# Sticky Continuing-Tenant Rents*

Joshua Gallin[1], Lara Loewenstein[2], Hugh Montag[3], and Randal Verbrugge[2]

[1]Federal Reserve Board of Governors
[2]Federal Reserve Bank of Cleveland
[3]US Bureau of Labor Statistics

September 16, 2024

PREPARED FOR THE 2024 NORTH AMERICAN MEETING OF THE URBAN ECONOMIC ASSOCIATION (9/21/24).
PRELIMINARY. PLEASE DO NOT CITE WITHOUT PERMISSION.

Declining mobility means that continuing-tenant rents are increasingly important for CPI shelter inflation. However, relatively little is known about them. Using the microdata that underlies CPI shelter, we document facts about continuing-tenant rents. They are sticky, with little cyclical variation in stickiness. Unit-level rent gaps—that is, the log difference between the unit's actual rent and its hypothetical new-tenant rent—grow over a tenancy. Higher new-tenant rents (and rent gaps) are correlated with the frequency and size of continuing-tenant rent changes and the probability of a tenant moving out. The current aggregate rent gap is in the 2.5 to 5 percent range.

**Keywords:** rent inflation, inflation measurement, monetary policy, forecasting
**JEL Classification:** E31, E37, E27, H31

*The views expressed in this paper are solely those of the authors and do not necessarily reflect the opinions of the Federal Reserve Bank of Cleveland, the Federal Reserve System, or the BLS. This paper provides a summary of research results. The information is being released for statistical purposes, to inform interested parties, and to encourage discussion of work in progress. The paper does not represent an existing, or a forthcoming new, official BLS statistical data product or production series. We are thankful for comments from presentation audiences at the Cleveland Fed, the BLS, the BLS-Census Workshop, the Federal Reserve Board, the 2024 annual conference of the Society for Economic Measurement, and the 2024 North American Meeting of the Urban Economic Association; specific feedback from David Zhang; and a helpful discussion from Peleg Samuels.

# 1 INTRODUCTION

The CPI is one of the most important economic indicators, used (for example) in Social Security cost-of-living adjustments, in financial contracts, and in wage escalation. Moreover, it is the basic foundation of the Personal Consumption Expenditures Price Index ("PCE") that forms the inflation objective of the Federal Open Market Committee (FOMC). Since shelter is the biggest component in the CPI (as well as a major component in the PCE), its dynamics are central to understanding inflation, and have proven useful for forecasting PCE inflation (Verbrugge and Zaman (2024)). In the US and in many other countries, official price indexes measure shelter inflation using movements solely in rents. At the time of this writing, CPI rent inflation seems stubbornly high, despite the fact that several alternative rent inflation measures have been subdued for a while.[1]

Adams et al. (2024) demonstrated that the main reason that alternative rent indexes frequently diverge from CPI shelter indexes is that these alternative indexes measure rent inflation experienced by new tenants, whereas the CPI measures rent inflation experienced by *all* tenants. Continuing-tenant rents drive the difference between CPI shelter and alternative indices. Moreover, aggregate renter mobility rates have been declining since 2010, causing continuing tenant rents to compose an increasingly dominant component of CPI shelter inflation.

In this paper,[2] we use the BLS Housing Survey (the micro data that underlies to the CPI) from 1999–present to study the dynamics of continuing-tenant rents. These data are unique in that they include rent observations for a panel of about 40,000 rental units, which are surveyed every six months, and includes information on the move-in date for each tenant. As most leases are annual,[3] this feature allows us to observe almost all changes in rents for continuing tenants over the course of the lease, including during two periods of high turmoil in rental markets: the Great Recession and the COVID-19 pandemic.[4] These data also include information that allows us to identify rents for new tenants.

We make three contributions to the literature. First, we quantify the impact that declining renter mobility has had on the importance of continuing tenant rents (versus new tenant rents) in the CPI tenant rent and owner's equivalent rent (OER) indexes. We find that in 2003 continuing-tenant rents accounted for 85 percent and 87 percent of CPI tenant rent and OER year-over-year inflation respectively. Since 2010, as mobility decline accelerated,

[1]The year-on-year change of the CPI Rent of Primary Residence is 5.1 percent as of July 2024.

[2]This paper builds on its prior version, Gallin and Verbrugge (2017).

[3]See "Housing Leases in the U.S. Rental Market" in the BLS's *Spotlight on Statistics* available at https://www.bls.gov/spotlight/2022/housing-leases-in-the-u-s-rental-market/home.htm.

[4]The only other similar representative dataset that we are aware of is the American Housing Survey, but that only surveys housing units every two years and will therefore miss many changes in rents for continuing tenants.

the share of CPI tenant rent and OER inflation attributable to continuing tenants increased to just under 90 percent and 92 percent in 2024 for CPI tenant rent and OER respectively.

This increasing importance of continuing-tenant rent inflation is the result of a rightward shift in renter tenancy lengths that are a direct result of declining mobility. This implies that understanding the dynamics of continuing-tenant rents is essential to understanding aggregate shelter inflation.

Our second set of results regard the overall degree, and cyclicality, of rent stickiness (the frequency and size of rent changes) for continuing-tenants relative to new-tenants.[5] Continuing-tenant rents are sticky. Prior to 2015, 70 percent of units with continuing-tenants experienced no change in rent over 6-month periods. This fraction gradually fell after 2015, to around 60 percent today. For new-tenants, rents are less sticky, with only 30 percent of units with a new tenant having no rent change prior to 2015. New-tenant rent stickiness also fell gradually after 2015 and is currently just over 20 percent today. Both continuing- and new-tenant rents exhibit more downward stickiness than upward stickiness.

Stickiness does not vary substantially across the business cycle. The exception is during the COVID-19 pandemic period where the share of units without a change rose for both continuing- and new-tenant before reverting back to trend. The size and dispersion of rent changes are also largely uncorrelated with the business cycle.

Our third set of findings relates to the (unit-level) rent gap, which we define as the log difference between the current rent and the hypothetical rent that new tenant might pay for the unit. This rent gap varies over time, becoming especially high during the COVID19 inflationary period. It has since declined. As of March 2024, this gap remains notable: between 2.5 and 5 percent depending on the method of calculation. This gap also varies by tenure length, with continuing-renters with longer tenures generally having larger rent gaps, indicating a continuing-tenant rent discount.

As post-COVID-19 inflation remains above the Federal Reserve's two percent target, there is intense policy interest in the future path of rent inflation. As such, we examine the influence of rent gaps, as well as local vacancies and other local variables, on the frequency and size of continuing tenant rent changes. At the unit level, the size of the rent gap influences both the frequency and the size of continuing-tenant rent changes.

Last, we show that a larger rent gap predicts a slightly lower probability that the tenant will move out within 6 months. This implies that the rent gap and mobility are directly related, although the effect is economically small.

Taken together, the findings noted above are useful for determining which standard theories of price stickiness are consistent with the data in the rental market. Given the industrial

[5] In our work, we distinguish between new tenant rents and "market" rents. Consistent with the usage of this terminology in other contexts, market rents include all rents set at time $t$, whether new tenant leases or continuing tenant lease renewals.

organization of rental markets—with landlords of different levels of scale and sophistication, diverse rental units with highly idiosyncratic match quality, continuing landlord-tenant relationships, and rental market segmentation even within neighborhoods (for example, Adams and Verbrugge (2021))—as well as recent technological advances (such as the availability of Zillow Zestimates, and software such as RealPage YieldStar (later rebranded as AI Revenue Management)[6] that have impacted pricing for sophisticated landlords, it is perhaps not surprising that no single theory appears to be consistent with all of the facts.

Our paper related to the large literature on price-setting behavior for non-housing goods and services such as Calvo (1983); Dotsey et al. (1999); Bils and Klenow (2004); Klenow and Kryvtsov (2008); Nakamura and Steinsson (2008); Vavra (2010); Midrigan (2011); Bils et al. (2012) and Eichenbaum et al. (2014), and especially to the literature on wage stickiness, which includes, but is not limited to Kahn (1997); Pissarides (2009); Hall (2005); Daly and Hobijn (2014); Kurmann and McEntarfer (2019), and Fallick et al. (2022). Just as continuing-tenant rents are stickier than new-tenant rents, wages for workers in continuing worker-firm relationships are stickier than the wage growth experienced by newly-hired workers (Grigsby et al. 2021). However, the consequences of that nominal stickiness for the household are quite different: zero nominal wage growth is usually not good news for a worker, but zero nominal rent growth is usually good news for a tenant. And while the flexibility of new hire wages is the crucial component for many models of frictional labor markets, it is the dynamics of continuing-tenant rents that is more important for inflation dynamics and policy considerations.

The literature on rental market price stickiness is relatively out of date or is not specific to the US. The closest paper to ours is Genesove (2003), who studied rent stickiness in the US over the 1974-1981 period, including conducting some analyses that distinguish between new- and continuing-tenant rents. Aysoy et al. (2014) repeats much of Genesove's analysis in the context of Turkey for the 2008-2011 period. Hoffmann and Kurz-Kim (2006), using German CPI data over the 1998-2003 period to highlight rent stickiness, but did not distinguish continuing-tenant rents from new tenant rents. In the Japanese context—where continuing-tenant leases rarely alter the rent, partly because of institutional constraints noted by Shimizu (2009)—Shimizu et al. (2010), Diewert et al. (2020) and Suzuki et al. (2021) also distinguish between newly-signed leases in turnover versus continuing-tenant units. The paucity of attention paid to micro-level rent dynamics in general, and continuing-tenant rent dynamics in particular, is a surprising gap in the literature, given their importance for monetary policy, for inflation dynamics and real exchange rate dynamics, and also given the importance of rent for household welfare.

[6] In some neighborhoods, the impact of RealPage software is stark. For instance, in one neighborhood in Seattle, 70 percent of apartments were managed by just 10 property managers, each of whom used this product: see Vogell (2024)

There is a small theoretical literature explaining stickiness in rents, including Wang and Zhou (2000), Lai et al. (2007) and Gallin and Verbrugge (2019); our findings provide evidence helpful in discriminating between competing theories of rent stickiness. Finally, our paper also relates to the literature on rent inflation measurement that includes Diewert (2009); Diewert et al. (2009); Crone et al. (2001, 2010); Verbrugge et al. (2017); Gallin and Verbrugge (2019); Adams and Verbrugge (2021) and Adams et al. (2024).

We proceed as follows. In Section 2, we discuss the BLS Housing Survey and our other data sources; In Section 3, we discuss mobility trends and the increasing importance of continuing-tenant rents in CPI tenant rent inflation; In Section 4, we describe our empirical facts about continuing-tenant rent stickiness; In Section 5, we describe our rent gap calculation and related facts; In section 6, we discuss the relationship between continuing-tenant rent inflation and OER; In Section 7, we discuss the implications of our results for macroeconomic modeling; and in Section 8, we conclude.

## 2 DATA

We use the BLS Housing Survey data, which is the confidential survey conducted by the BLS that is used to compute the CPI tenant rent and owners' equivalent rent (OER) indexes. The survey follows a sample of around 40,000 renter-occupied housing units from 75 metro areas across the country.[7]

The survey's multistage sampling design, described in Appendix Section A.1, aims to create a sample representative of rental expenditure. Adams et al. (2024) compare summary statistics from the BLS Housing Survey to the American Housing Survey (AHS), which is another carefully crafted survey of housing units, and show that they are very similar. Housing units in public housing, or where the tenant is a recipient of any rental assistance program that provides them with a non-market rent (as opposed to a voucher program where their rent is the market rent, but the payment is subsidized), are excluded from the BLS Housing Survey.

The relevant feature of the data for this paper is that each housing unit is contacted every six months. Surveyors record the contract rent, the utilities and services (such as parking) included with the rent, any work done by the tenant in lieu of rent,[8] the tenant's move-in date, structure type, major structural changes, whether the property is rent controlled, and some other unit characteristics. Housing units are split into six approximately equal panels, with panel 1 interviewed in January and July, panel 2 interviewed in February and August,

[7] Prior to 2018, the BLS Housing Survey sampled housing units from 87 metro areas. The geographic revision in 2018 consolidated some areas and split others.

[8] For example, if a tenant is responsible for shoveling a sidewalk in exchange for $50 off their monthly rent.

and so on. This allows us to observe most rent changes for each unit including those that are associated with a new tenant and those associated with a lease renewal. Starting in 2012, the BLS sample began converting to a six-year rotation whereby each rental unit is included in the sample for only six years. Prior to 2012, a unit would typically remain in the sample for much longer.

The BLS performs several steps to create an "economic rent" that underlies the official CPI tenant rent index. First, the BLS adjusts the contract rent for any rent discounts such as the tenant receiving the first month free. Second, the BLS adjusts the rent depending on the whether the tenant or the landlord is responsible for utilities. Third, the BLS performs a depreciation adjustment to account the aging of the housing unit. Fourth, for housing units that are vacant or non-responses, the BLS imputes a rent based on similar housing units. For vacant units, this imputation corrects for a vacancy bias that could occur if the unit were to subsequently drop out of the sample.

In almost all of our analysis, we use contract rents adjusted for any in-kind payments made by the tenant, but that do not include adjustments for utilities or aging. Thus, we only use data for which we observe a collected rent, dropping any imputations. When a tenant receives a free months rent, the BLS records this by reducing their current rent by 5/6 (or 4/6 if they received two free months) for that collection period. We adjust any contract rents at the beginning of tenancies that are 5/6 or 4/6 of the next collected contract rents to be equal to their subsequent contract rent. This effectively ignores any free rent concessions that are meant to increase occupancy, and is akin to focusing on "regular" prices in the non-housing context. It also means that we treat all renters the same as we only observe free month rent concessions if we have an observation within 6 months of the tenant moving in, which is not always the case. While most renters have annual leases,[9] in our analysis we find that contract rent changes are not uncommon on 6-month multiples from the move-in date. This is in large part because even for renters signing new leases, contract rents are sticky and often do not change (the probability of a rent change relative to 6 months ago moves between 16 and 24 percent over the remaining course of the tenancy after the tenant has lived in the unit for one year).[10] We therefore focus on rent changes every 6 months.

Summary statistics for the BLS Housing Survey are in Table 1. Values are for the full sample of units in the BLS Housing Survey. Apartments, which includes multifamily buildings of all sizes, make up 60 percent of the sample. Tenants in these units tend to have shorter tenures (a mean of 33 months relative to 36 and 41 months for single family attached and detached respectively). Unsurprisingly, their rents are also changed more frequently, as indicated by the mean rent spell, which is 13 months relative to 15 and 17 months for single

[9]See this: https://www.bls.gov/spotlight/2022/housing-leases-in-the-u-s-rental-market/.

[10]The BLS did start collecting lease information from respondents, but we find no correlation between rent changes in the data and coded lease renewals. This may also be because of errors in data collection.

family attached and detached.

As our measure of new-tenant rent growth, we use the CoreLogic Single Family Rent Index (SFRI), which is a new-tenant rent index for single family attached and detached single family homes. These indexes are available for a select number of cities. We also use effective asking rents by city from CoStar, which is a measure of new-tenant rents for (larger) multifamily properties.

In addition, we use the Quarterly Census of Employment and Wages (QCEW) to measure wage growth, county-level annual population estimates from the Census for population growth, local monthly unemployment rates from the BLS, and city-level multifamily vacancy rates from CoStar.

## 3 RESULTS I: THE INCREASING IMPORTANCE OF CONTINUING-TENANT RENT INFLATION

Over our data period, mobility (as measure by share of new tenants in sample) was roughly constant at about 25 percent 2000-2010, but then declined by about 10 percentage points, to about 15 percent currently. As can be seen in Figure 1a, declining mobility is not unique to our data: we see a similar decline in mobility in two other surveys that are constructed using survey methodology, CPS and ACS.

Mobility has been falling, for both homeowners and renters, since at least 1980. The literature has pointed to numerous factors that contribute to explaining the decline: aging, dual-career households, declining regional variation in the returns to skill, declines in job turnover, declining responsiveness to housing appreciation, labor market adjustments happening via international migration–see Partridge et al. (2012); Molloy et al. (2011, 2016); Kaplan and Schulhofer-Wohl (2017); Olney and Thompson (2024); Basso and Peri (2020); Jia et al. (2023). However, the literature has not settled upon a definitive and comprehensive explanation of this decline.

Below, we document a sharp decline in the move-out hazard rate that occurred over the 2009-2013 period (the move-out hazard has only risen modestly since then). The very gradual decline in measured mobility likely represents the gradual transition to a new equilibrium consistent with the rapid drop in the move-out hazard. We hope that documenting this rapid decline in the move-out hazard will allow future work to more sharply differentiate between competing explanations of the decline in mobility.

Our next task is to demonstrate that continuing tenant rents are increasingly important drivers of CPI shelter indexes. Naturally, declining mobility renders a larger CPI aggregation weight on continuing tenant rents, and we provide this computation below. However, as we explain next, this need not translate into a one-for-one increased influence of said rents on CPI shelter dynamics. To estimate this influence, we must construct new rent indexes.

### *3.1 Decomposing CPI Tenant Rent, and Importance of Continuing Tenant Rents*

In this section we decompose CPI tenant rent inflation into the portion explained by continuing tenant rents and new-tenant rents.

Month-on-month CPI tenant rent inflation is effectively calculated as follows:[11]

$$\pi_t^{t+1} = \frac{\sum_a \left[ \gamma_{a,t} \left( \frac{\sum_i w_{a,s,t} \text{economic rent}_{i,a,s,t}}{\sum_i w_{a,s,t} \text{economic rent}_{i,a,s,t-6}} \right)^{1/6} \right]}{\sum_a \gamma_{a,t}} \tag{1}$$

where $w_{a,s,t}$ is the sampling weight for units in segment $s$ in index-area $a$ in month $t$ and represents the inverse probability of selecting those units. Economic $\text{rent}_{i,a,s,t}$ is the economic rent for housing unit $i$ in segment $s$ in index-area $a$ in month $t$. The economic rent at time $t-6$ includes an aging adjustment that adjusts for decline in unit quality over the last 6 months. Lastly, $\gamma_{a,t}$ is the expenditure weight for index-area $a$ in month $t$, and represents the total rental expenditures in index area $a$ at time $t$ as measured by the Consumer Expenditure Survey.

First, rent-relatives are calculated for each index area by calculating the weighted sum of current rents and rents from the last collection period for those housing units, which was 6 months ago. The sixth root converts these six-month relatives into monthly rent relatives. The weighted average of these rent relatives, where the weights represent aggregate expenditures on rent by index-area, is national rent relative. An index is then constructed using the national rent relative, as in $I_{t+1} = \pi_t^{t+1} I_t$. Finally, a year-on-year log difference is taken to calculate the annual CPI rent inflation rate, $\pi_t^{t+12}$.

We first construct the simple weight measure of the importance of continuing tenants, by computing the share of segment weights attributed to continuing tenants. That share is calculated as the weighted average of the sum of segment weights within each index area for continuing tenant units over the weighted average of the sum of all segment weights within each index area, where the weights are the expenditure aggregation weights used in Equation 2. These are plotted in red in Figure 1b. As expected, the weight on continuing tenant rent has increased notably starting around 2010.

However, this increase in weight need not translate into a one-for-one increased influence of said rents on CPI shelter dynamics. This is because CPI shelter movements can be

[11] The calculation of official CPI tenant rent inflation is slightly more complex. More specifically, first index area rent indexes are created. Then price relatives are calculated relative to a "pivot month"—the month prior to which the index area expenditure weights are updated, which happens every one or two years—using these indexes. The weighted average of these price relatives are then used to create an index from which one month tenant rent inflation is calculated. In practice, however, taking the weighted average of the one month index area price relatives is very close to the official methodology. A comparison is included in Figure B.1 in the appendix.

decomposed into movements in continuing tenant rents, and "jump rates"—the (typically large) movements in the unit's rent when a new tenant moves into the unit. (These jump rates are the current basis of the vacancy imputation in the CPI shelter indexes, a longstanding correction that without which some believe the CPI would be downward biased; see, e.g., Crone et al. (2010), although this belief is not universal.) In principle, increases in average jump rates might greatly mitigate the increased weight on continuing tenant units. To investigate this possibility, we must construct new rent indexes.

To decompose CPI tenant rent inflation into various components, we apply Equation 1 to subsets of the data. In particular, for computing the importance of continuing tenant rent inflation on overall inflation, we initially separate the data into observations where in period $t$, the unit has a new tenant, or a continuing tenant.

This divides the sample into two categories. The first category is comprised of observations where, over the six-month period, the rent change pertains to the same tenant (a continuing tenant rent change). The second category is comprised of observations where, over the six-month period, the rent change pertains to a movement from the last rent experienced by the previous tenant to the first rent experienced by a new tenant: i.e., the jump rate. As is well known, jump rate inflation is notoriously large, reflecting continuing tenant discounts that have been studied in the literature, and that we will discuss in the sequel.

Constructing an inflation rate using each of these two subsets yields two year-on-year inflation series between which lies overall CPI tenant rent inflation. Indeed, CPI rent inflation is a weighted average of these two inflation series. We can back out the weight for continuing tenants by solving for the unknown in the following equation:

$$\pi_t^{t+12} = w_{c,t+12}\pi_{c,t}^{t+12} + (1 - w_{c,t+12})\pi_{n,t}^{t+12} \tag{2}$$

where $\pi_{c,t}^{t+12}$ is annual inflation for continuing tenants and $\pi_{n,t}^{t+12}$ is annual inflation for new-tenants.

A 12-month moving average of the values for $w_c$ are plotted in black in Figure 1b. At a high level, these two alternative measures of the importance of continuing tenant rents yield the same conclusion. The weight of continuing tenant rents in the CPI was 80 percent or more in 2003, fell slightly through 2008, and has since risen markedly to a current weight of almost 90 percent. This finding indicates that it will be difficult to understand the dynamics of CPI rent if one does not understand the dynamics of continuing tenant rents.

We can further decompose CPI rent movements by using further subsets of the data, and applying Equation 1. Specifically, we split each of the two subsamples discussed above into those with *changes* in contract rents and those without, again backing out the weight using the analogue of 2. We then further split the sample into those with positive and negative contract rent changes, and again back out the weight. The weight for each subset with respect to the full-sample CPI tenant rent inflation is the product of each of the weights, so that the weight for continuing tenants with positive rent changes is the weight on continuing tenants times the weight for continuing tenants with rent changes with respect to all continuing tenants, times the weight on continuing tenants with positive rent changes with respect to continuing tenants with rent changes. The same procedure gives weights for new-tenants.

The weights multiplied by their respective inflation rates gives the contribution of each component to overall CPI tenant rent inflation. The results are in Figure 2. The black solid line is overall CPI rent inflation. New-tenants without rent changes are a small share of the sample and have very low rent inflation, so are not visible in the figure. Continuing tenants with no rent changes are visible at the very top. They make up a relatively large share of the sample, though a trivial share of CPI rent inflation. Their inflation rate is non-zero only because it is calculated using economic rent as opposed to the contract rent. (As noted above, economic rent includes changes in the cost of utilities and adjusts for changes in the age of the unit between observations.) Overall, Figure 2 indicates that while new-tenant rent inflation is important to CPI, continuing-tenant rents, and especially continuing-tenants with rent increases, have a large influence on overall CPI tenant rent inflation.

## 4 RESULTS II: FACTS ABOUT CONTINUING TENANT RENTS

### *4.1 Tenure Length and Move-Out Hazard Functions*

Declining mobility has changed the distribution of current tenancies in the BLS housing survey. Figure 4a plots the share of observations of different tenancy lengths in the data at four different time points. In the earlier part of the same, over 30 percent of the sample had a tenant that had moved in less than one year prior, with lower shares for higher tenancies; for instance, only about 20 percent of the sample had a tenant that had been in the unit greater than 6 years. But the tenancy length distribution changed after 2010. In 2015, only about 20 percent of the sample had a tenant that had been in the unit less than one year. In 2020, this had dropped still further. The relative shares of units with tenants that had lived in their units between 1 and 2 years was similar to the earlier periods, but the shares of observations with tenants that had lived in their units longer increased. In 2020, the share of units with a tenant that had been in the unit for more than 6 years increased to over 25 percent of the sample.[12]

AS noted above, move-out hazard functions are closely connected to declining mobility. In Figure 4b we plot the probability that a tenant no longer occupies that unit at the next observation. These are calculated as a hazard rate, so that the denominator is the number of units with a tenant that have stayed in their unit for a given period of time, while the

[12] These distributions vary by property type, as can be seen in Figure B.2 in the appendix.

numerator is the number of tenants who will move out. We calculate this probability for different tenure lengths.

The probability of moving out increased over the 2000-2005 period, and then stabilized. Then, over the 2010-2014 period, the probability of moving out declined notably: hazard rates for all tenure lengths dropped, ending below 2000 rates for shorter-tenure renters. For example, in 2009, the probability that a tenant would move out after one year was over 30 percent. By 2013 it had dropped to 20 percent. This decline in the probability of moving out occurs for both multifamily and single family properties, although the change happens faster for single family properties, as can be seen in Figure B.3 in the appendix.

### *4.2 The Extensive and Intensive Margins of Continuing-tenant and New-tenant Rents*

We continue our analysis by examining the extensive and intensive margins of rent change. Throughout this analysis we will look at rent changes relative to the last observation of that unit (so 6 months prior). We consider 6-month changes instead of annual changes because while the probability of a rent change at 6-month intervals is lower than at 1 year intervals from move-in, they are not negligible. This can be seen in Figure 3, where we plot the hazard of a rent change for given tenure lengths.

We first look at the overall degree, and cyclicality, of rent stickiness, and of rent cuts and of rent increases. We then look at the intensive margin, that is, the size of rent increases and decreases. In examining both margins, we distinguish between continuing tenant rents and new tenant rents.[13] Rents are notoriously sticky (Genesove (2003); Gallin and Verbrugge (2019); Suzuki et al. (2021)). Most of that stickiness comes from continuing tenant rents. This can be seen in Figure 5, where we plot the distribution of rent changes in our sample for continuing- and new-tenants. Over 70 percent of the observations for continuing tenants have the same contract rent as they did 6 months prior. By contrast, about 40 percent of new tenants have the same contract rent as the previous observation for that unit. As in the nominal wage rigidity context, the shape of the distribution—and in particular, its left tail—suggests downward rent rigidity.

A formal test of downward rent rigidity in a given period is given by the ratio of the percentage of units with no change in rent, to the percentage of units with either no change or a decrease in rent (see Fallick et al. (2022))[14]. Appendix Figure B.4 provides a plot

[13]In our work, terminologically we distinguish between new tenant rents and "market" rents. Consistent with the usage of this terminology in other contexts, market rents include all rents set at time $t$, whether new tenant leases or continuing tenant lease renewals.

[14]This estimator derives from Dickens et al. (2007). It assumes that all reported rent changes of zero would have instead been nominal rent cuts in the absence of downward nominal rigidity. Under this assumption, the ratio of the number of zeros to the sum of the number of zeros and the number of nominal rent cuts provides an estimate of the proportion of units that are potentially subject to downward nominal rigidity. Of course, menu costs could result in a spike at zero, as could contract length (most commonly 12 months).

of this ratio over time, for both continuing and new tenants. This averages 89.5 percent percent over time and is remarkably stable for continuing tenants—reflecting the fact that the distribution of rent changes for continuing tenants is quite stable over time—but, as will be evident immediately below, shows cyclical variation for new tenants. For new tenants, this measure averages 58.5 percent percent.

We next look at both margins of rent changes over time. For both continuing tenants and new tenants, rents became somewhat less sticky over our sample period, with nominal rigidity declining since the early 2010s. While this timing coincides with the growth in the use of rent-setting software and with the growth of institutional investment in single-family homes,[15] our data do not include information on landlord characteristics, nor do they allow us to determine how landlords set rents. Rent stickiness varied little during the Financial Crisis and its aftermath, but rose somewhat during the pandemic period, peaking in early 2021 before falling back.

For continuing tenants, stickiness appears to be only modestly cyclical; similarly, the proportion of continuing-tenant units experiencing rent increases, or rent decreases, evidently varies only modestly with overall rent dynamics. Figure 6a plots the share of continuing-tenant rent observations over time that have received a rent increase, a rent decrease, or no change in their contract rent since their last observation 6 months ago. In interpreting this figure, note that if every continuing-tenant unit in the sample experienced a rent change with 100 percent probability every 12 months, we would expect the "no change" line to be flat at 50 percent. The share with no change was essentially trendless until the early 2010s. This share only rose slightly as the Financial Collapse unfolded (while the share of rent increases modestly fell, and the share of decreases modestly rose). However, the share with no change began to decline in the early 2010s from about 70 percent to about 60 percent more recently (interrupted by a much more notable bump associated with the pandemic period). This overall decline in stickiness since the early 2010s has come mainly from an increase in the share of continuing renters seeing a rent increase, which has increased relatively steadily since 2010. The share experiencing a rent decrease has very modestly declined.

As is well known, for units experiencing new tenants, rent stickiness is far less pronounced—and the extensive margins are much more cyclically sensitive. For new tenant rents as well, stickiness fell gradually after 2015, from 30 percent to the low 20s today (interrupted by a pronounced pandemic bump). In this category as well, the overall decline in stickiness

However, as usually modeled, these are symmetric rigidities, which cannot fully explain the asymmetries evident in Figure 5.

[15]The surge of institutional investment in single-family homes as rental properties began in late 2011. Since then, growth has been rapid. A recent Amherst Capital report indicates that institutional investors owned 240,000 single family homes in the U.S. as of January 2019 (Bordia (2019). While overall stickiness for continuing tenants is greater for single family homes than for multifamily homes (see) B.5 in the Appendix), the overall decline in stickiness is similar across theses property types.

has come mainly from an increase in the share of continuing renters seeing a rent increase. Increases and decreases in new tenant rents are much more cyclically sensitive.The fraction of new-tenant units experiencing a rent increase fell markedly (from about 50 percent to near 30 percent) as the Financial Collapse occurred, then rebounded quickly as the economy began to recover. The pattern of rent decreases over this period is a mirror image. During the pandemic, the probability of new tenant units experiencing rent increases initially fell, then rose sharply as rent inflation accelerated. (The probability of rent decreases also fell.)

Turning to the intensive margin, the size of the rent changes also differ between the tenant types. These are depicted in figures 6c and 6d. New tenants see larger changes in their rent in absolute value relative to continuing tenants, with increases for new-tenants averaging about 10 percent relative to about 7 percent for continuing tenants. Declines also hover around 10 percent for new tenants while those for continuing tenants are generally less. Figures B.5 and B.6a in the appendix split the sample by property type.

These graphs indicate little variation over time of the average size of rent changes—until the pandemic period, when (at its onset) the absolute size of rent decreases for continuing tenants increased rather notably (rent decreases increased by about five percentage points), and the absolute size of rent increases rose notably for both categories of renters.[16] This pandemic surge in the size of rent changes is in partial contrast to the case for prices of goods and services other than shelter, where, as Nakamura et al. (2018) demonstrate, the mean absolute size of price changes remained essentially flat over their entire sample period—which includes the Great Inflation.[17] Regarding the extensive margin of those non-shelter prices, there is widespread evidence that this margin covaries positively with inflation; see, e.g., Nakamura et al. (2018) and Montag and Villar (2022).

In Figure 7 we plot an additional measure of rent stickiness for continuing renters: the hazard of the first rent change over time for given tenancy lengths. The hazard is defined as the share of all continuing rents that experience a rent change after having lived in their unit for a given amount of time relative to all renters that have lived in their units that long and have not yet had their rent changed. The results indicate that prior to 2009, the probability of a first rent change after 1 year fluctuated between 20 and 35 percent. After dipping following the Financial Collapse, this hazard rate increased steadily—consistent with rent stickiness declining—dipping then rising sharply during the pandemic period, and ending the sample at about 45 percent. Over time, hazard rates have generally increased since 2010 for longer tenure lengths as well.

Looking at probability of first rent change across tenure lengths for any given time period reveals an overall hazard rate that is generally declining by tenure length. That the hazard

[16] Thus as rents accelerated, this acceleration was driven by both the intensive and extensive margins.

[17] There is, however, a large dispersion in the size of (non-shelter) price changes; see also Blanco et al. (2024b). The latter paper points out that these facts are difficult to reproduce in standard menu-cost models.

rate is declining is not surprising, given the degree of heterogeneity in the rental market (see Álvarez et al. (2005)).

## 5 RESULTS III: THE RENT GAP

### *5.1 Estimating the Rent Gap*

What is the relationship between continuing tenant rents and new tenant rents? To study this question, we construct a hypothetical "new tenant" rent for each tenant/unit pair $i$. We start with the initial rent that was set when tenant $i$ moved into his unit at time $s$ in geographic area $c$: $R_{i,c,s}$. If this unit had turned over continuously since the move-in date, then this initial rent would have grown at the rate of new tenant rents in area $c$. This hypothetical new tenant rent for unit $i$ can be compared to its actual rent.

This estimate is not perfect. For one, we are assuming that the rent at move in is what the new-tenant rent index would imply for that unit. In reality, some units may rent at a higher initial rent and have subsequent lower rent growth over the tenancy, or vice versa: the unit may have had a lower initial rent than the implied new-tenant rent for that market and had subsequent higher rent growth. In the first instance, we will overestimate the rent gap. In the second instance, we will underestimate the rent gap. Another reason our estimates may be off is because of unobserved changes in the quality of the unit over the course of a tenancy.

For single-family detached and attached housing units, we will use the CoreLogic SFRI index for a geographic area c, denoted $L_{c,t}$, as our indicator of new tenant rent movements in that area. When available we will use the city-level attached or detached single-family rent index for their respective property types. Otherwise we will use the city-level detached and attached combined index. For small multifamily units with fewer than 4 units, we use the single family detached. For multifamily units, we will use the city-level quarterly effective asking rent from CoStar. We also create an alternative measure of the rent gap where we fill in missing values for single family and small multifamily properties using the national attached or detached single family rent indexes from CoreLogic.

If the rent for tenant $i$ between time $s$ and $t$ had grown at the new-tenant rate, then its rent today would be given by

$$\tilde{R}_{i,c,t} = R_{i,c,s} \frac{L_{c,t}}{L_{c,s}} \tag{3}$$

Thus, $\tilde{R}_{i,c,t}$ is a a hypothetical "new tenant" rent for tenant $i$. We form the unit-level rent gap, that is the gap between this hypothetical rent and the actual rent at time $t$, according to

$$\text{Rent Gap}_{i,c,t} = \ln \tilde{R}_{i,c,t} - \ln R_{i,c,t} \tag{4}$$

When this rent gap is positive, then the actual rent of the unit lies below the hypothetical new tenant rent. If continuing tenant rents were simply a noisy version of new tenant rents, then this gap would fluctuate randomly about 0.[18]

We can only estimate a rent gap if we observe the tenant at move-in, since otherwise we do not know their initial rent. We set the rent gap for units whose move-in rent is unobserved to the average rent gap for a renter of that tenure in that survey month in that city. Given the change to a rotating 6-year sample, we never observe move-in rents for tenants that have been in their unit longer than 6 years in the more recent sample. We therefore assume all tenants that have remained in their units longer than 6 years have a rent gap equal to the gap for the average 6-year tenancy for that city, property type, and survey month. We winsorize the rent gap at negative and positive 60 percent.

We can estimate rent gaps for about 70 percent of the sample. We do not attempt to estimate gaps for properties that are neither single-family or multifamily residences (e.g., mobile homes). The share of the sample for which we estimate a rent gap is depicted in Figure 8. The red line shows the share of the sample with a rent gap using the procedure described above. The blue line shows the share with a rent gap when we use the national-level CoreLogic SFRI indices to fill in additional values for units where we do not have a city-level SFRI. The national SFRI indices only become available in 2004, which is why the two lines are equivalent prior to that year.

In Figure 9a we plot the average rent gap over time using our two different estimates: the full sample using the national indices is in red, while the estimate using only city-level rent indices is in blue. To calculate this average, we re-weight the distribution of tenure lengths for which we have an estimated rent gap to match the distribution of tenure lengths in the full dataset. We also use CPI weights to adjust for sampling probability.

The rent gap has fluctuated systematically over the past two decades. The average gap is positive, indicating that usually, new tenant rent inflation has exceeded continuing tenant rent inflation. Rent gaps are cyclical: following the financial collapse, new tenant rents fell much faster than continuing tenant rents, so gaps became negative on average. As rents recovered, new tenant rents eventually grew faster, leading to positive rent gaps that peaked sometime near 2015 – after which continuing tenant rents began to slowly catch up.

During the pandemic period, rent gaps rose sharply and reached historic highs: the rent gap rose above 5 percent according to both measures—and even topped out at 10 percent, when estimated using the full sample. Currently, the differential between these alternative estimates remains elevated, and thus these estimates yield conflicting implications about the

[18] Our general approach is loosely related to error-correction models for rent, constructing an error-correction term (or gap) using metro-level or aggregate CPI rents versus new tenant rent analogues (see, e.g., Cotton (2024), Adams et al. (2024)—and see also Loewenstein et al. (2024)) although we are the first to construct unit-level rent gaps.

likely path of rents going forward. In particular, the city sample rent gap has come down substantially, and is effectively at its pre-COVID19 levels,suggesting that continuing-tenant rents have basically caught up with new tenant rents. Conversely, the full sample estimate is still elevated, suggesting that continuing-tenant rent growth is likely to be elevated for some time yet.

Rent gaps vary significantly by tenure length. In Figure 9b we plot the average rent gap over time by tenure length using the city sample. In general, longer tenures result in larger rent gaps, though this is not always true. For example, after the Great Recession, rent gaps for tenants that had remained in their unit 1 year were slightly higher than those for tenants that had remained in their unit for 5 years. This temporary pattern is the result of the decline in new-tenant rents during this period, and provides further evidence that continuing-tenant rents are downward sticky. In Appendix Figures B.7a and B.7b, we show that rent gaps tend to be larger for detached units.

For the rest of the paper we will use the city-sample estimates of rent gap.[19] However, the lack of data for certain cities does create some uncertainty about our measure, as the full sample estimate demonstrates.

### *5.2 The Rent Gap as a Predictor of Rent Changes*

We next run a set of regressions with the rent gap on the right-hand side to see if it has predictive power over and above changes in new-tenant rents for changes in continuing tenant rents. To explore this question, we run regressions of the following form:

$$Y_{i,t} = \beta \text{Rent Gap}_{i,t-1} + \delta \mathbf{X}_{i,c,t} + \gamma_t + \gamma_p + \gamma_c + \epsilon_{i,t} \quad (5)$$

We are interested in both the extensive and intensive margins, that is, whether rent gaps raise the probability of rent adjustment, and whether rent gaps influence the size of an adjustment when it occurs. Thus, $Y$ is either an indicator for: whether there is any rent change; whether there is a positive rent change; whether there is a negative rent change; what the size of the log change in rent conditional on a positive or negative rent change. The vector $X$ includes a host of other controls including city-level growth in new-tenant rents, an indicator for whether the property is rent controlled, growth in CPI excluding shelter, population growth, average wage growth, the multifamily vacancy rate and the change in the unemployment rate, all measured as of time $t-1$ where t is measured in years.

All growth rates are calculated as annual log differences. To avoid overlapping time periods we limit the regression sample to one-year increments from the observation closest to the move-in date.

[19] Table B.1 presents the summary statistics for housing units in this subsample.

The regression results are in Table 2. The first two columns have an indicator of a rent change on the left-hand side of the regression. We have interacted the rent gap with a property type categorical variable in column 2. In these regressions, conditional on other covariates, a bigger rent gap either appears to *reduce* the probability of a rent change (column 1), or reduce it only for single family units but have no influence on other units (column 2).

What is the explanation for this surprising result? It is because a larger rent gap will increase the probability of an *increase* in rent, but will also *decrease* the probability of a decrease in rent. The overall influence on "will the rent change at all?" depends on the relative size of these two disparate impacts. Thus in columns (3)-(4) vs. (5)-(6), we separately investigate the probability of an increase in rent compared to a decrease in rent.

Faster growth in new tenant rents increases the probability of a rent increase—as well as tending to increase the rent gap (see previous subsection). Still, the marginal influence of a larger rent gap is positive, although the effect diminishes for single family houses. Other covariates generally appear to be important: rent controlled units are more likely to see rent increases and local population growth increases the probability that rents rise. Conversely, a rise in the vacancy rate reduces the probability of a rent increase, as does a rise in the local unemployment rate.

Columns (5) and (6) repeat the analysis for rent decreases. A larger rent gap decreases the probability of a rent decrease, which matches our intuition. Higher local wage growth reduces the probability of a rent decrease; a higher vacancy rate and local population growth increase the probability of a rent decrease.

Next, we explore the intensive margin, namely, the impact of the rent gap on the size of the subsequent rent change. In columns (7) and (8), we look at rent increases. The size of a rent increase increases with local new tenant rent growth and the rent gap. The size of rent increases increases with local population and wages, but is smaller for rent-controlled units. In columns (9) and (10), we repeat the analysis for the size of rent decreases. The rent gap increases the size of rent decreases for all structure types. Strangely, a rise in new tenant market rents also raises the size of rent decreases.

In summary, we find that both the rent gap and new tenant market rents affect the probability and size of rent changes, although occasionally in surprising ways. Our analysis confirms that rents respond to local economic forces.

### *5.3 The Rent Gap and Tenure Length*

Does a larger rent gap (a lower current rent relative to the new-tenant rent) predict that a tenant will remain in the unit longer? On the one hand, that tenant is paying a low rental rate relative to what they would pay if they were to move to a similar unit. On the other hand, as shown in Section 5.2, a larger rent gap is correlated with a higher probability of a rent increase, and a larger rent increase conditional on there being an increase. Tenants in units with larger rent gaps may therefore be more likely to move out as they are faced with larger rent increases.

To understand whether larger rent gaps are correlated with the end of tenancies, we run the following regression:

$$\text{Move Out}_{it} = \beta \text{Rent Gap}_{it} + \gamma \mathbf{X} + \delta_c + \delta_{t,m} + \epsilon_{it} \tag{6}$$

where Move $\text{Out}_{it}$ is an indicator for whether the tenant moves out before the next survey, Rent $\text{Gap}_{it}$ is the rent gap for unit $i$ at time $t$, and $X$ is a vector of other covariates that includes year-on-year growth in new-tenant rents, an indicator for whether the property is rent controlled and city-specific economic variables such as: ex-shelter CPI inflation over the last year; population growth; wage growth; the current multifamily vacancy rate; and the annual change in the unemployment rate. The regressions also include city fixed effects ($\delta_c$, and survey month by move-in month fixed effects ($\delta_{t,m}$).

We run the regressions separately for single family homes in column (1)–(4) and multifamily units in columns (5)–(6). The results are in Table 3. A one percentage point increase in the rent gap decreases the move out probability by a statistically significant 0.03 percentage points in all specifications for single-family homes, and decreases the move-out probability by 0.02 percentage points for most multifamily specifications. These effects are small. However, exit from a unit is not entirely exogenous: it is correlated with local economic conditions, such as growth in local population (positively), increases in the local new tenant rent (negatively), and local vacancy rate (positively). Tenants in rent controlled units are significantly less likely to move out, although the effect diminishes with property structure type fixed effects.

## 6 OWNERS' EQUIVALENT RENT: IMPLICATIONS OF RECENT CHANGES IN WEIGHTING

The BLS Housing Survey is not only used to estimate the price index for rent, but is also used to create the index for owner's equivalent rent. Therefore, continuing tenant rent inflation has not only become more influential for CPI tenant rent, but also for OER. Indeed, the January 2023 methodological changes introduced into the CPI in response to Adams and Verbrugge (2021)[20] have increased the weight on detached units, which experience less turnover.[21] This methodological change raises two questions. First, is OER more sensitive to continuing tenant rent inflation? Second, has the recent methodology change made such sensitivity surge?

In Figure 10 we replicate the exercises we conducted in Section 3 with OER. Namely, we calculate a measure of the importance of continuing tenant rent inflation in OER, and decompose annual OER inflation into components, including rent changes for new- and continuing tenants.

Just as for CPI tenant rent, Figure 10a indicates that continuing tenant rent inflation has become an increasingly importance component of OER over time. Moreover, continuing tenant rent inflation is more important for OER than CPI tenant rent. This is because some units in areas without any homeowners are excluded from the calculation of OER. These properties tend to be multifamily homes and therefore have larger turnover. OER is also weighted to towards single-family homes even within the sample that is used for its calculation. The increasing importance of continuing tenant rents in OER is further illustrated in Figure 10b, which is a decomposition of OER inflation into new- and continuing-tenant rent increases and decreases. However, we find no evidence that the recent methodology change has had an appreciable effect on the sensitivity of OER to continuing tenant rent inflation.

## 7 IMPLICATIONS FOR MODELING

Rent is a significant contributor to the macroeconomy for several reasons. First, it is a significant expenditure for many households. Second, it is not purchasable with credit, so households are unable to smooth out rent payments. Third, rent is a consistent and frequent payment for many households, which often enters their budget constraint. Rent stickiness is therefore significant for welfare, macroeconomic modeling, and monetary policy.

As is well known from the price stickiness literature, the source and magnitude of price rigidity will have different implications for the macroeconomy, such as the passthrough of

[20]see https://www.bls.gov/cpi/notices/2022/methodology-changes-2022.htm.

[21]For a theory explaining this, see Halket and di Custoza (2015)

aggregate shocks.[22] Our results do not definitively lead to a single theory of rent rigidity, but do allow us to rule out several simple theories of price rigidity that have been proposed in the literature.

At first glance, a simple Calvo model of price adjustment seems like it should describe rent changes well. Landlords and tenants often sign yearly or multi-year leases, such that rents can only be changed at specific times. However, our results rule out a simple Calvo model of price adjustment. This is because, as we noted above, the probability of a rent change is not merely time-dependent, but rather influenced by changes in local conditions, including the rent gap. Of course, this finding does not by itself rule out a Calvo-plus type of model (Nakamura and Steinsson (2010)), where landlords can update prices by paying a cost as well.

A prominent alternative theory of price stickiness is menu costs: a fixed (or fixed and variable) cost for changing a price. In a literal sense, menu costs exist for most rental units, since most rental units are transacted on the basis of multi-period contracts. But those type of menu costs—that is, the costs of negotiating and writing up a new lease—are borne every time a lease is renewed; and yet, despite these costs being borne, the rent is often unchanged. Thus, if there are other fixed costs of changing a rent upon lease renewal, they must derive from other sources such as the costs of acquiring information or, perhaps, to costs with a behavioral basis, such as customer anger at rent increases thought to be unjustified (see, e.g., Rotemberg (2008)). In the aggregate, some of these types of costs have surely fallen with the advent of rent-setting software, and the widespread availability of Zillow rent estimates for single-family homes. Indeed, the wider availability of such information for landlords may be reflected, as we noted above, in the modest decline in rent stickiness since the early 2010s that was referenced above.

However, menu cost models will face further difficulties in matching all of the evidence—namely, the intensive margin, the extensive margin, and dispersion of price changes—for the reasons noted in Blanco et al. (2024b). Matching all the facts may require a model with time-varying menu costs or modeling along the lines of Blanco et al. (2024a).

Our results illustrate several complexities that may be specific to the rental and real estate markets. We find that rental markets are at least partially segmented along several dimensions, including structure type. Real estate models may benefit from incorporating these segmented patterns. Our results also show that there is a correlation between tenant tenure and the size of the rent gap. This relationship may be driven by a behavioral or information mechanism that could be developed through a model.

[22] For instance, if continuing-tenant rents are sticky because landlords must pay a menu cost to update them, then rents may become more flexible if inflation rises.

## 8 CONCLUSION

This is the first paper to use the BLS Housing Survey to study continuing-tenant rents. Continuing-tenant rents have become increasingly important drivers of CPI rent and OER inflation as mobility has declined, and are thus of key importance for monetary policy deliberations.

Continuing-tenant rents are sticky—much stickier than new-tenant rents—and that stickiness does not vary substantially with the business cycle. This is true for both downward and upward rigidity and for price dispersion. However, this stickiness has declined somewhat since 2015, with the exception of an increase in stickiness surge during the COVID-19 pandemic.

We construct a rent gap measure, which is a unit-level estimate of the difference between the actual rent for the unit compared to the counterfactual rent that would be charged if the rent had kept up with market rents since the tenant moved in. The average rent gaps fluctuate over time, rising through the 2010s and again during the COVID-19 pandemic period. Rent gaps generally increase in tenure length. Current rent gaps are in the 2.5-5 percent range, driven by large rent gaps of longer-tenure tenants. Local conditions, but especially new tenant rents and the (unit-level) rent gap, predict subsequent frequency and size of rent changes.

Rent gaps are an important contributor towards rent changes and thus overall inflation. Future research will have to investigate not only the effects of rent gaps, but the mechanisms through which they operate.[23] For instance, the interaction between tenure and the rent gap suggest that there may be behavioral or informational factors at work, and that rent gaps cannot solely be explained by simple pricing frictions. All told, the facts we document regarding the extensive margin, the intensive margin, and the dispersion of rent changes will be difficult to explain with any simple model of rent stickiness.

[23]See Cotton (2024) and Loewenstein et al. (2024) for examples of forecasting research.

## References


Adams, Brian, Lara Loewenstein, Hugh Montag, and Randal Verbrugge (2024). "Disentangling rent index differences: data, methods, and scope." *American Economic Review: Insights*, 6(2), pp. 230–245.

Adams, Brian and Randal Verbrugge (2021). "Location, location, structure type: Rent divergence within neighborhoods."

Álvarez, Luis J, Pablo Burriel, and Ignacio Hernando (2005). "Do decreasing hazard functions for price changes make any sense?" *Available at SSRN 683151.*

Aysoy, Cem, Cevriye Aysoy, and Semih Tumen (2014). "Quantifying and explaining stickiness in housing rents: A turkish case study with micro-level data." *Journal of Housing Economics*, 25, pp. 62–74.

Basso, Gaetano and Giovanni Peri (2020). "Internal mobility: The greater responsiveness of foreign-born to economic conditions." *Journal of Economic Perspectives*, 34(3), pp. 77–98.

Bils, Mark and Peter J Klenow (2004). "Some evidence on the importance of sticky prices." *Journal of political economy*, 112(5), pp. 947–985.

Bils, Mark, Peter J Klenow, and Benjamin A Malin (2012). "Reset price inflation and the impact of monetary policy shocks." *American Economic Review*, 102(6), pp. 2798–2825.

Blanco, Andrés, Corina Boar, Callum J Jones, and Virgiliu Midrigan (2024a). "The inflation accelerator." Technical report, National Bureau of Economic Research.

Blanco, Andrés, Corina Boar, Callum J Jones, and Virgiliu Midrigan (2024b). "Nonlinear dynamics in menu cost economies? evidence from US data." Technical report, National Bureau of Economic Research.

Bordia, Sandeep (2019). "Single-family rentals growing as an institution-owned asset class."

Calvo, Guillermo A (1983). "Staggered prices in a utility-maximizing framework." *Journal of monetary Economics*, 12(3), pp. 383–398.

Cotton, Christopher D (2024). "The pass-through of gaps between market rent and the price of shelter."

Crone, Theodore M, Leonard I Nakamura, and Richard Voith (2010). "Rents have been rising, not falling, in the postwar period." *The Review of Economics and Statistics*, 92(3), pp. 628–642.

Crone, Theodore M, Leonard Isamu Nakamura, Richard Voith, et al. (2001). *Measuring American rents: a revisionist history.* Economic Research Division, Federal Reserve Bank of Philadelphia.

Daly, Mary C and Bart Hobijn (2014). "Downward nominal wage rigidities bend the phillips curve." *Journal of Money, Credit and Banking*, 46(S2), pp. 51–93.

Dickens, William T, Lorenz Goette, Erica L Groshen, Steinar Holden, Julian Messina, Mark E Schweitzer, Jarkko Turunen, and Melanie E Ward (2007). "How wages change: micro evidence from the international wage flexibility project." *Journal of Economic Perspectives*, 21(2), pp. 195–214.

Diewert, W Erwin (2009). "Durables and owner-occupied housing in a consumer price index." In *Price Index Concepts and Measurement*, pp. 445–500. University of Chicago Press.

Diewert, W Erwin, Alice O Nakamura, and Leonard I Nakamura (2009). "The housing bubble and a new approach to accounting for housing in a cpi." *Journal of Housing Economics*, 18(3), pp. 156–171.

Diewert, W Erwin, Kiyohiko G Nishimura, Chihiro Shimizu, Tsutomu Watanabe, W Erwin Diewert, Kiyohiko G Nishimura, Chihiro Shimizu, and Tsutomu Watanabe (2020). "New estimates for the price of housing in the japanese cpi." *Property Price Index: Theory and Practice*, pp. 299–323.

Dotsey, Michael, Robert G King, and Alexander L Wolman (1999). "State-dependent pricing and the general equilibrium dynamics of money and output." *The Quarterly Journal of Economics*, 114(2), pp. 655–690.

Eichenbaum, Martin, Nir Jaimovich, Sergio Rebelo, and Josephine Smith (2014). "How frequent are small price changes?" *American Economic Journal: Macroeconomics*, 6(2), pp. 137–155.

Fallick, Bruce, Daniel Villar, and William Wascher (2022). "Downward nominal wage rigidity in the United States in times of economic distress and low inflation." *Labour Economics*, 78, p. 102,246.

Gallin, Joshua and Randal J Verbrugge (2016). "Panel data estimates of age-rent profiles for rental housing." Working Paper 16-30, Federal Reserve Bank of Cleveland. doi:10.26509/frbc-wp-201630. URL https://www.clevelandfed.org/en/newsroom-and-events/publications/working-papers/2016-working-papers/wp-1630-age-rent-profiles.aspx.

Gallin, Joshua and Randal J Verbrugge (2017). "Sticky rents." Board of Governors of the Federal Reserve System.

Gallin, Joshua and Randal J Verbrugge (2019). "A theory of sticky rents: Search and bargaining with incomplete information." *Journal of Economic Theory*, 183, pp. 478–519.

Genesove, David (2003). "The nominal rigidity of apartment rents." *Review of Economics and Statistics*, 85(4), pp. 844–853.

Grigsby, John, Erik Hurst, and Ahu Yildirmaz (2021). "Aggregate nominal wage adjustments: New evidence from administrative payroll data." *American Economic Review*, 111(2), pp. 428–471.

Halket, Jonathan and Matteo Pignatti Morano di Custoza (2015). "Homeownership and the scarcity of rentals." *Journal of Monetary Economics*, 76, pp. 107–123.

Hall, Robert E (2005). "Employment fluctuations with equilibrium wage stickiness." *American economic review*, 95(1), pp. 50–65.

Hoffmann, Johannes and Jeong-Ryeol Kurz-Kim (2006). "Consumer price adjustment under the microscope: Germany in a period of low inflation."

Jia, Ning, Raven Molloy, Christopher Smith, and Abigail Wozniak (2023). "The economics of internal migration: Advances and policy questions." *Journal of economic literature*, 61(1), pp. 144–180.

Kahn, Shulamit (1997). "Evidence of nominal wage stickiness from microdata." *The American Economic Review*, 87(5), pp. 993–1008.

Kaplan, Greg and Sam Schulhofer-Wohl (2017). "Understanding the long-run decline in interstate migration." *International Economic Review*, 58(1), pp. 57–94.

Klenow, Peter J and Oleksiy Kryvtsov (2008). "State-dependent or time-dependent pricing: Does it matter for recent us inflation?" *The Quarterly Journal of Economics*, 123(3), pp. 863–904.

Kurmann, André and Erika McEntarfer (2019). "Downward nominal wage rigidity in the United States: new evidence from worker-firm linked data." *Drexel University School of Economics Working Paper Series WP*, 1.

Lai, Rose Neng, Ko Wang, and Jing Yang (2007). "Stickiness of rental rates and developers' option exercise strategies." *The Journal of Real Estate Finance and Economics*, 34, pp. 159–188.

Loewenstein, Lara, Jason Meyer, and Randal Verbrugge (2024). "New-tenant rent passthrough and the future of rent inflation." Technical report, Federal Reserve Bank of Cleveland.

Midrigan, Virgiliu (2011). "Menu costs, multiproduct firms, and aggregate fluctuations." *Econometrica*, 79(4), pp. 1139–1180.

Molloy, Raven, Christopher L Smith, and Abigail Wozniak (2011). "Internal migration in the United States." *Journal of Economic perspectives*, 25(3), pp. 173–196.

Molloy, Raven, Riccardo Trezzi, Christopher L Smith, and Abigail Wozniak (2016). "Understanding declining fluidity in the US labor market." *Brookings Papers on Economic Activity*, 2016(1), pp. 183–259.

Montag, Hugh and Daniel Villar (2022). "Price-setting during the Covid era." Technical report, US Bureau of Labor Statistics.

Nakamura, Emi and Jón Steinsson (2008). "Five facts about prices: A reevaluation of menu cost models." *The Quarterly Journal of Economics*, 123(4), pp. 1415–1464.

Nakamura, Emi and Jon Steinsson (2010). "Monetary non-neutrality in a multisector menu cost model." *The Quarterly Journal of Economics*, 125(3), pp. 961–1013.

Nakamura, Emi, Jón Steinsson, Patrick Sun, and Daniel Villar (2018). "The elusive costs of inflation: Price dispersion during the us great inflation." *The Quarterly Journal of Economics*, 133(4), pp. 1933–1980.

Olney, William W and Owen Thompson (2024). "The determinants of declining internal migration." Technical report, National Bureau of Economic Research.

Paben, Steven P., William H. Johnson, and John F. Schilp (2016). "The 2018 revision of the Consumer Price Index geographic sample." *Monthly Labor Review*. doi:10.21916/mlr.2016.47. URL https://www.bls.gov/opub/mlr/2016/article/the-2018-revision-of-the-CPI-geographic-sample.htm.

Partridge, Mark D, Dan S Rickman, M Rose Olfert, and Kamar Ali (2012). "Dwindling US internal migration: Evidence of spatial equilibrium or structural shifts in local labor markets?" *Regional Science and Urban Economics*, 42(1-2), pp. 375–388.

Pissarides, Christopher A (2009). "The unemployment volatility puzzle: Is wage stickiness the answer?" *Econometrica*, 77(5), pp. 1339–1369.

Ptacek, Frank (2013). "Updating the rent sample for the CPI Housing Survey." *Monthly Labor Review*. doi:10.21916/mlr.2013.25. URL https://www.bls.gov/opub/mlr/2013/article/updating-the-rent-sample-for-the-cpi-housing-survey.htm, institution: US Bureau of Labor Statistics.

Rotemberg, Julio J (2008). "Behavioral aspects of price setting, and their policy implications." Technical report, National Bureau of Economic Research.

Shimizu, Chihiro (2009). "Econometric approach of residential rents rigidity-micro structure and macro consequences."

Shimizu, Chihiro, Kiyohiko G. Nishimura, and Tsutomu Watanabe (2010). "Residential rents and price rigidity: Micro structure and macro consequences." *Journal of the Japanese and International Economies*, 24(2), pp. 282–299. doi:https://doi.org/10.1016/j.jjie.2009.12.006. URL https://www.sciencedirect.com/science/article/pii/S0889158309000665, special Conference Issue Sticky Prices and Inflation Dynamics.

Suzuki, Masatomo, Yasushi Asami, and Chihiro Shimizu (2021). "Housing rent rigidity under downward pressure: Unit-level longitudinal evidence from tokyo." *Journal of Housing Economics*, 52, p. 101,762.

Vavra, Joseph (2010). "The empirical price duration distribution and monetary non-neutrality." *Working paper series, SSRN eLibrary.*

Verbrugge, Randal, Alan Dorfman, William Johnson, Fred Marsh III, Robert Poole, and Owen Shoemaker (2017). "Determinants of differential rent changes: mean reversion versus the usual suspects." *Real Estate Economics*, 45(3), pp. 591–627.

Verbrugge, Randal and Robert Poole (2010). "Explaining the rent–oer inflation divergence, 1999–2007." *Real Estate Economics*, 38(4), pp. 633–657.

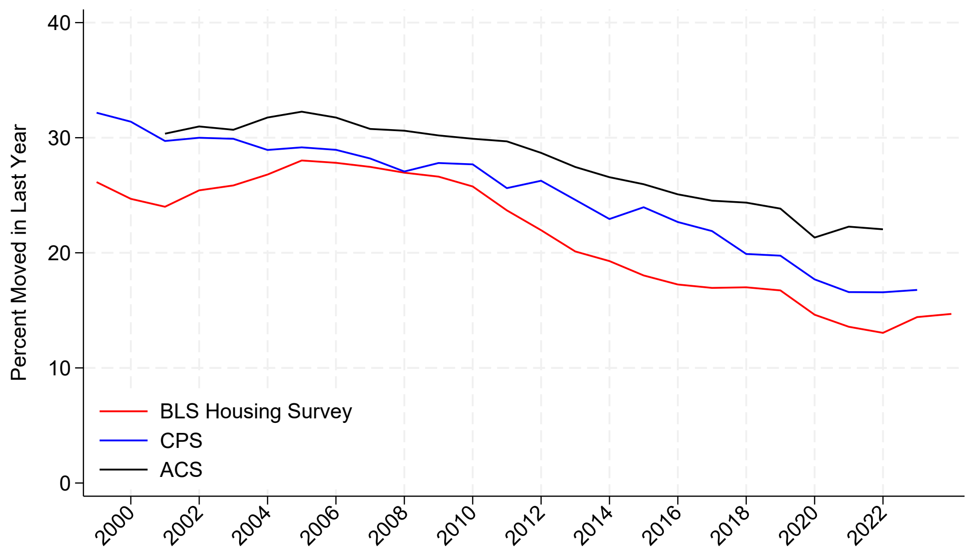
Verbrugge, Randal and Saeed Zaman (2024). "Improving inflation forecasts using robust measures." *International Journal of Forecasting*, 40(2), pp. 735–745.

Vogell, Heather (2024). "Rent going up? one company's algorithm could be why." https://www.propublica.org/article/yieldstar-rent-increase-realpage-rent. Accessed: 2024-07-03.

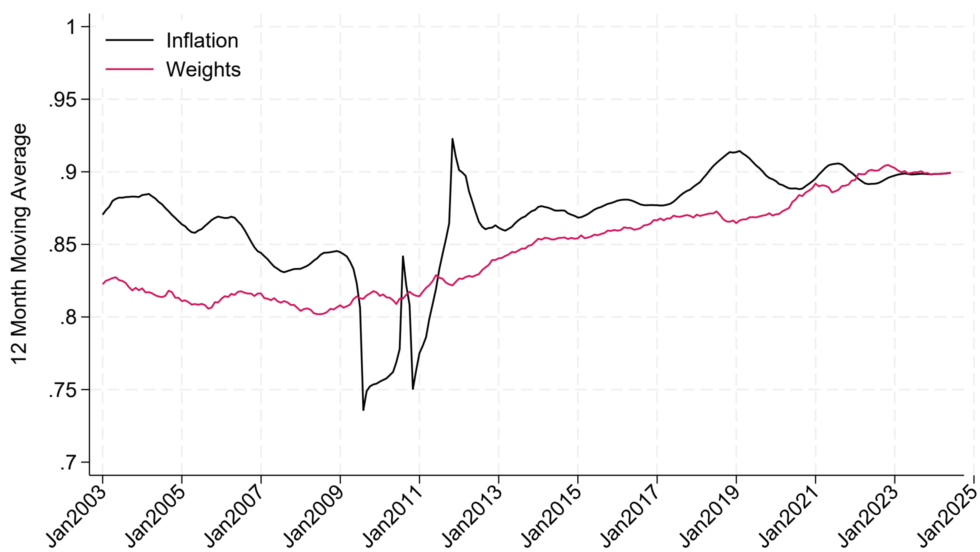
Wang, Ko and Yuqing Zhou (2000). "Overbuilding: A game-theoretic approach." *Real Estate Economics*, 28(3), pp. 493–522.

**Figure 1.** Renter Mobility and the Importance of Continuing Tenants.

**(a)** Renter Mobility

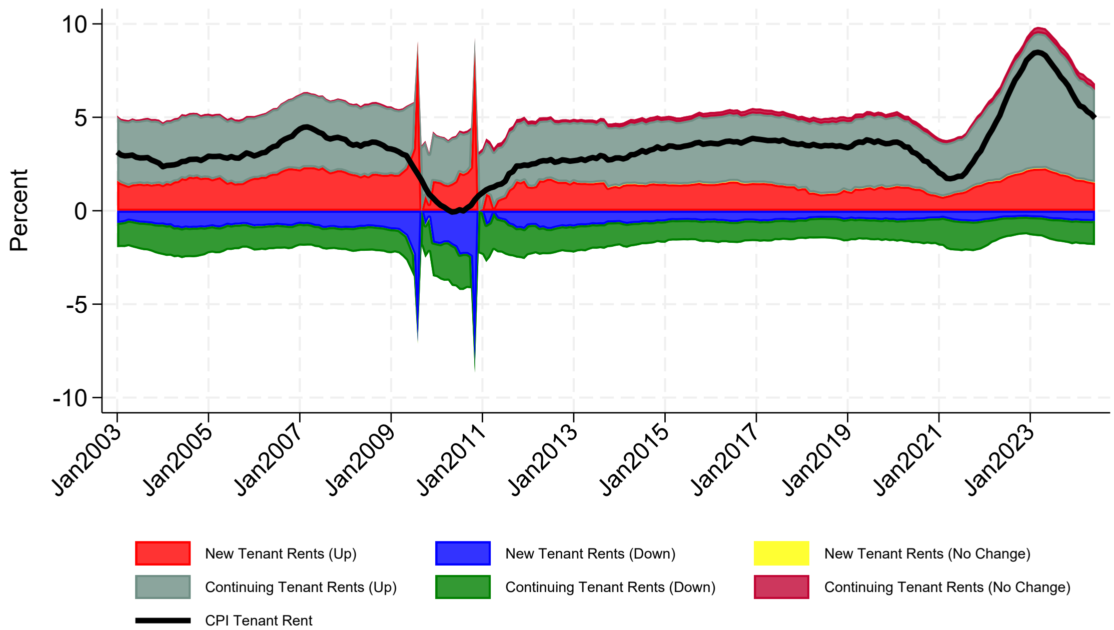



**(b)** Importance of Continuing Tenants in CPI Tenant Rent



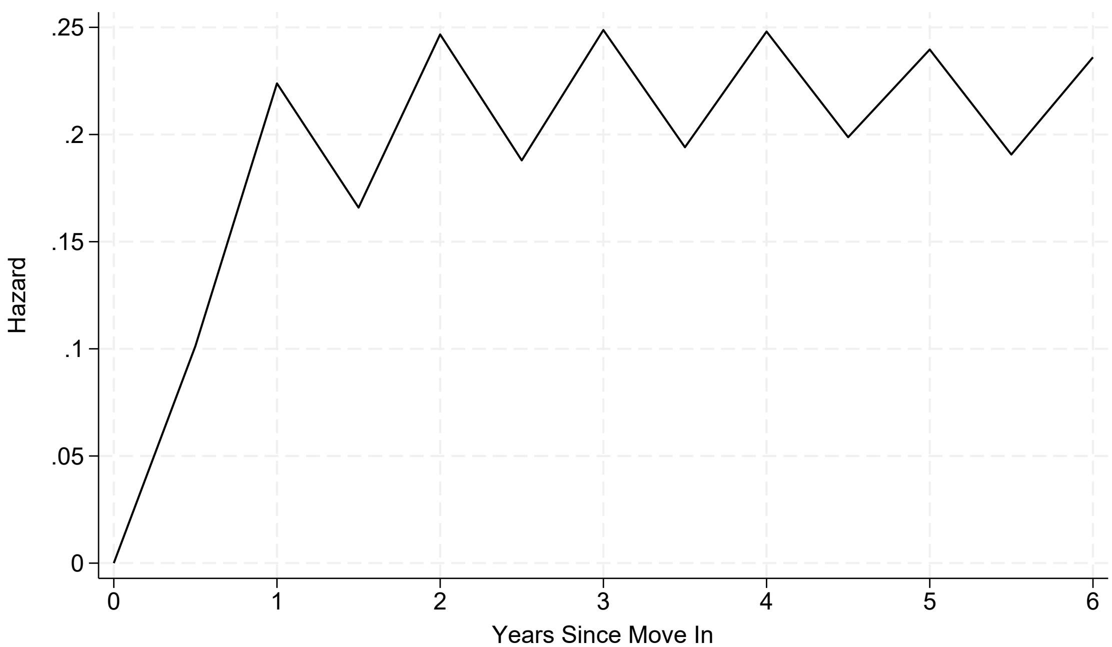

*Note:* Panel 1a is the share of renters that moved in the last 12 months. *Source:* ACS, CPS/ASEC, Authors' calculations using the BLS Housing Survey.

**Figure 2.** Components of CPI Tenant Rent Inflation.




*Note:* Each component is calculated as described in Section 3. Changes in rent are based on contract rents, while inflation is based on economic rents, hence why "no change" can result in non-zero inflation. *Source:* Authors' calculations using BLS Housing Survey

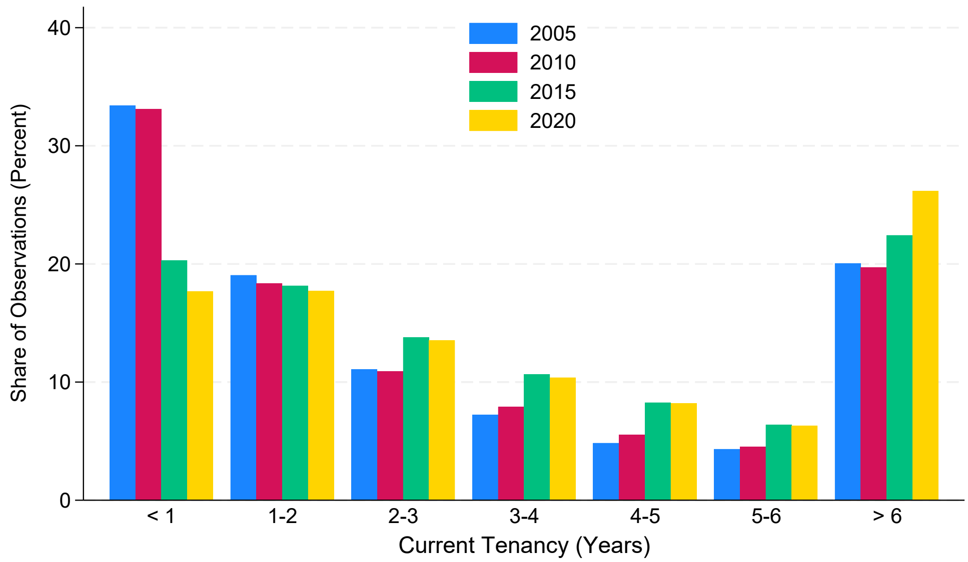
**Figure 3.** Probability of a Rent Change By Tenure Length



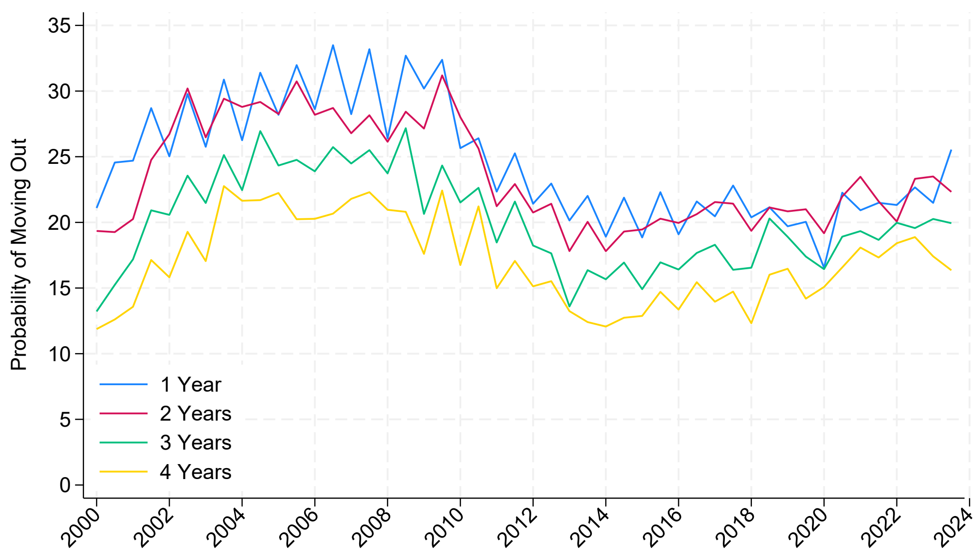

*Note:* Values are the probability of a rent change conditional on the tenure length. This includes all rent changes, not just the first rent change. *Source:* Authors' calculations using BLS Housing Survey.

**Figure 4.** The Probability of Moving Out and the Distribution of Tenancies.

**(a)** Distribution of Current Tenancies

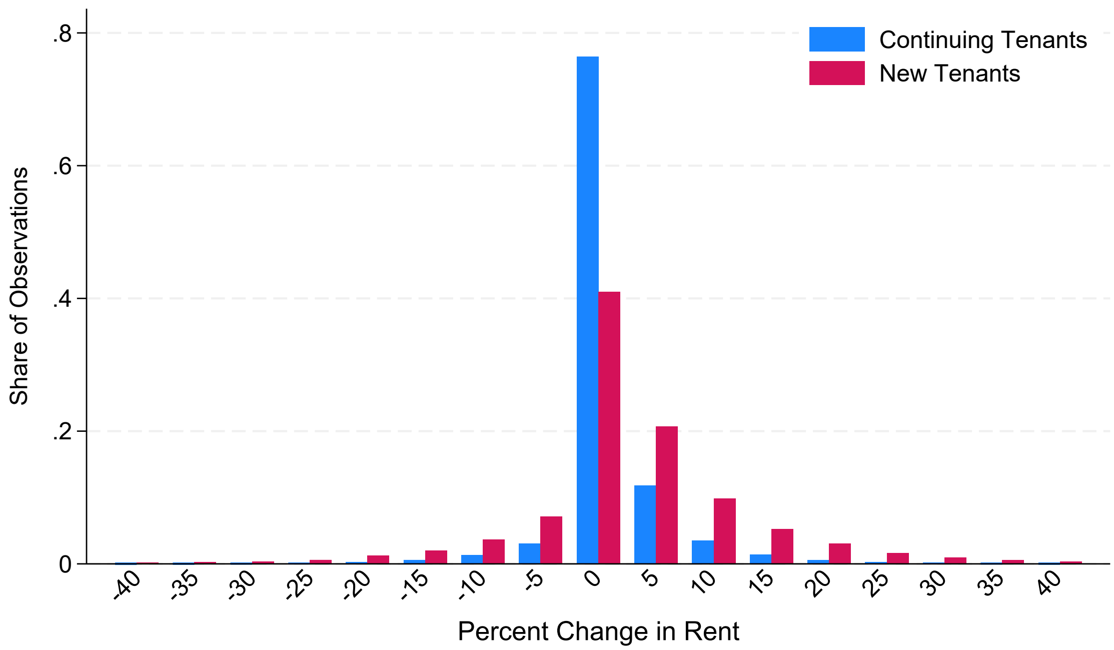



**(b)** Hazard of Moving Out by Tenure




*Note:* Figure 4a is the plot of the current distribution of observed tenures for four separate time periods. Figure 4b is a plot of the probability of a tenant ending their tenancy conditional on having lived in the unit a given number of years. *Source:* Authors' calculations using BLS Housing Survey.

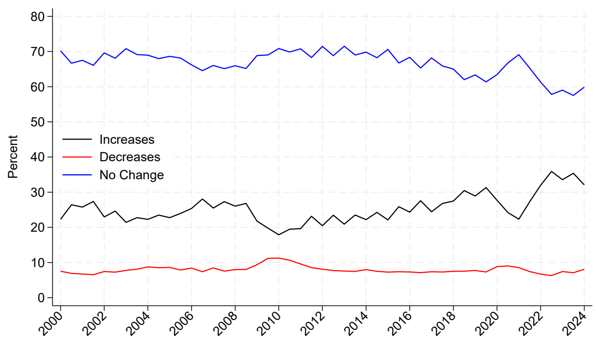
**Figure 5.** Distribution of Rent Change Sizes



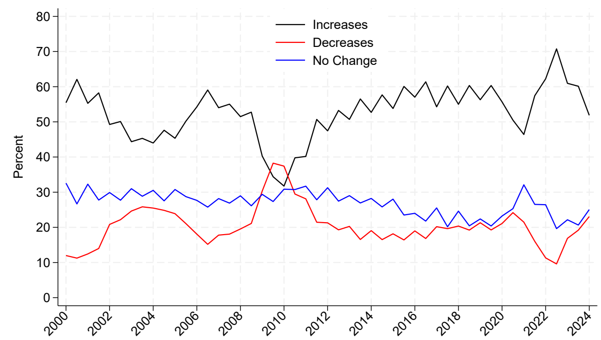

*Note:* The bars indicate the share of observations that experience a log change in contract rent relative to the last observation for that housing unit of a given size for continuing tenants in blue and new tenants in red. *Source:* Authors' calculations using the BLS Housing Survey.

**Figure 6.** Frequency and Size of Rent Changes by Type of Tenant.

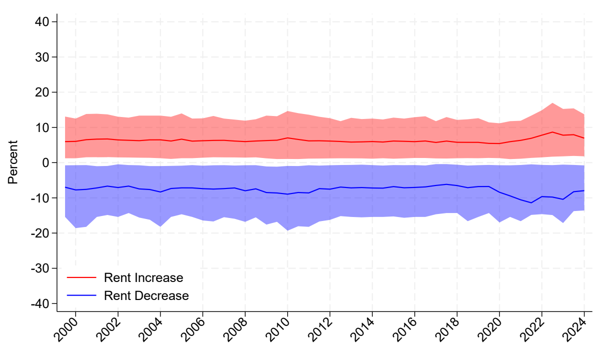
**(a)** Rent Change Frequency: Continuing Tenants



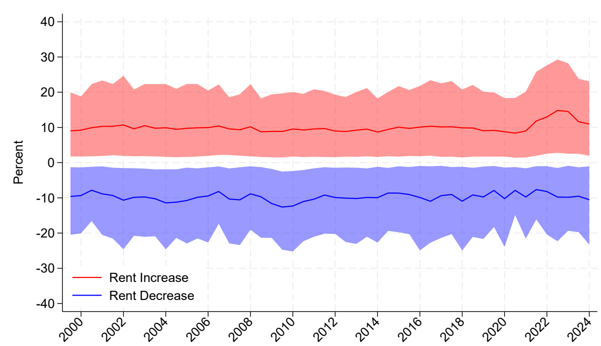

**(b)** Rent Change Frequency: New Tenants




**(c)** Rent Change Sizes: Continuing Tenants

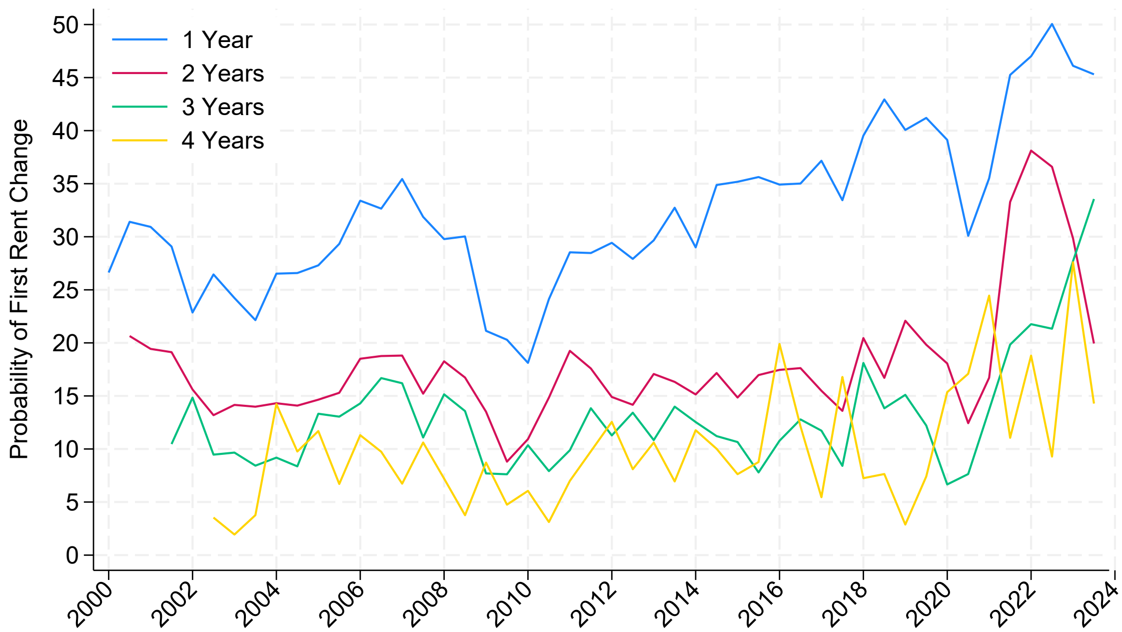



**(d)** Rent Change Sizes: New Tenants



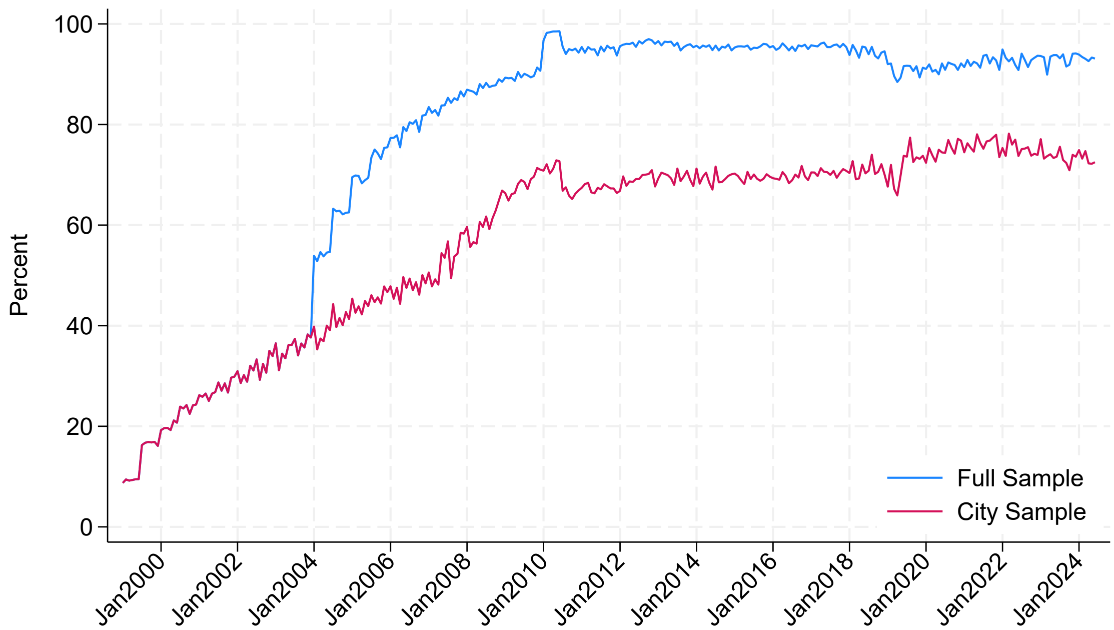

*Note:* The top two panels indicate the share of housing units in every half-year that see an increase, decrease, or no change in their contract rent. The bottom two panels are the log change in contract rent conditional on an increase or decrease. *Source:* Authors' calculations using the BLS Housing Survey.

**Figure 7.** Probability of First Rent Change by Tenure Length.




*Note:* Values depict the share of housing units that experience a change in their contract rent conditional on the tenant having remained in the unit a given period of time and having not yet received a rent change. *Source:* Authors' calculations using the BLS Housing Survey.

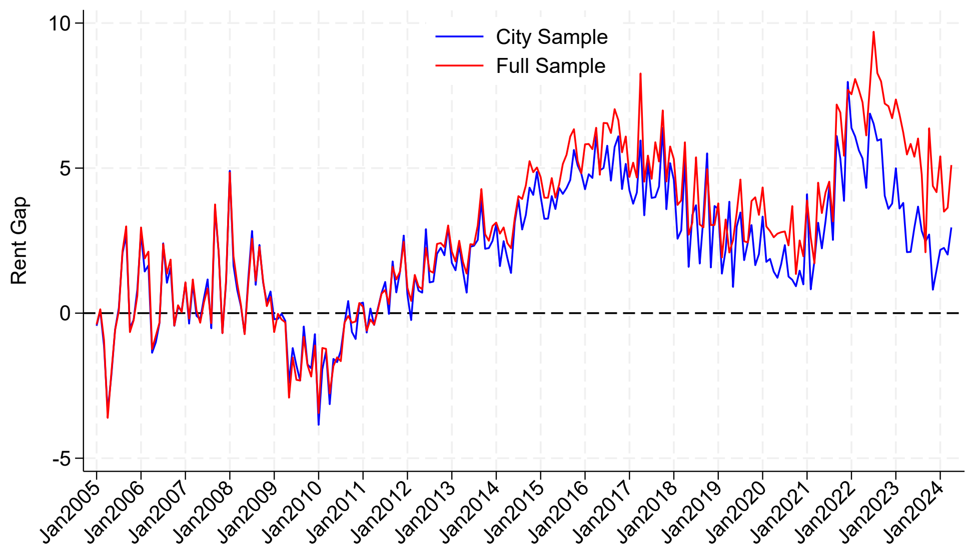
**Figure 8.** Share of Observations With A Rent Gap.



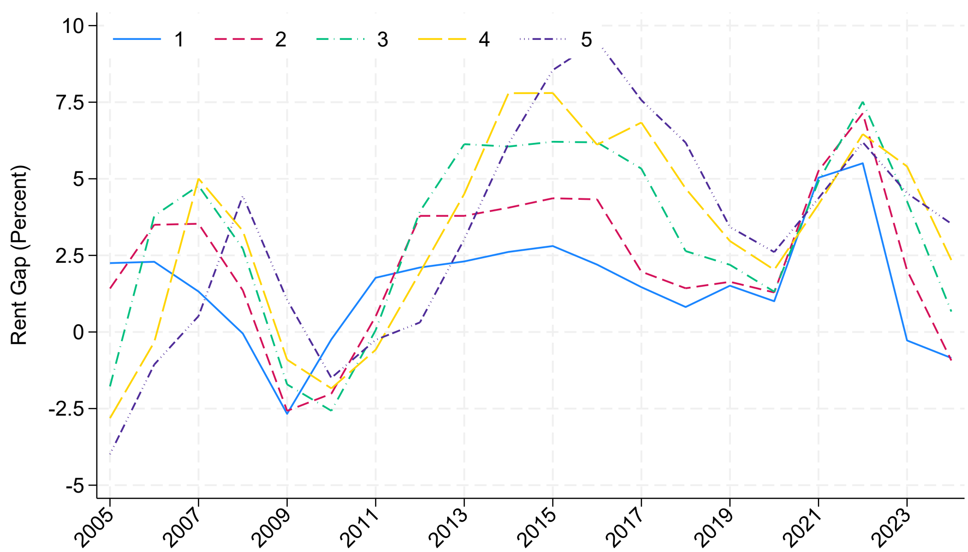

*Note:* The rent gap is calculated as described in Section 5.1. The full sample estimates the rent gap for additional single family attached and detached homes using the national single family rent indices from CoreLogic. *Source:* Authors' calculations using the BLS Housing Survey, CoreLogic SFRI, and CoStar.

**Figure 9.** The Rent Gap Over Time and Across Tenures.

**(a)** Average Rent Gap



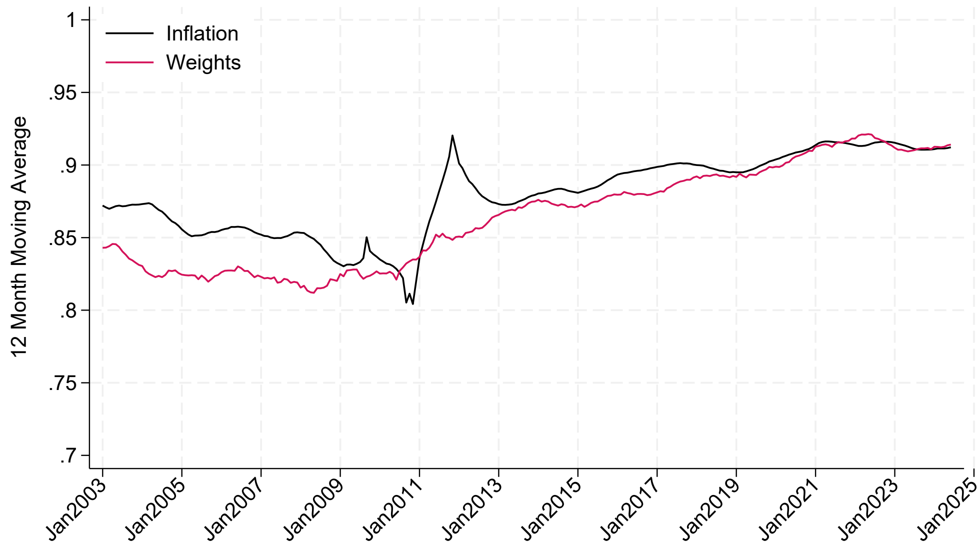

**(b)** Median Rent Gap by Tenure



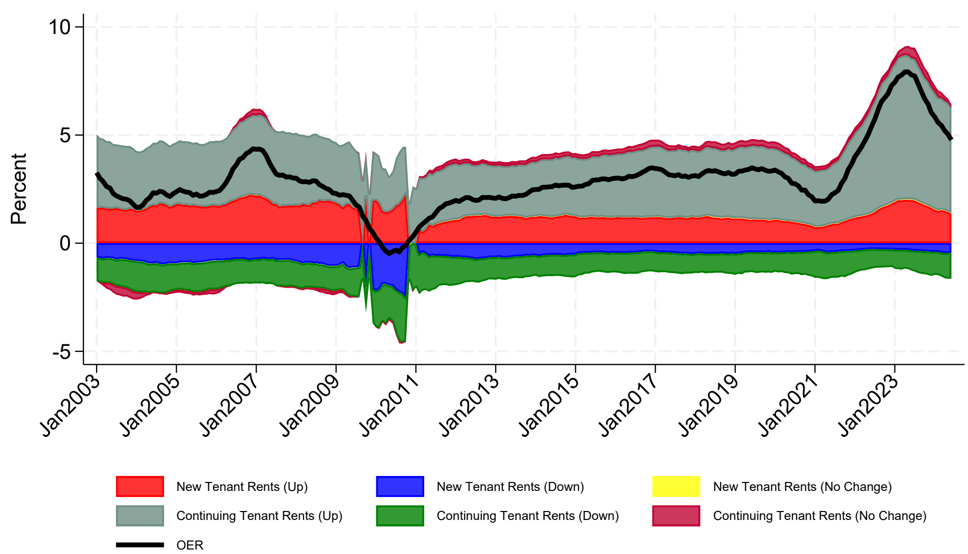

*Note:* The rent gap is calculated as the difference between an estimated new-tenant rent based on city-level property-type specific rent indices. The full sample estimate displayed in Figure 9a using property-type specific national indices to estimate the rent gap for additional observations. Figure 9b is a plot of the median rent gap for renters that have remained in their unit for a specific number of years. *Source:* Authors' calculations using the BLS Housing Survey, CoreLogic Single Family Rent Indices, and CoStar effective asking rent indices.

**Figure 10.** Continuing Tenants and Owners Equivalent Rent.

**(a)** Importance of Continuing Tenants in OER




**(b)** Components of OER Inflation




*Note:* These figures are the same exercises as described in Section 3 except for owners equivalent rent as opposed to tenant rent. *Source:* Authors' calculations using BLS Housing Survey.

**Table 1.** Summary Statistics.

| Structure Type | Obs. (#) | Share (%) | Mean Rent ($) | Median Rent ($) | Mean Tenure Length (months) | Median Tenure Length (months) | Mean Rent Spell Length (months) | Median Rent Spell Length (months) |
|---|---|---|---|---|---|---|---|---|
| Single Family Detached | 275,326 | 22 | 1120 | 900 | 41 | 26 | 17 | 12 |
| Single Family Attached | 203,433 | 16 | 894 | 750 | 36 | 22 | 15 | 12 |
| Apartment | 759,704 | 60 | 983 | 829 | 33 | 20 | 13 | 12 |
| All | 1,271,757 | 100 | 991 | 815 | 34 | 21 | 14 | 12 |

*Note:* Shares of single family detached, sinle family attached, and apartment do not add up to 100 because there are other property types (such as mobile homes) included in the total. *Source:* Authors' calculations using the BLS Housing Survey.

**Table 2.** The Rent Gap as a Predictor of Rent Changes

| | Probability of Rent Change | | | | | | Size of Rent Change | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Rent Change (%) | | Rent Up (%) | | Rent Down (%) | | Rent Change (Up) | | Rent Change (Down) | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Rent $\text{Gap}_{t-1}$ | -0.05** | -0.04* | 0.08*** | 0.06*** | -0.13*** | -0.10*** | 0.07*** | 0.09*** | 0.08*** | 0.10*** |
| | (0.02) | (0.02) | (0.03) | (0.02) | (0.02) | (0.01) | (0.01) | (0.02) | (0.01) | (0.03) |
| SF Attached × Rent $\text{Gap}_{t-1}$ | | -0.13** | | -0.10** | | -0.03 | | 0.01 | | 0.01 |
| | | (0.06) | | (0.04) | | (0.04) | | (0.05) | | (0.05) |
| Multifamily × Rent $\text{Gap}_{t-1}$ | | 0.00 | | 0.03 | | -0.03* | | -0.03* | | -0.03 |
| | | (0.03) | | (0.04) | | (0.02) | | (0.02) | | (0.03) |
| $\Delta \ln$ New-Tenant $\text{Rent}_{t-1}$ | 0.85*** | 0.85*** | 0.98*** | 0.98*** | -0.13* | -0.13* | 0.10*** | 0.10*** | 0.30*** | 0.29*** |
| | (0.13) | (0.13) | (0.10) | (0.10) | (0.07) | (0.07) | (0.02) | (0.02) | (0.08) | (0.08) |
| Rent Controlled | 3.24** | 3.24** | 3.09** | 3.09** | 0.15 | 0.15 | -1.21*** | -1.22*** | -0.18 | -0.18 |
| | (1.35) | (1.35) | (1.19) | (1.19) | (0.31) | (0.31) | (0.16) | (0.16) | (0.66) | (0.66) |
| $\Delta \ln$ CPI Ex $\text{Shelter}_{t-1}$ | -0.05 | -0.05 | 0.10 | 0.10 | -0.15 | -0.14 | 0.00 | 0.00 | 0.13 | 0.14 |
| | (0.16) | (0.16) | (0.14) | (0.14) | (0.09) | (0.09) | (0.04) | (0.04) | (0.16) | (0.16) |
| $\Delta \ln \text{Population}_{t-1}$ | 19.08*** | 19.09*** | 14.44*** | 14.44*** | 4.65** | 4.65** | 1.67*** | 1.67*** | -0.35 | -0.34 |
| | (4.89) | (4.89) | (3.03) | (3.03) | (2.12) | (2.13) | (0.32) | (0.32) | (1.05) | (1.06) |
| $\Delta \ln \text{Wage}_{t-1}$ | -1.34 | -1.34 | 13.06 | 13.06 | -14.40*** | -14.40*** | 6.83*** | 6.82*** | -1.58 | -1.58 |
| | (10.34) | (10.36) | (13.50) | (13.52) | (5.01) | (5.01) | (1.36) | (1.36) | (3.95) | (3.94) |
| Vacancy $\text{Rate}_{t-1}$ | -55.78** | -55.78** | -72.06*** | -72.03*** | 16.28** | 16.25** | 1.66 | 1.59 | 7.57 | 7.58 |
| | (20.94) | (20.91) | (17.57) | (17.55) | (7.30) | (7.29) | (3.97) | (3.98) | (16.42) | (16.44) |
| $\Delta$Unemp. $\text{Rate}_{t-1}$ | -0.14 | -0.14 | -0.32** | -0.32** | 0.18 | 0.18 | 0.08 | 0.08 | 0.09 | 0.09 |
| | (0.23) | (0.23) | (0.15) | (0.15) | (0.13) | (0.13) | (0.07) | (0.07) | (0.16) | (0.16) |
| Possible Remodel | 10.49*** | 10.49*** | 5.76** | 5.76** | 4.73*** | 4.72*** | 3.24*** | 3.23*** | -1.73** | -1.74** |
| | (2.04) | (2.04) | (2.66) | (2.66) | (1.07) | (1.07) | (1.07) | (1.07) | (0.65) | (0.65) |
| $R^2_a$ | 0.05 | 0.05 | 0.06 | 0.06 | 0.01 | 0.01 | 0.02 | 0.02 | 0.03 | 0.03 |
| Observations | 335,650 | 335,650 | 335,650 | 335,650 | 335,650 | 335,650 | 95,547 | 95,547 | 28,210 | 28,210 |
| Month FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Prop Type FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| PSU FEs | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

*Note:* Columns 1-6 are linear probability models with an indicator for a rent change in columns 1 and 2, an indicator for a rent increase in columns 3 and 4, and an indicator for a rent decrease in columns 5 and 6. Columns 7-10 have log changes in rent on the left-hand side, where those changes are conditional on a rent increase in columns 7 and 8 and conditional on a rent decrease in columns 9 and 10. The regression sample is limited to observations that are one year increments from the first observation closest to the move-in date. All differences are from one year prior. *Source:* Authors' calculations using BLS Housing Survey, CoreLogic SFRI, BLS CPI indices and local unemployment rates, Census population estimates, the QCEW, and CoStar.

**Table 3.** Effect of Rent Gap on Probability of Moving Out

| | Probability of Moving Out (in percentage points) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Single Family Homes | | | | Multifamily Homes | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Rent Gap | -0.03** | -0.03** | -0.03** | -0.03** | -0.03*** | -0.02*** | -0.02*** | -0.02*** |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) |
| $\Delta \ln$ New-Tenant Rent$_t$ | -0.12*** | -0.08* | -0.08* | -0.08* | -0.32*** | -0.24*** | -0.23*** | -0.23*** |
| | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) |
| $\Delta \ln$ CPI Ex Shelter | 0.19 | 0.19 | 0.19 | 0.19 | 0.25** | 0.22** | 0.23** | 0.23** |
| | (0.18) | (0.18) | (0.18) | (0.18) | (0.10) | (0.10) | (0.10) | (0.10) |
| $\Delta \ln$ Population | 0.05 | 0.13 | 0.13 | 0.14 | 0.44*** | 0.51*** | 0.53*** | 0.53*** |
| | (0.18) | (0.18) | (0.18) | (0.19) | (0.09) | (0.09) | (0.09) | (0.09) |
| Rent Controlled | -2.33*** | -2.28*** | -2.28*** | -2.28*** | -0.59* | -0.57* | -0.57* | -0.57* |
| | (0.85) | (0.85) | (0.85) | (0.85) | (0.31) | (0.31) | (0.31) | (0.31) |
| Vacancy Rate | | 0.45*** | 0.45*** | 0.46*** | | 0.36*** | 0.35*** | 0.35*** |
| | | (0.12) | (0.12) | (0.12) | | (0.06) | (0.06) | (0.06) |
| $\Delta \ln$ Wage$_{t-1}$ | | | 0.00 | 0.01 | | | -0.10*** | -0.10*** |
| | | | (0.06) | (0.06) | | | (0.03) | (0.03) |
| $\Delta$Unemp. Rate | | | | -0.13 | | | | -0.02 |
| | | | | (0.15) | | | | (0.07) |
| $R^2_a$ | 0.02 | 0.02 | 0.02 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 |
| Observations | 105,763 | 105,763 | 105,763 | 105,763 | 419,271 | 419,271 | 419,271 | 419,271 |
| Mean(Move Out) | 12.88 | 12.88 | 12.88 | 12.88 | 20.51 | 20.51 | 20.51 | 20.51 |
| sd(Move Out) | 33.49 | 33.49 | 33.49 | 33.49 | 40.38 | 40.38 | 40.38 | 40.38 |
| Mean(Rent Gap) | 4.16 | 4.16 | 4.16 | 4.16 | 1.08 | 1.08 | 1.08 | 1.08 |
| sd(Rent Gap) | 10.01 | 10.01 | 10.01 | 10.01 | 7.57 | 7.57 | 7.57 | 7.57 |
| Survey Month × Move-In Month FEs | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Prop Type FEs | ✓ | ✓ | ✓ | ✓ | - | - | - | - |
| City FEs | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

*Note:* The left-hand side is an indicator for whether a new tenant occupied that unit in period $t+1$. The regression sample is limited to observations that are one year increments from the first observation closest to the move-out date. All differences are from one year prior. *Source:* Authors' calculations using BLS Housing Survey, BLS CPI indices and local unemployment rates, Census population estimates, the QCEW, CoreLogic SFRI, and CoStar.

# Online Appendix

## A DATA

### *A.1 The BLS Housing Survey and the CPI Rent Index*

The BLS Housing Survey uses a multistage sampling design meant to draw a sample representative of rental expenditure.[24] The first stage selects large geographic areas called "primary sampling units" (PSUs). PSU definitions now match metropolitan and micropolitan statistical areas. Before the BLS redesigned its geographic sample in 2018, PSUs had been modified metropolitan statistical areas and groups of counties with smaller towns (Paben et al. 2016). Each PSU is subdivided into segments, which become the fundamental units for sampling and weighting. Segments are often Census block groups. Segments are selected using a probability-proportional-to-size (PPS) method, where "size" is an estimate of total shelter expenditure within the segment. Finally, the BLS randomly samples enough rental units to yield at least five responding units per segment.

The BLS classifies large metro areas as self-representing primary sampling units and calculates rent indices for them individually. Smaller metro areas are classified as non-self-representing PSU's, which are aggregated together when calculating rent indices. Rental units are selected within sampled segments, which generally correspond to Census Block Groups ("neighborhoods") within each metro area.

The BLS selected a new sample in 1999. Subsequently, the survey lost units to demolition, to conversion to other uses, or to respondent non-cooperation.[25] The survey periodically added new units sampled from construction permit data. More recently, the BLS implemented a rolling sample replacement design, with a new sample drawn starting in 2012. Since 2016, units remain in the sample for only six years; one-sixth of the sample is replaced annually.

CPI rent is calculated using the average six-month change in economic rent in that month's sample, which is converted into a monthly change by taking its sixth root. Let $\text{rent}_i^*(t)$ denote economic rent. Then the rent index at time $t$ for a particular index area is constructed as

$$I^R(t) = \left( \frac{\Sigma_i w_i \text{rent}_i^*(t)}{\Sigma_i w_i e^{F_{i,t}} \text{rent}_i^*(t-6)} \right)^{1/6} I^R(t-1) \tag{7}$$

where $w_i$ is the weight for unit $i$,[26] and $F_{i,t}$ is an age-bias factor that lowers the rent level

[24] For more details on the design of the Housing Survey sample see Ptacek (2013).

[25] Gallin and Verbrugge (2016) suggest that sample attrition was concentrated in higher-quality units; such attrition influences aging bias estimates, among other things.

[26] A unit's weight in the rent index depends on the estimated aggregate rent payments from its segment and the response rate for the segment.

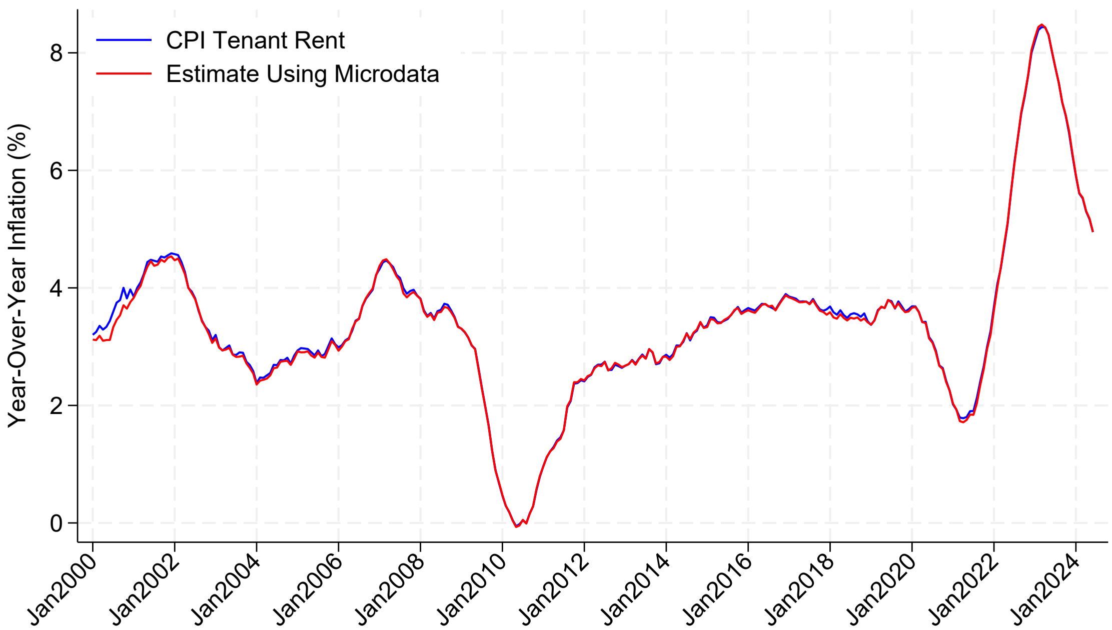
in period $t - 6$ to account for the fact that the observed change in rent will understate the constant-quality change in rent.[27]

Indices are calculated for each index area, which is either a large PSU or the set of PSUs representing the smaller cities in a Census division. The national index derived from the average of changes in the index area indices weighted by rent expenditure in that index area. Until January 2023 the aggregation weights were updated every two years, so that the indices in year $t$ are aggregated using expenditures from $t - 1$ or $t - 2$. Starting in January 2023, the aggregation weights are updated annually.

[27]For more details on the construction of CPI rent see Verbrugge and Poole (2010) or the BLS Handbook of Methods.

## B ADDITIONAL EXHIBITS REFERENCED IN THE MAIN TEXT

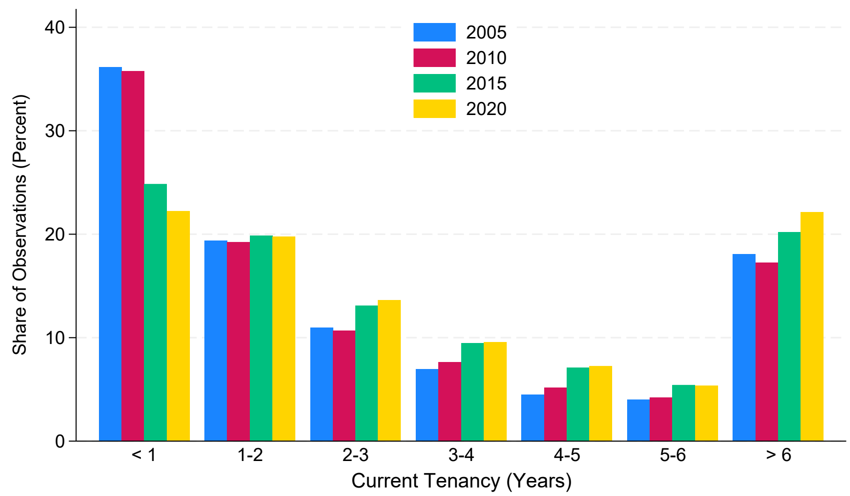
**Figure B.1.** Official CPI Tenant Rent Inflation vs Our Estimate



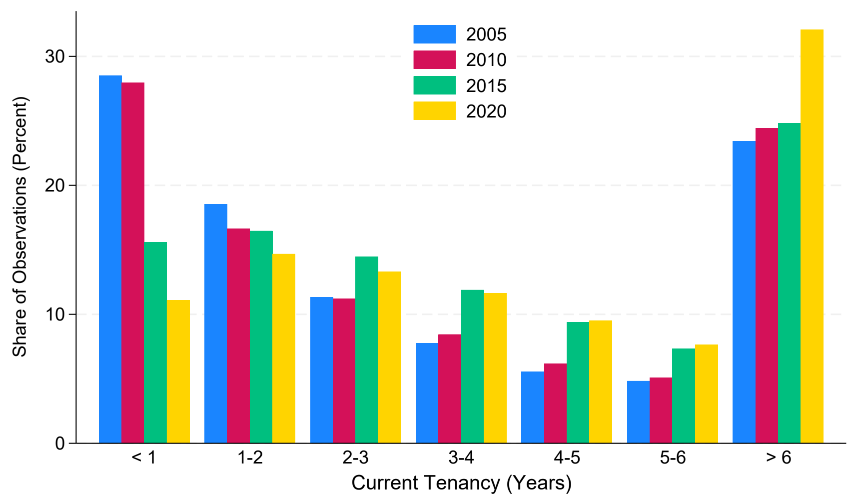

*Note:* The red line is our estimate of year-on-year CPI tenant rent inflation calculated using the weighted average of the one month index area price relatives as in Equation 1. The blue line is year-on-year CPI tenant rent inflation based on the published index. *Source:* Authors' calculations using the BLS Housing Survey and the BLS CPI tenant rent index.

**Figure B.2.** Distribution of Current Tenures by Property Type.

**(a)** Current Tenures: Multifamily

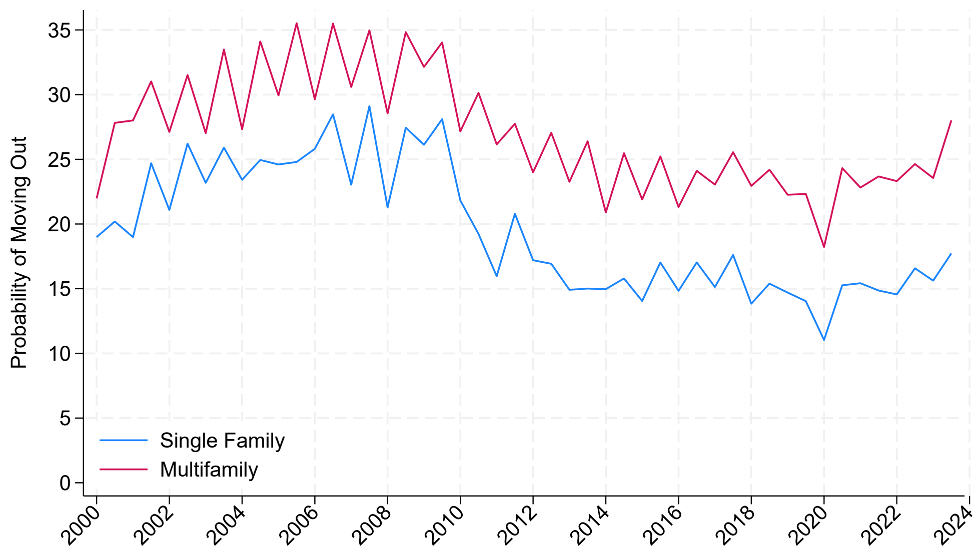



**(b)** Current Tenures: Single Family



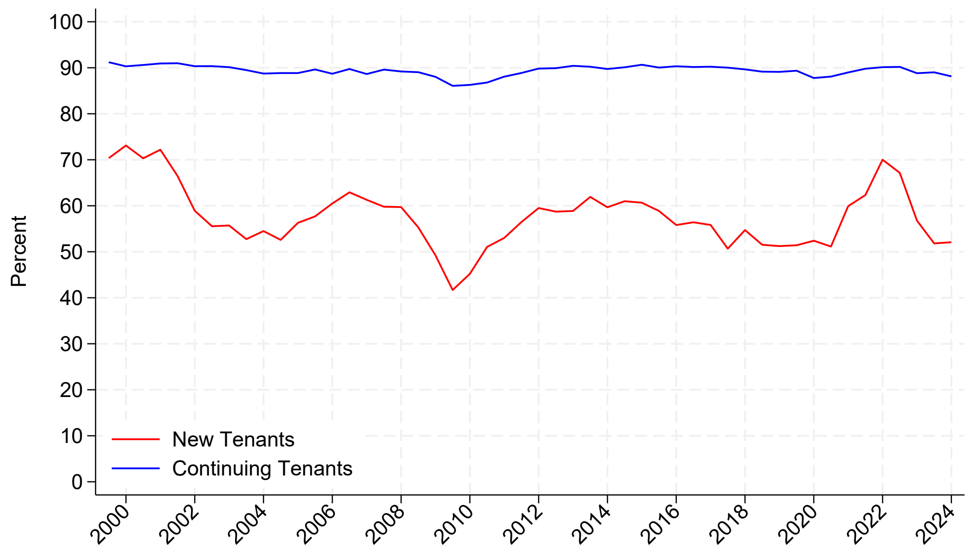

*Note:* These two figures are replications of Figure 4a separated by property type. *Source:* Authors' calculations using the BLS Housing Survey.

**Figure B.3.** Hazard of Moving Out: By Property Type



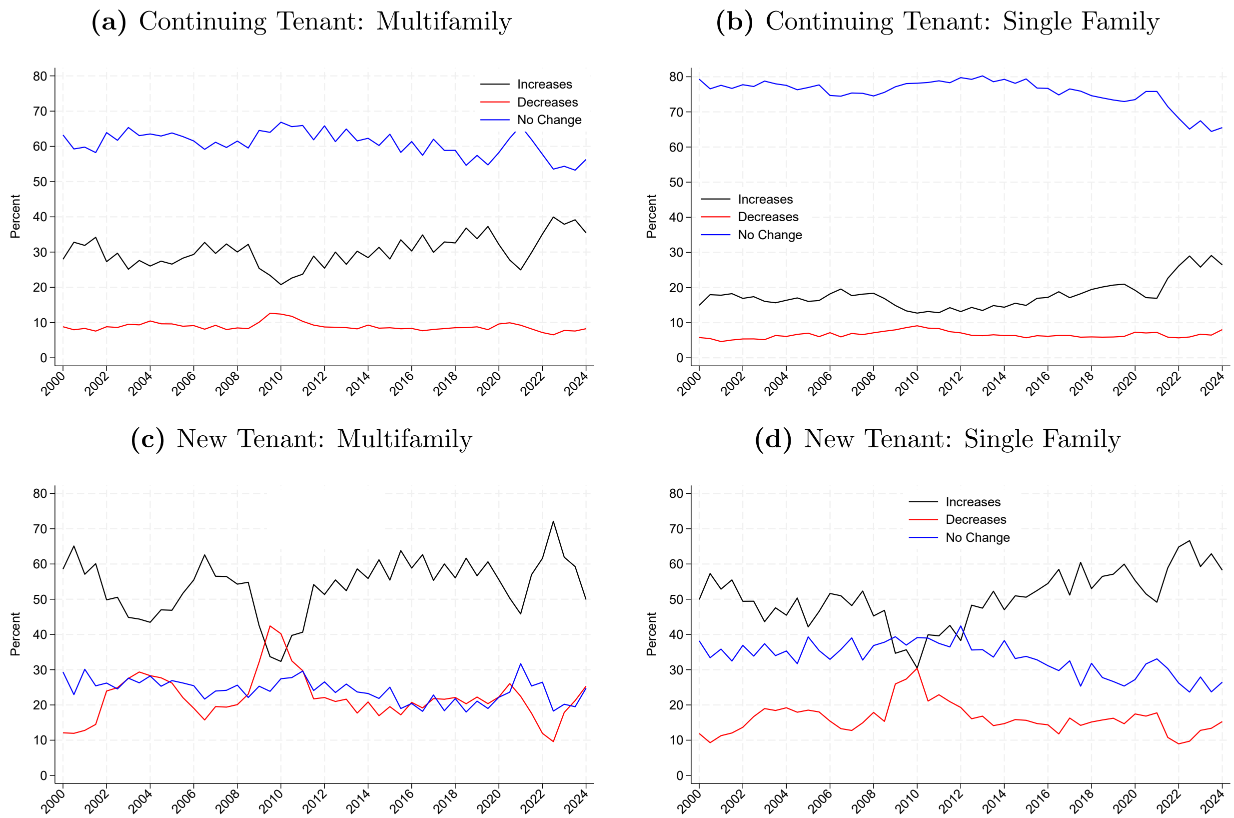

*Note:* This is the same concept as Figure 4b, but for tenants who have remained in their unit at least one year and separated by property type. *Source:* Authors' calculations using the BLS Housing Survey.

**Figure B.4.** Downward Stickiness




*Note:* Downward stickines is measured as the fraction of housing units with no rent change, divided by teh fraction of housing units with a non-positive rent change. *Source:* Authors' calculations using the BLS Housing Survey.

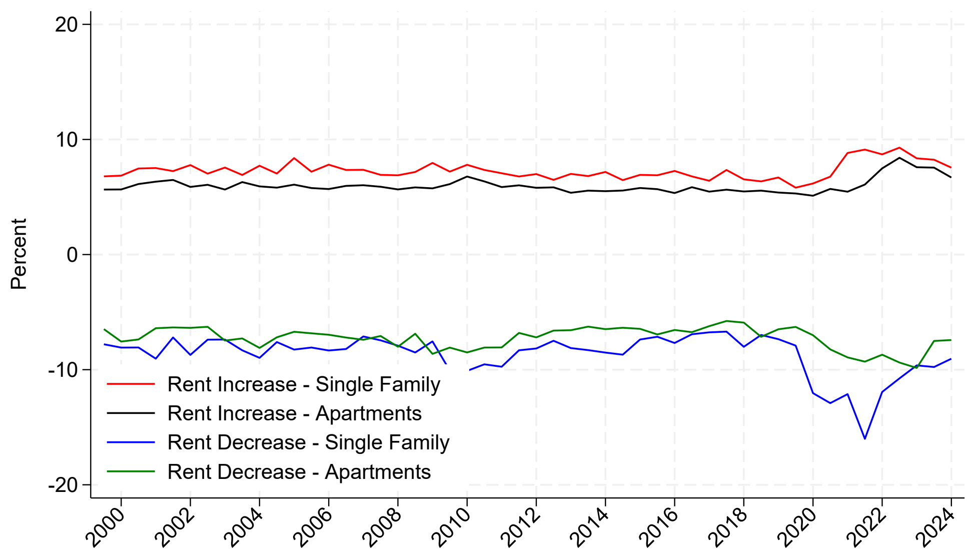
**Figure B.5.** Frequency of Rent Changes by Tenant Type and Property Type



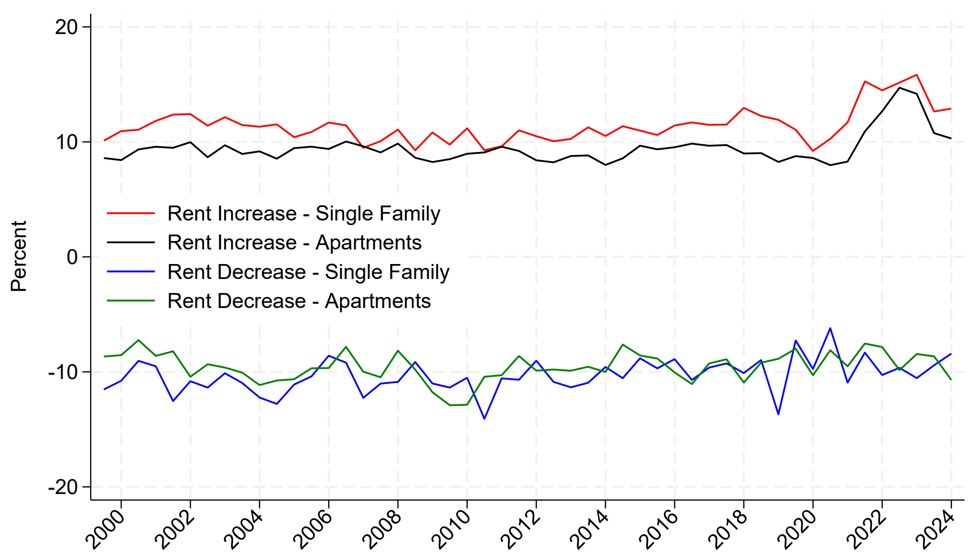

*Note:* These are the same in concept as Figures 6a and 6b, but separated by property type. *Source:* Authors' calculations using the BLS Housing Survey.

**Figure B.6.** Size of Rent Changes By Tenant Type and Property Type

**(a)** Continuing Tenants



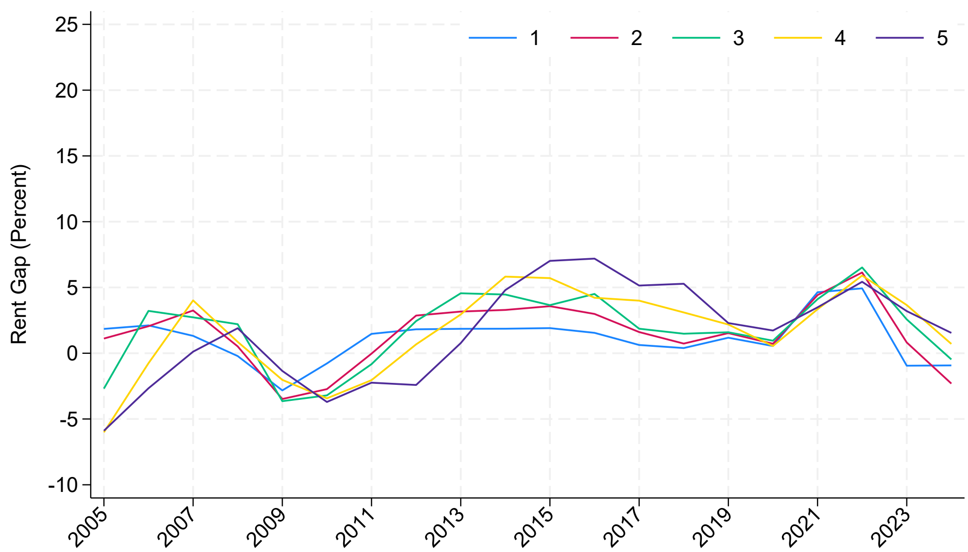

**(b)** New Tenants



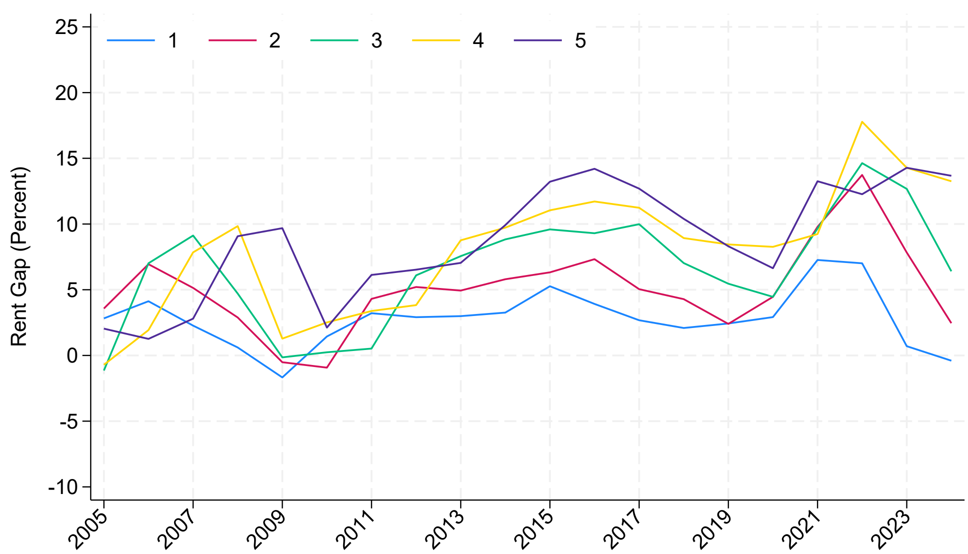

*Note:* These figures are the same concept as Figures 6c and 6d, but separated by property type. *Source:* Authors' calculations using the BLS Housing Survey.

**Figure B.7.** The Rent Gap by Tenure and Property Type

**(a)** Rent Gap by Tenure: Multifamily




**(b)** Rent Gap by Tenure: Single Family Detached




*Note:* These are the same concept as Figure 9b, but separated by property type. *Source:* Authors' calculations using the BLS Housing Survey, CoreLogic SFRI, and CoStar.

**Table B.1.** Summary Statistics for City-Level Rent Gap Sample

| Structure Type | Obs. (#) | Share (%) | Mean Rent ($) | Median Rent ($) | Mean Tenure Length (months) | Median Tenure Length (months) | Mean Rent Spell Length (months) | Median Rent Spell Length (months) |
|---|---|---|---|---|---|---|---|---|
| Single Family Detached | 148,779 | 20 | 1205 | 950 | 31 | 23 | 17 | 12 |
| Single Family Attached | 108,473 | 14 | 890 | 739 | 27 | 19 | 15 | 12 |
| Apartment | 503,552 | 66 | 1077 | 910 | 27 | 18 | 13 | 12 |
| All | 760,804 | 100 | 1076 | 899 | 28 | 18 | 13 | 12 |

*Note:* Summary statistics for sample limited to observations for which we can calculate a rent gap using city-level new-tenant rent indices. *Source:* Authors' calculations using the BLS Housing Survey, CoreLogic SFRI, and CoStar.