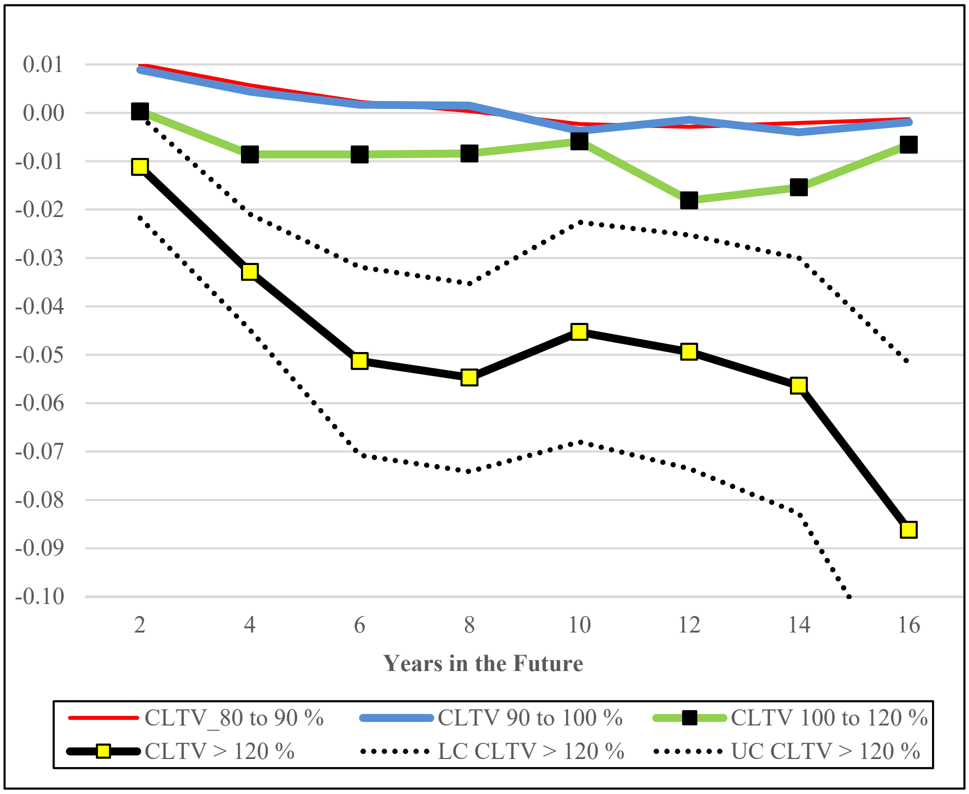


Figure 9: CLTV Tenure Transition Coefficients from Table 5
(Dependent variable equals 1 if own in year t+K and 0 if rent)

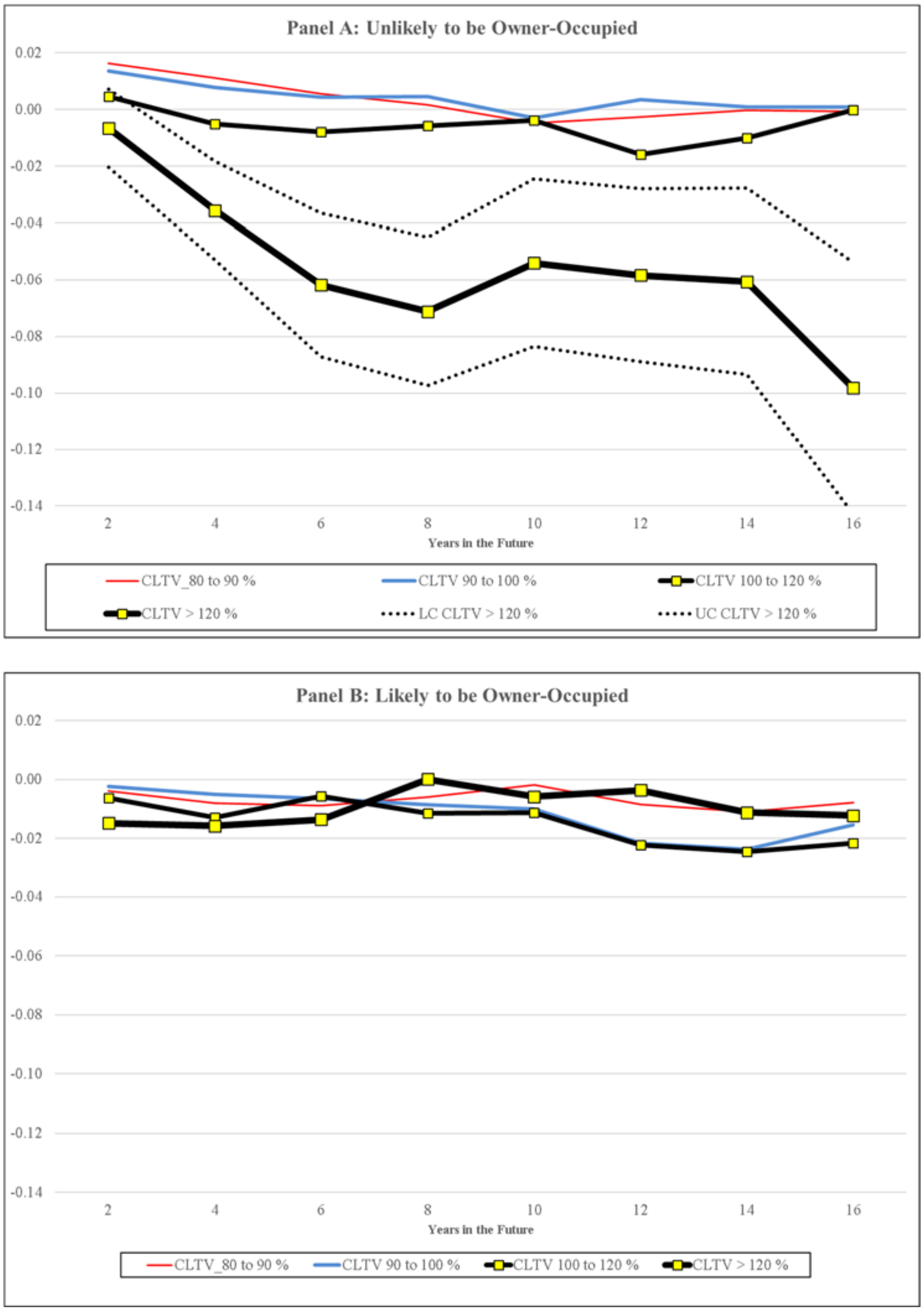


Table 1: Log Number of MSA-Level Owner-Occupied Units Relative to Year 2000 by Vintage and Structure Type in the 2000-2018 ACS Data[a]

	All Structure Types			Single Family Detached		Single Family Attached		Multi-Family	
	(1) Built Prior to 2000	(2) Built in the 1990s	(3) Built Prior to 1940	(4) Built in the 1990s	(5) Built Prior to 1940	(6) Built in the 1990s	(7) Built Prior to 1940	(8) Built in the 1990s	(9) Built Prior to 1940
Survey year 2005	0.0026	-0.0099	-0.0032	-0.0086	-0.0139	0.0687	0.1294	0.1908	0.1312
	(1.24)	(-1.91)	(-0.31)	(-3.19)	(-1.58)	(2.65)	(2.20)	(3.28)	(2.19)
Survey year 2006	0.0049	-0.0114	-0.0055	-0.0135	-0.0125	0.0748	0.1433	0.2114	0.0516
	(2.22)	(-2.06)	(-0.74)	(-4.52)	(-1.99)	(2.53)	(2.51)	(4.09)	(0.83)
Survey year 2007	0.0052	-0.0048	-0.0030	-0.0149	-0.0147	0.0868	0.1374	0.1636	0.0951
	(2.36)	(-0.94)	(-0.36)	(-5.42)	(-2.14)	(2.75)	(2.44)	(2.90)	(1.85)
Survey year 2008	-0.0063	-0.0230	-0.0322	-0.0223	-0.0308	0.0786	0.0330	0.1211	0.0390
	(-2.72)	(-4.95)	(-3.51)	(-6.95)	(-3.86)	(2.57)	(0.59)	(2.20)	(0.69)
Survey year 2009	-0.0166	-0.0399	-0.0371	-0.0284	-0.0400	0.0101	0.1152	0.2123	0.0421
	(-7.23)	(-6.51)	(-3.93)	(-8.64)	(-4.65)	(0.34)	(2.20)	(3.77)	(0.72)
Survey year 2010	-0.0210	-0.0449	-0.0380	-0.0355	-0.0355	0.0016	0.0810	0.0621	-0.0045
	(-8.72)	(-8.26)	(-4.26)	(-11.08)	(-5.07)	(0.05)	(1.45)	(1.19)	(-0.08)
Survey year 2011	-0.0339	-0.0616	-0.0617	-0.0433	-0.0574	0.0316	0.0421	0.0773	-0.0540
	(-13.54)	(-8.80)	(-6.95)	(-11.01)	(-7.64)	(0.93)	(0.70)	(1.28)	(-1.00)
Survey year 2012	-0.0445	-0.0762	-0.0687	-0.0497	-0.0607	-0.0411	-0.0755	-0.0437	-0.1179
	(-16.59)	(-11.91)	(-7.24)	(-12.17)	(-7.36)	(-1.27)	(-1.19)	(-0.69)	(-1.98)
Survey year 2013	-0.0532	-0.0993	-0.0717	-0.0562	-0.0643	-0.0927	-0.0268	0.0373	0.0176
	(-19.44)	(-15.63)	(-6.28)	(-14.39)	(-7.65)	(-2.88)	(-0.39)	(0.61)	(0.30)
Survey year 2014	-0.0574	-0.0902	-0.0759	-0.0552	-0.0633	-0.0843	-0.1265	0.0491	-0.0193
	(-19.09)	(-13.80)	(-7.03)	(-14.85)	(-7.05)	(-2.38)	(-1.85)	(0.77)	(-0.33)
Survey year 2015	-0.0593	-0.1124	-0.0698	-0.0584	-0.0663	-0.1046	-0.1111	-0.0475	0.0269
	(-19.44)	(-15.39)	(-6.22)	(-14.52)	(-7.06)	(-3.17)	(-1.64)	(-0.81)	(0.48)
Survey year 2016	-0.0620	-0.1084	-0.0681	-0.0557	-0.0663	-0.0788	-0.0694	0.0300	-0.1013
	(-20.26)	(-14.02)	(-6.24)	(-13.70)	(-7.11)	(-2.07)	(-1.20)	(0.53)	(-1.70)
Survey year 2017	-0.0486	-0.1140	-0.0539	-0.0559	-0.0437	-0.1249	-0.0404	-0.0606	-0.0071
	(-16.34)	(-14.94)	(-5.29)	(-14.47)	(-5.33)	(-3.26)	(-0.61)	(-0.91)	(-0.11)
Survey year 2018	-0.0498	-0.1108	-0.0481	-0.0498	-0.0524	-0.1462	-0.0179	-0.0384	0.0617
	(-16.73)	(-13.46)	(-4.78)	(-12.02)	(-5.76)	(-3.71)	(-0.29)	(-0.65)	(1.06)
Observations	3,925	3,925	3,923	3,925	3,923	3,509	2,425	2,868	2,672
MSA Fixed Effects	290	290	290	290	290	290	283	288	283
Within R-square	0.388	0.186	0.036	0.148	0.0340	0.0361	0.0239	0.0248	0.0139

[a] Data are from the year 2000 5% decennial census and the 2005 to 2018 1% American Community Survey (ACS). Data in each survey year are aggregated to MSA level using household weights. Mobile homes are excluded from all samples. T-ratios based on robust standard errors clustered at the MSA level are in parentheses.

Table 2: Percent of Current Homes Owner-Occupied K-Years in the Future by Initial Tenure in AHS Data[a]

	All Homes		Single Family Homes[b]		Multi-Family Homes	
	Currently Owner-Occupied	Currently Renter-Occupied	Currently Owner-Occupied	Currently Renter-Occupied	Currently Owner-Occupied	Currently Renter-Occupied
	(1)	(2)	(3)	(4)	(5)	(6)
2 Years Ahead	0.963	0.075	0.974	0.203	0.853	0.035
4 Years Ahead	0.946	0.109	0.961	0.302	0.803	0.051
6 Years Ahead	0.935	0.131	0.951	0.368	0.775	0.061
8 Years Ahead	0.926	0.149	0.944	0.423	0.749	0.069
10 Years Ahead	0.919	0.166	0.938	0.471	0.729	0.076
12 Years Ahead	0.912	0.181	0.932	0.512	0.710	0.083
14 Years Ahead	0.907	0.192	0.928	0.541	0.698	0.088
16 Years Ahead	0.902	0.201	0.923	0.561	0.686	0.091

[a]Data are from the American Housing Survey 1985-2013 bi-annual panel. All samples exclude mobile homes.
[b]Includes single family detached and single family attached.

Table 3: Single Family Own-to-Rent Tenure Transitions for Individual Homes in the 1985-2013 AHS [a]

	(1) 2 Years Ahead	(2) 4 Years Ahead	(3) 6 Years Ahead	(4) 8 Years Ahead	(5) 10 Years Ahead	(6) 12 Years Ahead	(7) 14 Years Ahead	(8) 16 Years Ahead
Current LTV Controls								
CLTV_80 to 90 %	0.0100	0.0057	0.0023	0.0004	-0.0023	-0.0029	-0.0021	-0.0013
	(6.40)	(2.89)	(0.99)	(0.18)	(-0.96)	(-1.05)	(-0.62)	(-0.34)
CLTV 90 to 100 %	0.0089	0.0044	0.0017	0.0015	-0.0037	-0.0014	-0.0040	-0.0019
	(4.30)	(1.33)	(0.48)	(0.38)	(-0.95)	(-0.34)	(-0.89)	(-0.39)
CLTV 100 to 120 %	0.0003	-0.0086	-0.0086	-0.0084	-0.0059	-0.0181	-0.0154	-0.0066
	(0.13)	(-2.32)	(-1.98)	(-1.37)	(-0.82)	(-3.04)	(-2.09)	(-0.77)
CLTV > 120 %	-0.0112	-0.0329	-0.0513	-0.0547	-0.0453	-0.0494	-0.0564	-0.0862
	(-2.08)	(-5.39)	(-5.17)	(-5.52)	(-3.91)	(-4.01)	(-4.19)	(-4.90)
Current Structure Controls								
SFD	0.0667	0.0959	0.1137	0.1288	0.1421	0.1556	0.1642	0.1726
	(31.21)	(36.26)	(40.59)	(40.90)	(39.19)	(36.94)	(35.84)	(32.56)
SFA	0.0572	0.0796	0.0950	0.1061	0.1223	0.1266	0.1385	0.1450
	(17.03)	(18.70)	(21.37)	(19.16)	(20.29)	(18.38)	(18.05)	(16.34)
Age of home (10 years)	-0.00001	-0.00006	-0.00011	-0.00016	-0.00022	-0.00026	-0.00029	-0.00034
	(-0.56)	(-2.23)	(-4.03)	(-4.39)	(-4.74)	(-6.26)	(-5.58)	(-5.79)
Garage present	0.0089	0.0119	0.0126	0.0150	0.0163	0.0156	0.0169	0.0186
	(11.67)	(12.67)	(10.29)	(10.31)	(10.54)	(8.58)	(9.27)	(9.35)
Rooms: 4 to 7	0.0489	0.0640	0.0719	0.0817	0.0898	0.0930	0.0915	0.0923
	(11.31)	(13.80)	(13.87)	(14.50)	(14.67)	(15.98)	(15.30)	(13.76)
Rooms: 8 to 10	0.0548	0.0749	0.0866	0.0993	0.1099	0.1160	0.1177	0.1210
	(13.32)	(17.31)	(17.91)	(19.54)	(19.23)	(19.91)	(18.46)	(17.82)
Rooms: > 10	0.0539	0.0764	0.0869	0.0991	0.1111	0.1143	0.1204	0.1213
	(12.85)	(16.64)	(18.45)	(20.00)	(19.46)	(16.33)	(16.32)	(16.43)
Baths: 2	0.0106	0.0157	0.0206	0.0238	0.0265	0.0284	0.0285	0.0287
	(12.66)	(14.90)	(15.67)	(17.01)	(14.71)	(14.95)	(14.53)	(14.66)
Baths: > 2	0.0128	0.0178	0.0231	0.0259	0.0288	0.0293	0.0289	0.0287
	(10.07)	(12.12)	(12.75)	(13.74)	(13.10)	(12.77)	(12.33)	(9.66)

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Table 3 continued: Single Family Own-to-Rent Tenure Transitions for Individual Homes in the 1985-2013 AHS [a]

	(1) 2 Years Ahead	(2) 4 Years Ahead	(3) 6 Years Ahead	(4) 8 Years Ahead	(5) 10 Years Ahead	(6) 12 Years Ahead	(7) 14 Years Ahead	(8) 16 Years Ahead
<u>Current Neigh Controls</u>								
Green space on block	0.0010	0.0009	0.0018	0.0019	0.0022	0.0016	0.0021	0.0020
	(1.32)	(0.82)	(1.16)	(0.98)	(1.05)	(0.71)	(0.91)	(0.88)
Water on block	0.0041	0.0056	0.0072	0.0076	0.0091	0.0088	0.0106	0.0106
	(4.45)	(5.44)	(5.84)	(4.32)	(5.46)	(4.07)	(4.57)	(2.38)
Bars on house	-0.0012	0.0031	-0.0013	-0.0013	-0.0010	-0.0028	0.0077	-0.0062
	(-0.44)	(0.85)	(-0.35)	(-0.26)	(-0.17)	(-0.39)	(0.84)	(-0.62)
Bars on block homes	-0.0074	-0.0122	-0.0127	-0.0123	-0.0174	-0.0152	-0.0189	-0.0150
	(-3.33)	(-4.82)	(-3.67)	(-3.15)	(-3.89)	(-3.50)	(-3.93)	(-3.01)
Junk on street	-0.0088	-0.0078	-0.0205	-0.0083	-0.0194	-0.0161	-0.0156	-0.0175
	(-2.31)	(-1.92)	(-3.75)	(-1.42)	(-2.61)	(-1.88)	(-1.84)	(-1.76)
Abandoned bldgs on block	-0.0027	-0.0059	-0.0104	-0.0184	-0.0105	-0.0140	-0.0227	-0.0235
	(-1.02)	(-1.84)	(-2.16)	(-3.14)	(-2.00)	(-1.95)	(-2.44)	(-2.14)
CBD of MSA	-0.0093	-0.0141	-0.0198	-0.0242	-0.0271	-0.0287	-0.0323	-0.0354
	(-6.83)	(-8.70)	(-10.52)	(-15.12)	(-12.04)	(-12.18)	(-11.79)	(-13.94)
Suburb of MSA	-0.0035	-0.0058	-0.0086	-0.0110	-0.0139	-0.0160	-0.0156	-0.0175
	(-3.62)	(-3.84)	(-5.44)	(-9.84)	(-8.82)	(-8.54)	(-6.58)	(-8.81)
Suburb of non-MSA	-0.0079	-0.0133	-0.0164	-0.0193	-0.0230	-0.0254	-0.0304	-0.0334
	(-7.49)	(-9.24)	(-6.79)	(-5.99)	(-8.72)	(-8.89)	(-11.40)	(-11.85)
<u>Current Occupant Controls</u>								
Log real current house value	0.0024	0.0042	0.0050	0.0049	0.0072	0.0111	0.0127	0.0135
	(3.54)	(4.80)	(3.99)	(3.15)	(4.15)	(9.09)	(6.74)	(6.09)
Log real income	0.0036	0.0046	0.0047	0.0063	0.0069	0.0069	0.0087	0.0103
	(8.59)	(9.07)	(8.03)	(9.14)	(7.44)	(6.35)	(7.85)	(7.98)
Age of household head	0.0038	0.0061	0.0078	0.0088	0.0095	0.0102	0.0099	0.0096
	(27.30)	(30.59)	(32.94)	(38.32)	(34.59)	(31.86)	(24.49)	(23.06)
Age squared	-0.0000	-0.0000	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001
	(-23.95)	(-28.78)	(-32.93)	(-36.42)	(-33.04)	(-31.43)	(-24.62)	(-23.79)

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Table 3 continued: Single Family Own-to-Rent Tenure Transitions for Individual Homes in the 1985-2013 AHS [a]

	(1) 2 Years Ahead	(2) 4 Years Ahead	(3) 6 Years Ahead	(4) 8 Years Ahead	(5) 10 Years Ahead	(6) 12 Years Ahead	(7) 14 Years Ahead	(8) 16 Years Ahead
Married	0.0119	0.0191	0.0227	0.0243	0.0255	0.0277	0.0252	0.0243
	(17.10)	(19.43)	(17.26)	(15.98)	(14.88)	(12.89)	(9.09)	(7.21)
Children < 18 present	0.0013	0.0018	0.0011	-0.0005	-0.0015	-0.0037	-0.0041	-0.0024
	(1.34)	(1.60)	(0.75)	(-0.32)	(-0.91)	(-2.05)	(-2.15)	(-1.32)
Years since moved in	0.0004	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006
	(10.92)	(11.90)	(12.18)	(11.11)	(8.53)	(7.19)	(6.62)	(6.43)
Like neigh (1 to 10)	0.0016	0.0026	0.0036	0.0043	0.0051	0.0050	0.0051	0.0056
	(6.74)	(9.00)	(9.75)	(11.67)	(11.23)	(9.51)	(9.23)	(8.19)
Like home (1 to 10)	0.0016	0.0024	0.0030	0.0027	0.0028	0.0028	0.0025	0.0015
	(5.45)	(7.00)	(8.00)	(5.59)	(5.17)	(5.39)	(4.35)	(2.03)
MSA by Year FE	2,047	1,900	1,753	1,606	1,459	1,312	1,167	1,021
Observations	316,444	302,639	259,581	241,216	209,429	184,617	160,499	137,661
Within R-squared	0.0382	0.0518	0.0602	0.0661	0.0728	0.0790	0.0806	0.0827
Total R-squared	0.0412	0.0547	0.0625	0.0683	0.0747	0.0806	0.0823	0.0841

[a] Estimates are from linear probability models using the 1985-2013 American Housing Survey Bi-Annual Panel. Dependent variables equals 1 if own in year t+K and 0 if rent. All observations are owner-occupied in year-t. T-ratios based on robust standard errors clustered at the MSA-by-year level are in parentheses.

Table 4: Predicted Homeownership Status[a]

Panel A: Predicted Homeownership Rate by Current Owner-Occupancy Status

Prob(Own) in %	Currently Rented	Currently Owner-Occupied	Total
< 0.50	77.52	7.44	31.54
0.50 to 0.60	4.34	3.02	3.47
0.60 to 0.70	5.51	5.45	5.47
0.70 to 0.80	5.96	12.49	10.24
0.80 to 0.90	4.35	22.46	16.23
0.90 to 1.0	1.90	26.99	18.36
> 1.0	0.41	22.16	14.68
Total	100	100	100

Panel B: Current Owner-Occupancy Status by Predicted Homeownership Rate

Prob(Own) in %	Currently Rented	Currently Owner-Occupied	Total
< 0.50	84.53	15.47	100
0.50 to 0.60	42.99	57.01	100
0.60 to 0.70	34.65	65.35	100
0.70 to 0.80	20.00	80.00	100
0.80 to 0.90	9.22	90.78	100
0.90 to 1.0	3.55	96.45	100
> 1.0	0.97	99.03	100
Total	34.39	65.61	100

[a]Values in the table were computed based on the estimated probability that a home is currently owner-occupied as reported in Appendix Table A-1. Data for the exercise are the same AHS data used for the models in Table 3.

Table 5: Own-to-Rent Tenure Transitions in the 1985-2013 AHS Panel
For Homes UNLIKELY ($P < 0.9$) and LIKELY ($P > 0.9$) to be Currently Owner-Occupied [a, b]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: UNLIKELY	**2 Years Ahead**	**4 Years Ahead**	**6 Years Ahead**	**8 Years Ahead**	**10 Years Ahead**	**12 Years Ahead**	**14 Years Ahead**	**16 Years Ahead**
CLTV_80 to 90 %	0.0163	0.0112	0.0056	0.0017	-0.0048	-0.0026	-0.0002	-0.0007
	(7.47)	(4.28)	(1.88)	(0.49)	(-1.45)	(-0.71)	(-0.03)	(-0.14)
CLTV 90 to 100 %	0.0136	0.0079	0.0043	0.0046	-0.0030	0.0036	0.0009	0.0009
	(5.22)	(1.91)	(0.90)	(0.96)	(-0.64)	(0.71)	(0.18)	(0.17)
CLTV 100 to 120 %	0.0045	-0.0050	-0.0078	-0.0057	-0.0038	-0.0158	-0.0101	-0.0001
	(1.36)	(-0.98)	(-1.37)	(-0.76)	(-0.51)	(-2.26)	(-1.13)	(-0.01)
CLTV > 120 %	-0.0066	-0.0356	-0.0618	-0.0711	-0.0540	-0.0583	-0.0606	-0.0982
	(-0.94)	(-4.02)	(-4.79)	(-5.33)	(-3.58)	(-3.75)	(-3.62)	(-4.33)
MSA by Year FE	2,045	1,899	1,753	1,606	1,459	1,312	1,166	1,021
Observations	157,221	148,672	127,237	119,044	103,943	92,289	80,944	69,868
Within R-squared	0.0357	0.0485	0.0560	0.0619	0.0698	0.0769	0.0792	0.0824
Total R-squared	0.0380	0.0504	0.0570	0.0630	0.0708	0.0777	0.0803	0.0832
Panel B: LIKELY	**2 Years Ahead**	**4 Years Ahead**	**6 Years Ahead**	**8 Years Ahead**	**10 Years Ahead**	**12 Years Ahead**	**14 Years Ahead**	**16 Years Ahead**
CLTV_80 to 90 %	-0.0038	-0.0080	-0.0089	-0.0060	-0.0018	-0.0084	-0.0109	-0.0078
	(-2.32)	(-3.25)	(-3.63)	(-2.07)	(-0.59)	(-2.31)	(-2.75)	(-1.83)
CLTV 90 to 100 %	-0.0024	-0.0051	-0.0065	-0.0085	-0.0100	-0.0216	-0.0236	-0.0153
	(-0.91)	(-1.54)	(-1.74)	(-2.29)	(-2.24)	(-4.40)	(-3.19)	(-2.08)
CLTV 100 to 120 %	-0.0062	-0.0130	-0.0056	-0.0115	-0.0113	-0.0222	-0.0245	-0.0216
	(-2.11)	(-2.69)	(-1.01)	(-1.64)	(-0.99)	(-2.34)	(-2.50)	(-1.97)
CLTV > 120 %	-0.0148	-0.0158	-0.0136	0.0001	-0.0058	-0.0036	-0.0112	-0.0122
	(-3.05)	(-2.06)	(-1.42)	(0.01)	(-0.51)	(-0.26)	(-0.86)	(-0.69)
MSA by Year FE	2,014	1,873	1,726	1,579	1,431	1,285	1,146	1,005
Observations	159,223	153,967	132,344	122,172	105,486	92,328	79,555	67,793
Within R-squared	0.00418	0.00848	0.0129	0.0161	0.0215	0.0242	0.0286	0.0312
Total R-squared	0.00388	0.00795	0.0121	0.0151	0.0202	0.0233	0.0278	0.0301

[a] Estimates are from linear probability models using the 1985-2013 American Housing Survey Bi-Annual Panel. T-ratios based on robust standard errors clustered at the MSA-by-year level are in parentheses.

[b] Dependent variables equal 1 if own in year t+K and 0 if rent. All observations are owner-occupied in year-t.

Table 6: Own-to-Rent Tenure Transitions in the 1985-2013 AHS Panel
Pre- and Post-2000 by Likelihood of being Currently Owner-Occupied[a, b]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Panel A: UNLIKELY to be Currently Owner-Occupied (*P* < 0.9)				**Panel B: LIKELY to be Currently Owner-Occupied (*P* > 0.9)**			
	2 Yrs Ahead	**4 Yrs Ahead**	**6 Yrs Ahead**	**8 YrsAhead**	**2 YrsAhead**	**4 Yrs Ahead**	**6 Yrs Ahead**	**8 Yrs Ahead**
	Initial Survey Year (t) 1985 through 1999				Initial Survey Year (t) 1985 through 1999			
CLTV_80 to 90 %	0.0182	0.0136	0.0064	0.0029	-0.0025	-0.0056	-0.0070	-0.0054
	(6.21)	(4.23)	(2.03)	(0.79)	(-0.95)	(-2.02)	(-2.34)	(-1.56)
CLTV 90 to 100 %	0.0161	0.0091	0.0074	0.0073	-0.0093	-0.0048	-0.0060	-0.0039
	(4.38)	(1.78)	(1.53)	(1.67)	(-1.74)	(-1.03)	(-1.14)	(-0.82)
CLTV 100 to 120 %	0.0066	-0.0023	-0.0043	0.0005	-0.0144	-0.0196	-0.0097	-0.0148
	(1.14)	(-0.38)	(-0.61)	(0.06)	(-2.27)	(-2.17)	(-1.32)	(-1.58)
CLTV > 120 %	0.0024	-0.0314	-0.0538	-0.0582	-0.0245	-0.0143	-0.0048	-0.0098
	(0.17)	(-2.19)	(-3.05)	(-3.63)	(-1.71)	(-1.04)	(-0.54)	(-0.76)
MSA by Year FE	1,170	1,169	1,169	1,168	1,153	1,151	1,150	1,149
Observations	90,228	96,292	87,322	88,155	86,934	93,047	85,026	85,831
Within R-squared	0.0387	0.0531	0.0604	0.0680	0.00449	0.00964	0.0151	0.0179
Total R-squared	0.0402	0.0549	0.0612	0.0694	0.00421	0.00899	0.0146	0.0171
	Initial Survey Year (t) 2003 through 2013				Initial Survey Year (t) 2003 through 2013			
CLTV_80 to 90 %	0.0116	0.0042	0.0006	-0.0073	-0.0053	-0.0103	-0.0113	-0.0080
	(3.45)	(0.88)	(0.09)	(-0.81)	(-2.42)	(-2.08)	(-2.71)	(-1.14)
CLTV 90 to 100 %	0.0108	0.0038	-0.0048	-0.0007	0.0021	-0.0016	-0.0053	-0.0172
	(2.67)	(0.57)	(-0.54)	(-0.05)	(1.03)	(-0.38)	(-0.88)	(-2.33)
CLTV 100 to 120 %	0.0050	-0.0096	-0.0162	-0.0277	-0.0012	-0.0063	0.0021	-0.0019
	(1.15)	(-1.06)	(-1.56)	(-1.75)	(-0.38)	(-1.38)	(0.26)	(-0.21)
CLTV > 120 %	-0.0080	-0.0369	-0.0506	-0.0828	-0.0112	-0.0167	-0.0316	0.0104
	(-0.94)	(-3.10)	(-2.52)	(-3.42)	(-2.29)	(-1.77)	(-1.67)	(0.61)
MSA by Year FE	730	584	438	292	719	580	435	289
Observations	55,854	41,439	30,190	21,265	59,680	48,524	36,267	25,395
Within R-squared	0.0319	0.0429	0.0469	0.0482	0.00482	0.00887	0.0122	0.0149
Total R-squared	0.0352	0.0453	0.0473	0.0484	0.00444	0.00843	0.0120	0.0150

[a] Estimates are from linear probability models using the 1985-2013 American Housing Survey Bi-Annual Panel. T-ratios based on robust standard errors clustered at the MSA-by-year level are in parentheses.

[b] Dependent variables equal 1 if own in year t+K and 0 if rent. All observations are owner-occupied in year-t.

Table 7: Annual Single Family Housing Permits 2006-2018[a]

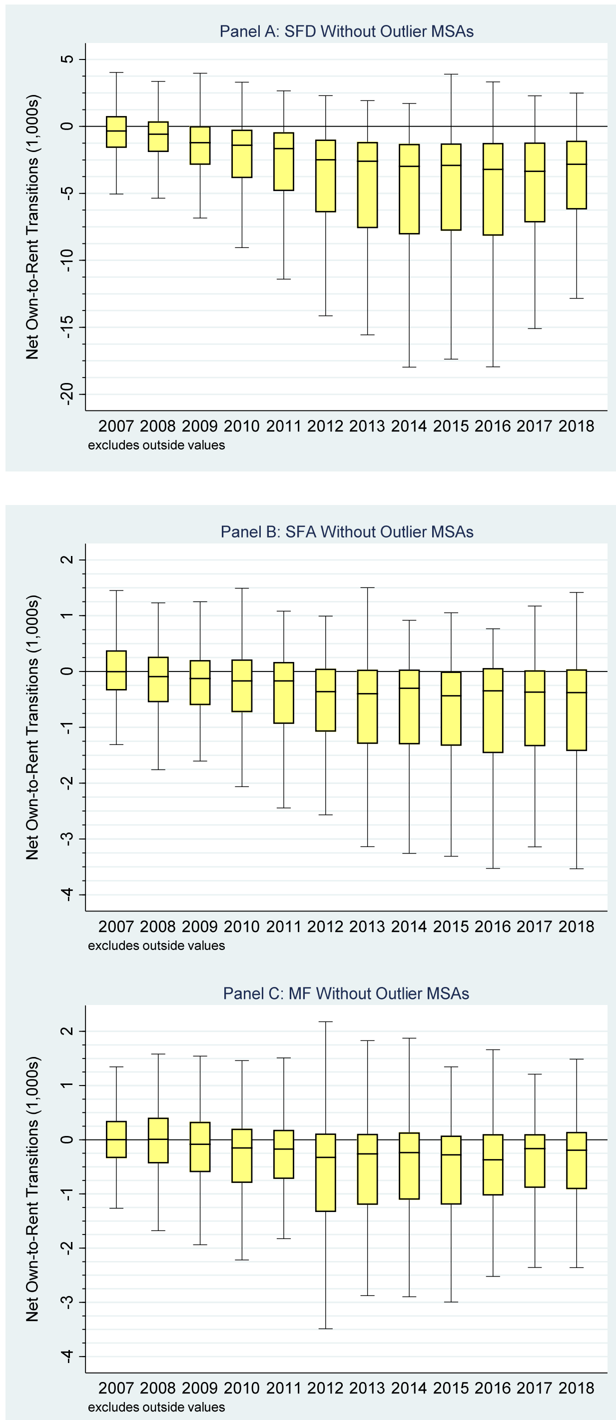
	Metropolitan Level			County Level		
HPI % Chg Since 2006	37.42	36.30	37.11	40.02	39.82	40.45
	(4.64)	(4.69)	(4.69)	(5.84)	(6.00)	(6.17)
Number of vacant SF units	-0.0788	-0.0787	-0.0789	-0.1259	-0.1188	-0.1165
	(-2.39)	(-2.72)	(-2.72)	(-4.19)	(-4.59)	(-4.58)
Net decline in SF owner-occupied homes since 2006						
Vintage Pre-2005	-0.0267	-	-	-0.0659	-	-
	(-2.88)	-	-	(-5.30)	-	-
Vintage 2000-2004	-	-0.2520	-0.2381	-	-0.3261	-0.3133
	-	(-2.69)	(-2.51)	-	(-3.43)	(-3.35)
Vintage Pre-2000	-	-0.0069	-	-	-0.0445	-
	-	(-1.12)	-	-	(-3.43)	-
Vintage 1990's and 1980's	-	-	-0.0306	-	-	-0.0759
	-	-	(-1.35)	-	-	(-2.40)
Vintage 1970's and 1960's	-	-	0.0191	-	-	-0.0094
	-	-	(0.64)	-	-	(-0.22)
Vintage 1950's and 1940's	-	-	-0.0143	-	-	-0.0519
	-	-	(-0.86)	-	-	(-2.57)
Vintage Pre-1940s	-	-	0.0119	-	-	-0.0262
	-	-	(0.78)	-	-	(-1.84)
MSA Fixed Effects	228	228	228	-	-	-
County Fixed Effects	-	-	-	461	461	461
Year Fixed Effects	13	13	13	13	13	13
Observations	2,793	2,793	2,793	5,054	5,054	5,054
Within R-squared	0.324	0.361	0.364	0.345	0.368	0.370
Total R-squared	0.109	0.126	0.131	0.159	0.166	0.169

[a] Dependent variable is the annual number of single-family housing permits including both SFD and SFA permits. T-ratios based on robust standard errors clustered at the level of indicated geography are in parentheses.

[b] County level single family housing permits were obtained from HUD at: https://socds.huduser.gov/permits/index.html . County level repeat sales home price indexes for all transactions were obtained from FHFA at: https://www.fhfa.gov/PolicyProgramsResearch/Research/Pages/wp1601.aspx. Details on the HPI index are available at Bogin et al (2016, 2019). County level single family vacancy rates were calculated using data from the same IPUMs census data used earlier in the paper. Additional separate household level files were downloaded from IPUMs to compute the vacancy counts. Using the individual level data from earlier in the paper, a crosswalk was created that matched weighted county measures to met2013 geography. Those weights were used to aggregate the HPI index, vacant housing, and permits in Table 7 to met2013 geography for the first three columns. Single family own-to-rent transitions at the met2013 level were obtained using the measures reported earlier in the paper. All of those earlier models were rerun at the county level to produce analogous measures for the county-level regressions in Table 7. Mobile homes were excluded in all cases.

Appendix: Supplemental Figures and Tables

Figure A-1: Distribution Across MSAs of Net Own-to-Rent Transitions of Pre-2000 Vintage Homes Since 2006 (Based on Census and ACS Data)



[a] Values are based on the Census and ACS data as described in the text and obtained from www.ipums.org.

Table A-1: Current Housing Tenure (1 if owned; 0 if rented)[a]

Variable	Coefficient	Variable	Coefficient
SFD	0.4497 (112.74)	Junk on street	-0.0149 (-3.38)
SFA	0.3685 (34.19)	Abandoned bldgs on block	-0.0184 (-6.61)
Age of home (years)	0.00004 (0.64)	CBD of MSA	-0.0442 (-20.36)
Garage present	0.1146 (27.82)	Suburb of MSA	-0.0345 (-15.87)
Rooms: 4 to 7	0.1293 (47.59)	Suburb of non-MSA	-0.0457 (-21.86)
Rooms: 8 to 10	0.1488 (37.31)	Log Occupant real income	0.0514 (36.18)
Rooms: > 10	0.1361 (23.95)	Age of head	0.0105 (38.21)
Baths: 2	0.0705 (28.08)	Age squared	-0.0001 (-21.52)
Baths: > 2	0.0736 (21.66)	Married	0.0447 (32.54)
Green space on block	-0.0101 (-3.75)	Children < 18 present	-0.0268 (-10.74)
Water on block	0.0090 (5.86)	Years since moved in	0.0016 (5.82)
Bars on house	0.0154 (3.99)	Like neigh (1 to 10)	-0.0074 (-21.29)
Bars on block homes	-0.0126 (-5.35)	Like home (1 to 10)	0.0228 (56.72)
MSA by Year FE	2,195		
Observations	592,780		
Within R-squared	0.551		
Total R-squared	0.567		

[a] Estimates are from linear probability models using the 1985-2013 American Housing Survey Bi-Annual Panel. T-ratios based on robust standard errors clustered at the MSA-by-year level are in parentheses.

Table A-2: Sample Means by Current Tenure Status and Probability Home is Owner-Occupied[a]

	Owner-Occupied Full Sample (388,938 obs)	Renter-Occupied Full Sample (203,842 obs)	Owner-Occupied P < 0.9 (197,801 obs)	Renter-Occupied P < 0.9 (199,133 obs)	Owner-Occupied P >= 0.9 (191,137 obs)	Renter-Occupied P >= 0.9 (4,709 obs)
Predicted probability owned	0.855	0.277	0.714	0.261	1.000	0.958
SFD	0.882	0.222	0.778	0.204	0.990	0.984
SFA	0.026	0.018	0.040	0.019	0.010	0.016
MF	0.093	0.760	0.182	0.777	0.000	0.000
House Age (years)	38.12	40.67	41.17	40.74	34.98	37.76
Garage	0.791	0.319	0.638	0.304	0.949	0.962
Rooms	6.081	3.939	5.520	3.895	6.662	5.795
Baths	1.529	1.096	1.307	1.083	1.760	1.634
Greenspace adjacent to block	0.236	0.201	0.220	0.200	0.253	0.249
Water feature adjacent to block	0.087	0.063	0.070	0.063	0.105	0.100
Bars on windows of home	0.022	0.034	0.027	0.034	0.016	0.021
Bars on windows on the block	0.045	0.108	0.065	0.110	0.025	0.030
Junk in the street	0.012	0.029	0.017	0.029	0.007	0.007
Abandoned buildings on the block	0.022	0.050	0.034	0.051	0.011	0.016
MSA Central City	0.248	0.477	0.318	0.484	0.176	0.169
MSA Urban	0.376	0.330	0.353	0.328	0.399	0.395
Non-MSA Urban	0.299	0.107	0.239	0.101	0.360	0.364
Rural	0.147	0.055	0.130	0.052	0.164	0.160
Occupant income ($2014; 1,000s)	85.80	41.19	65.89	40.02	106.39	90.71
Age of head (years)	53.02	42.91	47.82	42.64	58.41	54.36
Married	0.661	0.315	0.540	0.304	0.786	0.749
Children < 18 present (1 if yes)	0.258	0.232	0.307	0.232	0.207	0.242
Years since moved in	15.605	7.243	12.559	7.015	18.757	16.878
Like neigh (1 to 10)	8.322	7.525	8.038	7.501	8.617	8.515
Like home (1 to 10)	8.576	7.623	8.153	7.597	9.015	8.704

[a] Samples are from the 1985-2013 American Housing Survey Bi-Annual Panel and are the same as used in estimating the second model in Table 3.