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Missing Home-Buyers and Rent Inflation: The Role of Interest Rates and Mortgage Underwriting Standards

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Missing Home-Buyers and Rent Inflation: the Role of Interest Rates and Mortgage Underwriting Standards

Alessia De Stefani*

May 6, 2025

Abstract

I study how monetary policy interacts with mortgage underwriting standards in shaping tenure decisions and rental market equilibria. Using property-level data from the American Housing Survey, I show that the increase in mortgage rates between 2021 and 2023 pushed many potential first-time home-buyers above FHA mortgage payment-to-income limits, restricting their access to home-ownership. This resulted in additional demand pressure on local rental markets, contributing to rent price inflation in 2023. Rentals located in cities with larger shares of constrained first-time buyers experienced steeper price growth, controlling for unit characteristics and contemporaneous economic developments. Rent inflation was more pronounced in smaller units occupied by lower-income renters, underscoring the potential for second-round distributional effects of monetary policy.

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1. Introduction

The post-pandemic tightening cycle has rekindled fears that monetary policy could exacerbate home-buying inequality (Bosshardt et al., 2024; Ringo, 2024). With prospective buyers caught between historically high mortgage rates and soaring property prices (Figure A1), the rate at which US renters transitioned into home-ownership plummeted by 25 percent on average, between 2021 and 2023 (Figure 1). Meanwhile, rental prices surged, particularly in cities where the decline in first-time buyers was more severe (Figure A2), further intensifying affordability pressures. Yet, research on how monetary policy affects rental prices remains sparse, leaving its distributional effects largely unexplored.

This paper addresses this gap in the literature. Using property-level data from the American Housing Survey, I find that between 2021 and 2023 renters' propensity to transition into home-ownership declined sharply. This decline was largely due to rising mortgage rates which, by pushing many tenants beyond Federal Housing Administration (FHA) housing payment-to-income underwriting thresholds, reduced their access to home-ownership.[1] As potential home buyers were forced to remain renters for longer, demand pressure on local rental markets intensified while rental supply remained stable, in the short run. This resulted in rent price inflation in 2023, particularly among lower-income renters– underscoring the potential for second-round distributional effects of monetary policy.

Methodologically, I proceed in three steps. First, I use information on both renter and owner-occupied properties in the 2019-2023 waves of the American Housing Survey (AHS), a representative sample of US housing units. Exploiting the panel component of the survey, I identify first-time home-buyers (FTHB), or households moving from renting to owning between two periods. The data also contains detailed information on the characteristics of each individual property (e.g.location, size, age, etc.) and of its occupants (e.g. tenure status, income, house value, mortgage financing, family composition and demographics). With this information, I develop a household-specific mortgage payment-to-income (MTI) ratio for first-time buyers at the time of home purchase, obtaining time-varying MTI distributions over different waves of the survey. I also impute MTI ratios for renters, should they decide to purchase the same property they live in.[2]

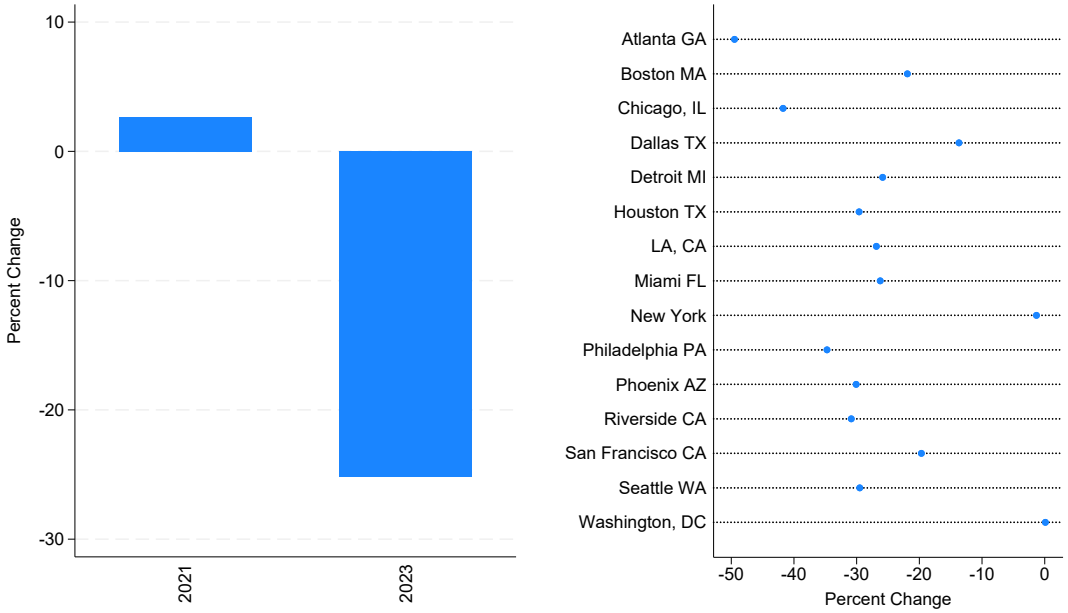
Combining observed MTI ratios for first-time buyers and imputed (potential) MTIs

[1] In any given year, FHA loans constitute a substantial portion of the US first-time home buyer market (Bhutta and Ringo, 2021).

[2] Details on the imputation of MTIs for renters are provided in Appendix B.

for renters, I show that there is a significant discontinuity in the probability of switching from renting to buying around an MTI ratio of 31. This ratio corresponds to a key underwriting parameter for FHA loans, the ratio of housing expenses to income, also called *front-end* ratio.[3] Using a regression discontinuity design, I show that the probability of switching from renting to buying is 5 percent lower just above an MTI ratio of 31 than just below, for household with similar demographic characteristics living in the same city and year.

Figure 1: *Change in the share of first-time buyers in 2023*



Sources: American Housing Survey, 2021-2023. The left-hand side of the chart displays the average percentage change in the share of renters who became home-buyers in 2021 (relative to 2019) and 2023 (relative to 2021). The right-hand side displays the percent decline in the share of first-time buyers by MSA between 2021 and 2023. Observations are weighted by frequency weights.

In a second step, I show that rising mortgage rates made the MTI underwriting threshold a binding constraint for many renter households, an effect which can largely explain the drop in the volume of first-time buyers between 2021 and 2023. I follow Defusco et al. (2020) and Bosshardt et al. (2024) and employ a non-parametric approach to examine how the change in mortgage rates between 2021 and 2023 altered the distribution of MTI ratios for first-time home-buyers. I develop a counterfactual distribution, simulating how the MTI distribution for 2021 first-time buyers would have looked like if

[3]Conventional mortgages apply similar underwriting limits. Freddie Mac mortgages for example cap the front-end ratio at 28 percent. Hence the FHA limit reflects the maximum allowable front-end ratio to be eligible for any mortgage sponsored by the government or by one of the agencies.

borrowers were subject to 2023 interest rates, holding loan demand and housing choices constant.[4] This hypothetical distribution of MTIs for 2021 homebuyers aims at simulating how the volume of first-time buyers would have looked like in 2023 absent the constraints induced by the interaction between pre-existing MTI limits and rising mortgage rates between the two periods. The difference between the observed 2023 distribution and its counterfactual can shed light on the drivers of the drop in volumes of first-time buyers.

I find that differences are negligible below the underwriting MTI limit of 31, while above this threshold the observed distributions drops by 29 percent relative to the 2021 counterfactual, accounting for the majority of the drop in volumes observed between the two periods. Using 2019 as a counterfactual year yields qualitatively similar results, as does adjusting mortgage volumes for the intensive margin of mortgage demand driven by changes in rates, incomes and house prices, based on the methodology proposed by Bosshardt et al., 2024. This evidence suggests that credit supply constraints driven by the interaction of rising interest rates and pre-existing MTI limits likely played a key role in determining the reduction in first-time buyers between the two waves.[5] A placebo test replicating the same analysis on data from the late 1970s, when average mortgage rates increased by a similar amount but payment-to-income limits were not as strictly binding, strongly supports this interpretation. The rise in mortgage rates between 2021 and 2023 pushed a significant mass of renters above underwriting payment-to-income limits, reducing their ability to step onto the housing ladder.

Finally, I show I show that the relative prevalence of constrained first-time buyers in a given metro area is a strong predictor of local rental market tightness, including a decline in vacancies and a significant increase in hedonic rent prices between 2021 and 2023. Housing units with similar characteristics exhibit significantly higher rent price growth the higher the share of ex-ante constrained home-buyers in the city, defined as 2019-2021 first-time buyers with an observed MTI below 31 and a counterfactual MTI above this threshold. These effects are robust to controlling for other simultaneous city-level time-varying developments which could drive both the share of constrained buyers and rental market tightness, such as growth in city-level population, average incomes

[4]Like Bosshardt et al. (2024), I assume a uniform increase in mortgage rates, taking as reference the difference between the prevailing rate on 30 year fixed-rate mortgages at the time of the interview and the same time in 2023. This coefficient is then applied to the borrower-specific mortgage rate, thus the counterfactual distribution retains considerable cross-sectional heterogeneity.

[5]This corroborates the evidence in Bosshardt et al. (2024), who find a similar result using overall DTI limits and studying the general population of home-buyers. Average real incomes increase between the two waves, both in the overall sample (Table 1) and among first time buyers (Table A2).

and house prices. An analysis of price dynamics by rental market segments indicates that the effects are particularly pronounced for smaller units occupied by renters in the bottom four deciles of the income distribution, suggesting that monetary tightening may have additional distributional consequences via the rental market, beyond its role in determining tenure decisions.

This paper relates closely to the literature discussing the interaction between monetary policy and debt servicing to-income limits in determining housing tenure decisions.[6] During the Great Recession, home-ownership rates among young buyers declined sharply, as tighter credit conditions led more borrowers to face binding payment-to-income constraints (Mabille, 2023).[7] During the same phase, loosening payment-to-income constraints driven by a reduction in effective mortgage rates led to an increase in home-purchasing behavior (Bhutta and Ringo, 2021). The same mechanism reduces the share of low-income households among home-buyers following monetary tightening episodes, particularly those purchasing a home for the first time (Ringo, 2024). Focusing on the most recent monetary tightening episode, Bosshardt et al. (2024) show that the majority of the drop in mortgage originations in 2022 and 2023 relative to previous years can be attributed to tightening debt servicing-to-income constraints, as low-income borrowers were pushed above underwriting thresholds by the rise in mortgage rates.

I contribute to this literature by (i) focusing explicitly on tracing the transitions from renting into first-time home-ownership and (ii) studying how fluctuations in tenure decisions affects rental market equilibria, an area where evidence is still scarce. Gete and Reher (2018) show that tighter lending standards lowered home-ownership rates after the Great Recession and increased demand for rental housing, leading to higher aggregate rental prices. Dias and Duarte (2019) show that, in contrast with house prices, the aggregate US rent price index increases in response to contractionary monetary policy shocks while home-ownership rates and rental vacancies decline. Dias and Duarte (2022) and Castellanos et al. (2024) tease out the theoretical mechanisms by which monetary policy can reduce home-ownership rates and drive up average rent prices, generating a temporary increase in headline inflation. The empirical evidence on these channels is mixed, with Dias and Duarte (2019), Castellanos et al. (2024) and Abramson et al. (2025) finding that aggregate and regional rental price indices increase after a tightening shock, while Cloyne et al. (2019), Albuquerque et al. (2025) and Groiss and Syrichas (2025) find the

[6] A related literature studies the effects of the introduction of DTI or LTV limits on credit allocation, house prices and real economic activity (Greenwald, 2018, Defusco et al., 2020, Acharya et al., 2022).

[7] Acolin et al. (2016) estimate that in this phase, tighter borrowing constraints related to wealth, income or credit scores lowered the home-ownership rate by about 5.2 percentage points, relative to 2004–2007.

opposite effects.

While most of this literature exploits conventional monetary policy shocks to study these dynamics, my results indicate that pre-existing mortgage underwriting standards are key to understand the effects of monetary policy on rental price growth. Moreover, by using property-level data, as opposed to aggregate or regional rent indices, I am able to show that rent price developments differ across tenants and market segments. Lower-income tenants are much more likely to be pushed out of home-ownership and at the same time to experience the steepest rent price increases, when monetary tightening interacts with pre-existing mortgage underwriting standards. This is likely to exacerbate the distributional consequences of monetary policy, especially since shelter makes up a larger share of the consumption basket among poorer consumers (Molloy, 2024, Jaravel, 2024). By highlighting how rising interest rates can affect shelter costs differentially across the renters' population, this paper uncovers a novel mechanisms by which monetary policy can affect consumption inequality, contributing to a growing literature on this topic (Coibion et al., 2017, Ampudia et al., 2018, Andersen et al., 2023, Bartscher et al., 2022). While this literature stresses the role of housing returns in determining the distributional effects of monetary policy, it largely abstracts from its effects on shelter costs, particularly those paid by renters.

More broadly, this paper also relates to the ongoing debate on the drivers of sticky inflation in the post-pandemic phase, particularly to the literature highlighting the key role of rising housing rents as drivers of the overall persistence in inflation despite sharp and persistent monetary tightening (Bolhuis et al., 2022).

This paper proceeds as follows. Section 2 describes the data and defines tenure transitions and other relevant variables. Section 3 presents the results on monetary policy, MTI constraints and tenure decisions. Section 4 examines the effects on rental markets and Section 5 briefly concludes.

2. Data

The American Housing Survey (AHS) is the one of the most comprehensive sources of national data on housing in the United States (Adams et al., 2024). Administered by the U.S. Census Bureau, the AHS has been conducted since 1973. Originally an annual survey, it is now fielded in odd-numbered years.

The AHS employs a stratified sampling design. Its target population comprises all

residential housing units in the United States—both occupied and vacant, excluding commercial structures. The sample is divided into two parts: a core national sample that is revisited over successive survey rounds (thus providing a longitudinal component) and independent metropolitan area samples that allow for localized analysis in major urban centers. Periodically, the sampling frame is refreshed by adding newly constructed housing units, ensuring that the survey remains representative of the evolving housing stock.

This paper uses the longitudinal component of the survey, thus focusing on the core national sample. To ensure consistency between the waves, I also exclude units with missing information on geographic location (i.e. MSA codes), hence focusing on the urban sample only. I use five waves of the survey: those conducted around the most recent monetary tightening cycle (2019 through 2023) and the two conducted in 1978 and 1980 respectively.

The urban sample is composed of 23,000-28,000 observations per wave, with about 62-64 percent of the units being owner-occupied. It reports information on 15 MSAs.[8] Beyond geographical location, the survey reports detailed information on each housing unit, including physical characteristics (age, size, type, structural conditions); housing costs (rent, mortgage, utilities, and maintenance expenses) and financing details (mortgage size, interest rate); demographic information on the occupants (income, household demographics and tenure status); and neighborhood attributes, such as perceptions of local quality, safety, and access to amenities.

The longitudinal component of the survey is designed to track housing units rather than occupants, but asks recent movers information on their previous tenure status. This allows me to identify first-time home buyers, defined as home-owners who report having moved into the housing unit in the survey year or previous year and having switched from renting to buying in the process.

Using information on the purchase value of the property, mortgage size, interest payments and household annual income, I calculate mortgage payment to income ratios (MTI) for first-time home buyers, defined as annual mortgage payments divided by annual household income.[9] Given its longitudinal component, the survey can be used to

[8] Atlanta, GA; Boston, MA; Chicago, IL; Dallas, TX; Detroit, MI; Houston, TX; Los Angeles, CA; Miami, FL; New York, NY; Philadelphia, PA; Phoenix, AZ; Riverside, CA; San Francisco, CA; Seattle, WA; Washington, DC.

[9] The survey only includes information on mortgage payments, not other debt payments. Hence, I can calculate the household-specific mortgage-to-income ratio (or front-end ratio) but not its overall debt-to income ratio, or back-end ratio.

calculate unit-specific (hedonic) changes in rent prices between waves. Following Molloy (2024), I exclude units in the bottom/top 5 percent of the rent change distribution in any given wave.

Descriptive statistics on unit characteristics and demographics for the 2021-2023 waves are summarized in Table 1. The share of first-time home buyers as a proportion of the sample remained stable between 2019 and 2021, but declined by about one percentage point in 2023 (a 25% reduction from 2021 levels). Other characteristics of the sample remained broadly unchanged, except for a slight increase in average MTI for first-time buyers in 2023 and a significant increase in rent inflation compared to both 2019 and 2021.

Table 1: *Descriptive statistics by survey year*

	(1)	(2)	(3)
	2019	2021	2023
First-time buyers (percent)	3.6	3.7	2.7
Share renters (percent)	37	37	37
Annual Income (2019 USD)	107,043	107,942	109,507
Age head	51.6	51.8	52.4
MTI (FTHB, percent)	23	22	25
Change in rent (percent)	7.6	6.4	11.4
Observations	28,147	27,157	23,942

Notes: American Housing Survey, 2019-2023. Change in rent is expressed as an average percent change relative to the previous wave (2 years before). Observations are weighted by frequency weights. Household income is expressed in 2019 USD.

Using survey information, I estimate the cost renters would face if they were to purchase the same property they live in. I do so in three steps. First, I predict the sale price of the rented property, based on the reported value of similar houses in the same city and year.[10] Second, I use these estimated property purchase price to impute the mortgage amount renters may need to borrow in order to finance the property acquisition. To do so, I use loan amounts of first-time home-buyers with similar demographics and similar (observed) property prices buying in the same city and year. Finally, I predict the interest rate a given renter would face on their mortgage, based on the mortgage rates paid by first-time home-buyer purchasing similar properties and borrowing similar amounts in the same city and year.[11] Further details on the imputation procedure are provided in

[10]The survey contains a wide set of unit-specific characteristics, which allows me to impute the renter-equivalent sale price of the property using an hedonic pricing model. This is conceptually very similar to the way owner-equivalent rents are imputed by the Bureau of Labor Statistics for owner-occupied properties, and used in the development of shelter inflation series.

[11]The AHS does not contain information on the mortgage maturity structure, but I assume that loan

Appendix B.[12]

Using these assumptions, I impute potential annual mortgage payments for renters, which rescaled by their annual income yields imputed MTIs if they were to purchase a similar property to the one they currently live in.[13] This measure is used to estimate the discontinuity in the propensity from rent to own around key mortgage underwriting thresholds.

3. Interest rates and first-time home buyers

This section studies how changes in mortgage rates interact with underwriting standards to determine the share of renters who can become home-owners. First, I establish that the share of mortgage payments to income, or front-end ratio, is a key parameter in determining the probability of becoming a first-time home-buyer, because it determines eligibility for a mortgage. Second, I exploit a non-parametric approach to understand how underwriting limits, which remained unchanged after 2021, interacted with rising interest rates, excluding a significant portion potential buyers from the owner-occupied housing market in 2023.

3.1. First-time buyers and mortgage underwriting standards: regression discontinuity

Loans issued under the umbrella of the Federal Housing Administration (FHA) need to comply with some key underwriting standards to ensure the solvency of the borrower. These include parameters on overall DTI ratios, which are typically not to exceed 43-50 percent of the borrowers' monthly income (Bhutta and Ringo, 2021). However, another important underwriting threshold for many lenders is the so called *front-end* ratio, or the ratio of mortgage payments (including insurance, taxes and fees) to income, hereby MTI. For FHA loans, this threshold is not supposed to exceed 31 percent of the borrow-

amortization will follow the schedule of a 30 year FRM. While FRM originations have declined slightly during the recent tightening cycle (De Stefani and Mano, 2025), this remains by far the most common mortgage typology in the US.

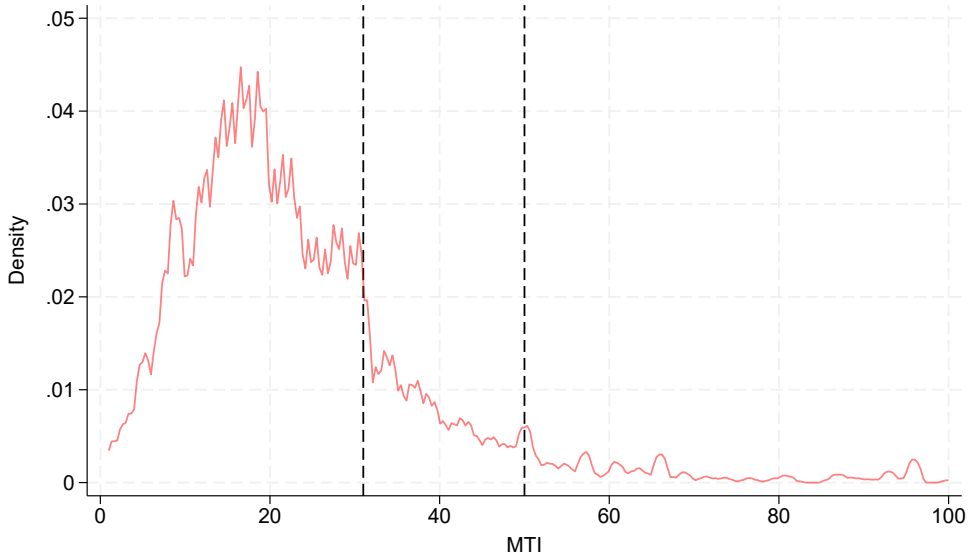
[12]The results are fully robust to an alternative imputation procedure, which assumes all renters will finance the property acquisition using a 30 year fixed-rate mortgage at the prevailing mortgage rates at the time of the survey.

[13]The implicit assumption is that renters will always want trade up, buying a housing unit of equivalent or higher cost than the one they live in. This is likely a reasonable assumption, as the units occupied by first-time buyers are on average larger than those occupied by renters (Figure A3).

ers' combined annual income.[14] While this is a soft threshold and indeed many first-time home buyers obtain FHA loans with higher MTIs, FHA mortgages with front-end ratios exceeding this threshold generally require manual underwriting, potentially triggering the request for compensating factors in the form of higher collateral, accumulated savings or previous credit history.

A simple graphical analysis of MTIs distribution among first-time home-buyers shows a significant discontinuity around this threshold (Figure 2) and bunching just below.

Figure 2: *Distribution of MTI ratios for first-time home buyers*



Sources: American Housing Survey, 2019-2023. The chart displays the frequencies of observed MTI ratio for all first-time home buyers. MTIs are rounded up to the closest integer. Observations are weighted by frequency weights.

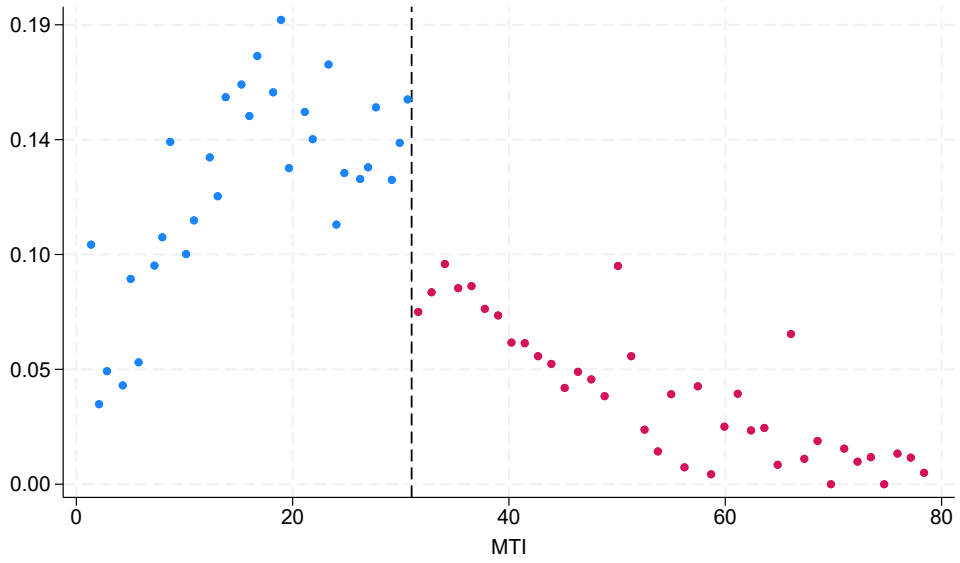
I exploit this discontinuity to study how much payment-to-income constraints matter for the relative probability of switching from renting to buying, in any given year. To do so, I impute MTI ratios which renters would face if they were to purchase the same home they currently live in.[15] By combining renter-imputed MTIs with observed MTIs for first-time buyers, I can estimate how the probability of switching from renting to buying changes in a close bandwidth around the front-end MTI threshold of 31, holding observable individual characteristics constant.

The probability of becoming a first-time buyer shows a clear discontinuity around the underwriting MTI threshold of 31, in this sample (Figure 3), while other relevant observed characteristics which could drive tenure choice remain continuous around the

[14] See HUD's Mortgage Credit Analysis for Mortgage Insurance, Chapter 4, Section F.
[15] See Section 2 and Appendix B.

threshold (Appendix Figure A4). Placebo tests do not indicate any relevant discontinuities around other thresholds (Figure A5). Moreover, some key determinants of MTI ratios among first-time buyers, such as leverage ratios and interest rates, remain fairly smooth around the threshold (Appendix figure A6).

Figure 3: *Share of first-time buyers vs renters by MTI ratio*



Sources: American Housing Survey, 2019-2023. The chart displays the relative percentage of first-time home-buyers as a proportion of the sample of first-time buyers and renters. For each MTI value, the vertical axis plots the average value of a dummy, taking value 1 if the unit is occupied by first-time buyers, 0 if occupied by renters. MTIs are observed for first-time buyers, imputed for renters; they are rounded up to the closest integer. Observations are weighted by frequency weights.

The regression-discontinuity design defined in Equation 1 aims at a more formal estimation of the change in probability of becoming a first-time buyer around the front-end MTI underwriting limit, conditional on observed household and unit characteristics:

$$Pr(FTHB_{imt} = 1) = \alpha + \beta_1 Threshold_{imt} + \beta_2 MTI_{imt} + \beta_3 MTI_{imt} * Threshold_{imt} + \gamma_n^N X_{imt} + \theta_{mt} + \varepsilon_{imt} \quad (1)$$

Where $FTHB$ is a dummy taking value 1 if a given unit i in MSA m in year t is occupied by a first-time buyer, 0 if occupied by a renter; MTI is the unit/household-specific mortgage-to-income ratio (this term is observed for first-time buyers and imputed for renters). X_{imt} is a vector of household and unit-specific controls.[16] θ_{mt} are MSA-by-year

[16]This includes income decile, family composition, educational attainment of the household head, their age and square of age; unit size, number of bedrooms and bathrooms and house value (observed for first-time buyers, imputed for renters).

fixed-effects, meant to capture all aggregate variation affecting equally all family units living in the same municipality during the same year. β_1 is the coefficient of interest, measuring the effect of being just above VS just below threshold on the probability of being a first-time buyer, conditional on a wide set of controls. The coefficient β_3 captures the shift in slope above and below the threshold. Table 2 presents the results of this equation, estimated over subsequently smaller windows around threshold.

Column 1 estimates the model using a global linear regression using the entire sample, including observations with MTI up to 100 percent.[17] The estimates are large and statistically significant, suggesting that similar families living in similar units in the same city and year experience a probability of becoming first-time buyers which is 5 percent lower when their MTI falls just above the threshold, compared to just below.

Columns 2-3 present a local linear regression, progressively narrowing the estimation window around the threshold, thus reducing the sample size significantly. The coefficients remain stable and significant. Column 3 limits the sample to observations with MTIs between 25 and 37, or about 6 points below and above the threshold, respectively. This is the optimal bandwidth according to the selection process described in Calonico et al. (2014). This rather conservative specification suggests that moving from just below to just above the limit reduces the probability of finding a first-time home buyer in the sample by about 5 percent. This suggests that front-end ratios matter in determining the probability of switching from renting to buying, as they define whether potential homebuyers can qualify for a loan under the prevailing underwriting rules and mortgage rates.

[17]Results are robust to different specifications. Table A1 presents the results of a specification which introduces a quadratic polynomial, showing that the estimates using a linear model are conservative. They are also robust to the use of robust bias-corrected confidence intervals, as in Calonico et al. (2014).

Table 2: *Probability of becoming a first-time buyer as a function of MTI limits*

VARIABLES	(1) FTHB 0-100	(2) FTHB 0-50	(3) FTHB 25-37
Threshold	-0.052***	-0.045***	-0.052***
	(0.007)	(0.010)	(0.017)
MTI	0.006***	0.005***	0.011***
	(0.000)	(0.001)	(0.003)
Threshold*MTI	-0.005***	-0.006***	-0.000
	(0.000)	(0.001)	(0.005)
Observations	23,181	18,268	4,768
R-squared	0.107	0.102	0.136
MSA by Year FE	Yes	Yes	Yes
HH and Unit controls	Yes	Yes	Yes

Notes: AHS 2019-2023. FTHB is a dummy taking value 1 if a household switches from renting to buying, 0 if it remains a renter. The sample includes first-time buyers and renters. MTIs are measured as mortgage service to income ratios: these are reported for home buyers and imputed for renters. Controls include age, race and educational attainment of household head, annual household income, family composition, and unit characteristics (size, n.bedrooms, n.bathrooms, unit type). MSA by year FE included. Heteroskedasticity-robust SEs in parentheses.

The following section exploits this discontinuity explicitly, by observing the missing and excess mass of home-buyers just above and just below the FHA underwriting threshold under different mortgage rate scenarios. This non-parametric approach can be used to infer how much of the change in volumes of first-time buyers between AHS waves is due rising mortgage rates, which made to mortgage-to-income limits a binding constraint for some potential buyers.

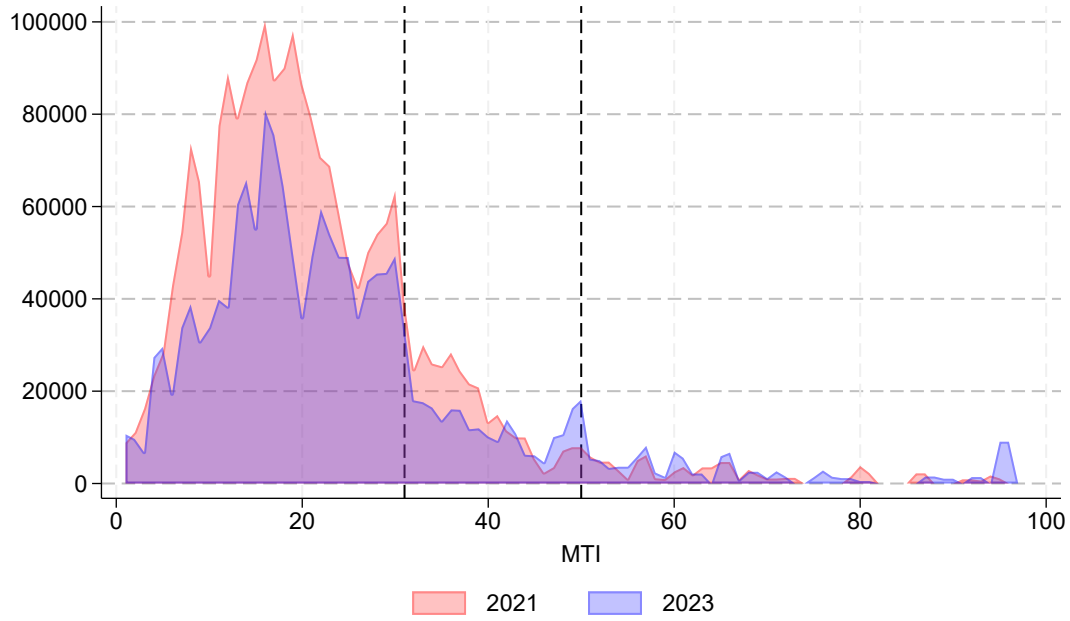
3.2. Measuring the effect of interest rates on purchasing behavior: counterfactual distributions

To assess how mortgage rates interacted with underwriting thresholds in driving the decline in first-time home-ownership, this section restricts the sample to first-time home-buyers observed between 2019 and 2023. Older waves are used to compare volumes of first-time buyers in a low-rate environment (2019-2021) to volumes in a high rate environment (2023) and to build counterfactual distributions, simulating what would have happened to volume of home-buyers in absence of credit supply constraints, following Bosshardt et al. (2024).[18]

[18]Defusco et al. (2020) and Bhutta and Ringo (2021) also use counterfactual distributions to estimate the extensive margin of mortgage demand, albeit focusing on different policies and time frames.

I proceed in two steps. First, I estimate the decline in volume of first-time home buyers between waves. Figure 4 shows that the number of first-time buyers declined significantly between 2021 and 2023: the frequency-weighted drop is about 300,000 units, roughly corresponding to the 25% decline reported in Table 1. This decline is broadly uniform over the MTI distribution, with the only significant spike in volumes compared to 2021 concentrated at 50 percent, the upper bound of the underwriting comprehensive DTI limit.

Figure 4: *Volume of first-time buyers by MTI and year*



Sources: American Housing Survey , 2021-2023. The chart displays the number of first-time home-buyers by MTI value and year. MTIs are rounded up to the closest integer. Observations are weighted by frequency weights.

Besides differences in volumes, the 2021 and 2023 distributions appear similar. They both exhibit a sharp drop in volumes around the front-end ratio of 31 percent and the demographic characteristics of their respective samples are comparable.[19] Hence, the 2021 distribution of first-time buyers can be used to build a counterfactual distribution for the policy year (2023), following the methodology proposed by Bosshardt et al. (2024). This counterfactual distribution can help uncovering what proportion of the missing mass of home buyers can be attributed to rising mortgage rates, which pushed a portion of potential home-buyers above binding payment to income limits.

[19] Appendix Table A2 shows that on average, first time home-buyers in 2021 and 2023 are very similar in age, income, demographic composition. LTV ratios at purchase decline over the years, consistently with tightening credit standards.

The counterfactual distribution is built by re-calculating the individual MTI ratios of 2021 first-time buyers, assuming that the interest rates charged on their mortgages resembled those prevalent in 2023. Similarly to Bosshardt et al. (2024), I assume a uniform increase in interest rates corresponding to the average change in rates on newly originated 30 years FRM between the first quarter of 2021 and the first quarter of 2023, corresponding to a 4.2 percentage points increase.[20]

I apply this average increase in mortgage rates to the borrower-specific mortgage rate, as reported in the survey. This methodology yields a fictional MTI ratio for each first-time home-buyer observed in 2021, which assumes a change in mortgage rates but holds other parameters (house value, loan amount, amortization schedule, household income) constant.[21] The average increase in mortgage payments between the observed 2021 distribution and the counterfactual is about 780$ per household/month, while MTIs increase by 9 percentage points on average.

Figure 5 plots both the observed 2023 distribution and the counterfactual 2021 distribution. The latter is smoother around the MTI thresholds by construction, as it aims at simulating volumes under a high interest rate regime as if buyers were unconstrained in their MTI and assuming demand remains constant on 2021 levels. Differences between the observed distribution for 2023 and the simulated counterfactual help uncovering the drivers of the decline in first-time buyers observed between 2021 and 2023 observed in Figure 4. If these changes were primarily driven by shifts in preferences, or a decline in the demand for owner-occupied housing, they should be relatively uniform across the MTI distribution. Instead, if the decline in buyers' volume was primarily driven by credit supply constraints, particularly those binding on the payment-to-income margin, the drop should be concentrated on buyers on the right-hand side of the MTI distribution, and the switch in densities should occur around the MTI underwriting threshold.

Figure 5 shows that most of the missing mass of home-buyers emerges above the MTI limit of 31, while loan volumes are relatively constant below this threshold. Figure A7 shows these differences expressed as a percentage of 2021 volumes. Below the MTI limit of 31, the volume of first-time buyers increases modestly, by 4 percent relative to

[20]The AHS does not provide mortgage origination dates, but all interviews are conducted in the first semester of any given year. Based on FRED data (Figure A1), the average rate on newly originated 30 year fixed-rate mortgages (FRMs) in the first semester of 2021 was 2.9 percent, while average rates had increased to 7.1 percent by the end of the first semester of 2023.

[21]Despite applying a homogeneous mortgage rate increase, individual mortgage interest rates retain significant cross-sectional heterogeneity in the counterfactual distribution, because of ex-ante differences in the rates paid by 2021 buyers. A small fraction of observations lack information on interest rates charged on the mortgage. For these buyers, the counterfactual distribution is built by applying the average percent increase in MTI ratios between observed and counterfactual across first-time buyers in a given wave.

2021 levels. Above the threshold, the cumulative drop is 29 percent of 2021 levels. By construction, the integral of these difference across the entire MTI distribution corresponds to the overall decline in first-time buyers between the two waves (25 percent), as presented in Table 1, since the counterfactual does not alter the overall volume of 2021 buyers, but just their placement in the distribution of MTIs. However, the fact that the reduction in the number of first-time buyers relative to 2021 occurs almost entirely above the MTI threshold of 31 (a 29 percent reduction above, compared to a 4 percent increase below) suggests that drop in volumes can largely be ascribed to binding payment-to-income constraints, as rising mortgage rates likely prevented a substantial portion of potential buyers from accessing the owner-occupied market.

The majority of the difference (20 percent) is concentrated between MTIs of 31 and 50, the FHA upper limit for overall DTI ratios, while loan volumes decline by 9 percent above 50 percent. Volumes also decline modestly (i.e. 5 percent) already between the MTIs of 25 and 31, as the distribution approaches the front-end ratio limit, indicating no bunching below the threshold to avoid the MTI limit. Repeating the same procedure with 2019 as the counterfactual year yields very similar results (Figure A8). Effects are quantitatively smaller, recording a decline of 24 percent in the volume of first-time buyers above the threshold and a 6 percent increase below, for an aggregate decline of 18 percent. This smaller difference is consistent with a more modest increase in mortgage rates between the two waves, as the change in average 30 year FRM rates corresponds to 3.5 percentage points between 2019 and 2023, compared to 4.2 between 2021 and 2023.

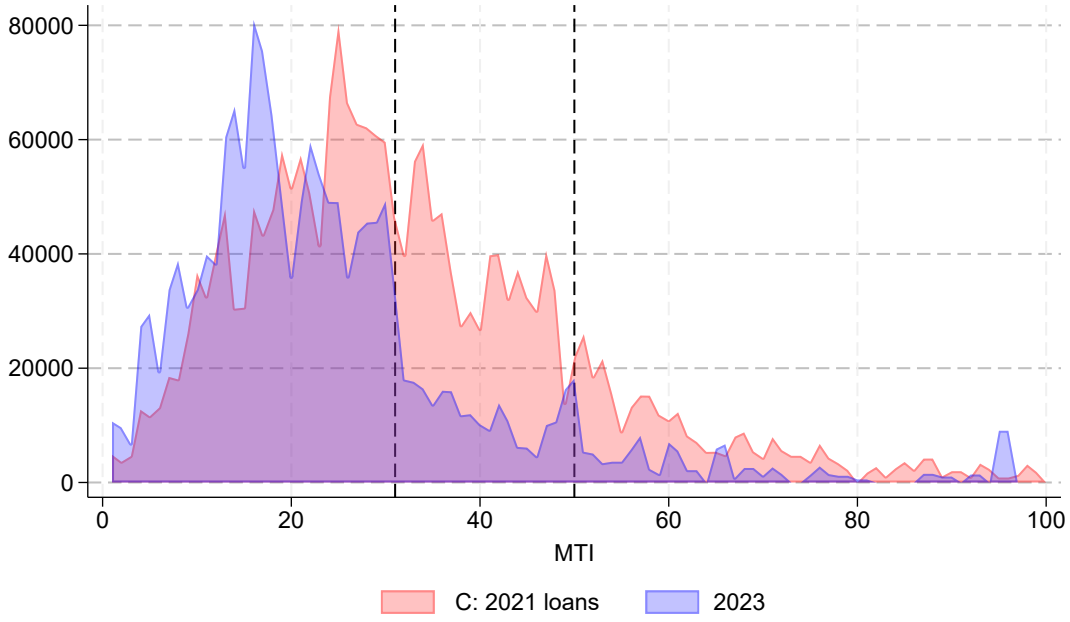
This baseline counterfactual approach focuses only on the extensive margin of mortgage demand, assuming that the intensive margin (i.e. mortgage size) remains constant between waves, irrespectively of credit conditions. In reality, a change in mortgage rates is likely to affect loan demand directly, as do fluctuations in income or house prices. Hence, Figure A9 presents a robustness test, where 2023 volumes are compared to a demand-adjusted 2021 counterfactual, following the same approach used in Bosshardt et al. (2024). This alternative specification takes into account potential shifts in the intensive margin of mortgage demand occurring due to the change in mortgage rates, first by reducing loan amounts by 2 percent for each percentage point increase in mortgage rates, following the elasticities identified by DeFusco and Paciorek (2017). Moreover, it further adjusts mortgage amounts to changes in average incomes and house prices recorded in any given MSA between two waves.[22] Results are fully robust to this defini-

[22]This is adjustment is obtained by regressing individual (log)loan amounts on (log)income and log(house value), conditional on MSA and year fixed-effects. These average elasticities are then multi-

tion of the counterfactual distribution and yield quantitatively similar estimates. Below the limit, 2023 volumes increase by 5 percent relative to the 2021 counterfactual, while they decline by 29 percent above.

Since MTI underwriting limits remain constant over this time frame, these results suggest that the decline in buyers' volumes can likely be attributed to credit supply constraints, as the increase in mortgage rates made the payment-to-income limit a binding limit for many potential first-time home-buyers.

Figure 5: *Volume of first-time buyers: 2023 and counterfactual distributions*



Sources: American Housing Survey , 2021-2023. The chart displays the number of first-time home-buyers by MTI value. The area shaded in blue represents observed 2023 volumes; the red area represents counterfactual distributions, based on 2021 data. MTIs are rounded up the closest integer. Frequency weights are assumed.

3.3. Robustness: the 1970s as a placebo test

To show that these results are not simply a mechanic result of the simulation but rather they reflect the interaction between binding payment-to-income constraints originating and the recent increase in mortgage rates, this section presents the results of a placebo test using the AHS waves conducted in 1978 and 1980.

plied by the average change in incomes and house prices in a given MSA between 2021 and 2023. Finally, individual loan amounts in the 2021 counterfactual are rescaled by this coefficient and divided by household income.

Similarly to recent years, the steep monetary tightening cycle of the late 1970s resulted in a dramatic increase in mortgage borrowing costs. However, unlike during the 2021-2023 episode, borrowers were not facing the same systematic payment-to-income constraints, both because manual underwriting was predominant at the time and because payment-to-income limits did not apply as strictly to mortgages sponsored by the FHA, or by the Agencies.[23]

The 1978 and 1980 waves of the AHS are the ideal laboratory to run a falsification exercise. Average mortgage rates increase from 9.3 percent in the first semester of 1978 to 14 percent in early 1980, or 4.7 percentage points, a increase in rates similar to the one recorded between 2021 and 2023. Consistently with rising mortgage costs, the total number of first-time home-buyers decline from about 3.2 percent of the sample to roughly 2.4 percent, a change that corresponds almost exactly to the percentage decline in volumes observed between 2021 and 2023.

However, unlike in 2021-2023, the distribution of observed MTIs ratios for first time home-buyers is radically different between the two waves (left-hand panel of Figure 6). Consistently with a scenario where borrowers face higher borrowing costs but are unconstrained by strict payment-to-income underwriting limits, the distribution of MTIs for first-time buyers in 1980 shifts decisively to the right, compared to 1978. We do not observe this shift between 2021 and 2023, when MTI limits were strictly enforced (Figure 4) and the two distributions remain broadly similar. Moreover, the observed MTI distributions do not exhibit a sharp drop in volumes at the MTI threshold of 31 in either year, likely indicating that these limits were not as strictly enforced.

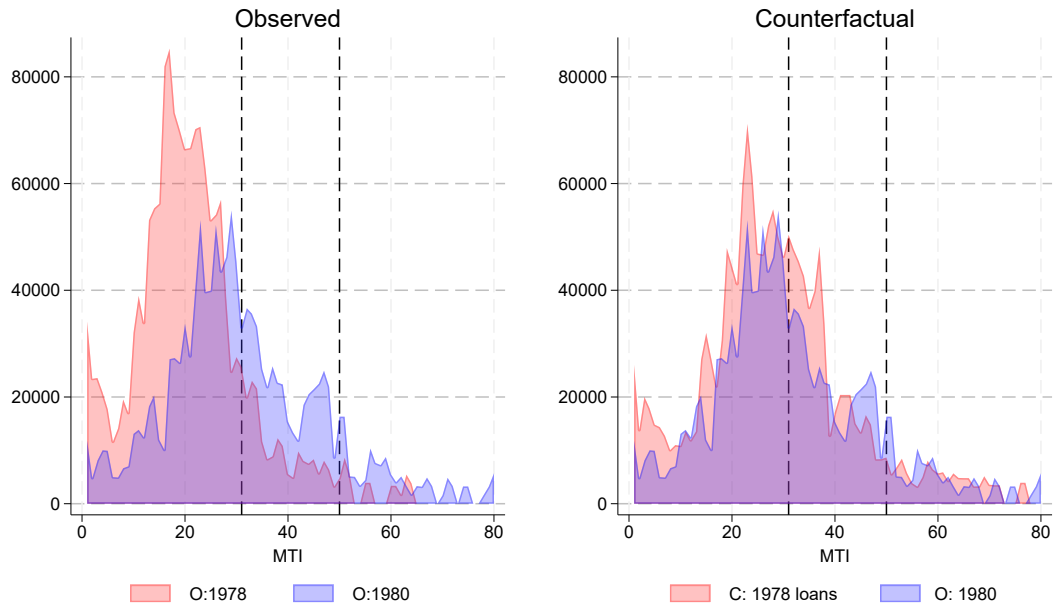
The right-hand panel of Figure 6 applies the same methodology described in Section 3 to develop a counterfactual MTI distribution for 1978 first-time buyers, as if they were subject to mortgage rates prevalent in 1980.[24] Albeit starting from different levels, the counterfactual 1978 distribution shifts to the right, closely resembling the observed 1980 distribution. As in Defusco et al. (2020), I interpret this as evidence validating the parallel trend assumption implied in this counterfactual analysis: in absence of the policy change (i.e. an interaction between rising mortgage rates and MTI limits) the coun-

[23]The first FHA underwriting manual, published in 1936, did not set explicit payment to-income limits, leaving this parameter to the discretion of the underwriter. As of the early 1980s, some income limits had been introduced, and front-end ratios were generally capped around 33-36 percent of income for both FHA and conventional loans (Dennis, 1981). However, individual loan officers retained a large margin of discretion in the application of these standards, as manual underwriting remained predominant until credit (FICO) scores were introduced in the 1990s.

[24]As these early waves of the AHS do not contain interest rate information for individual borrowers, I build the counterfactual distribution by assuming that all first-time buyers payed the average mortgage rate on 30 year FRMs in 1978, and the same in 1980.

terfactual is able to closely resemble the observed distribution. Moreover, the relative decline in loan volumes between the two waves occurs mostly *below* the MTI threshold of 31, and relatively less above, as it would be expected given that underwriting MTI limits were not strictly enforced at the time. The more uniform nature of the drop is potentially consistent with a simple reduction in loan demand due to rising interest rates, or it could indicate that credit supply constraints were binding on other margins than mortgage payment-to-income limits. Either way, the sharp contrast with the counterfactual distribution presented in Figure 5 indicates that the results presented in the latter are not a mechanic result of the simulation, but likely reflect the dominant role of payment-to-income constraints in driving the decline in home-purchasing activity in 2023.

Figure 6: *Placebo tests: 1978-1980 first-time buyers*



Sources: American Housing Survey , 1978-1980. The chart displays the number of first-time home-buyers by MTI value. The area shaded in blue represents observed 1980 volumes; the red area represents 1978 volumes, observed (LHS) and counterfactual (RHS). MTIs are rounded up to the closest integer. Frequency weights are assumed.

4. Regional heterogeneity and effects on rent price inflation

In this section, I test whether missing mass of first-time buyers in 2023 placed additional demand pressure on rental markets, determining short-run rent inflation. The underlying hypothesis is that as rising mortgage rates excluded potential homebuyers from

the owner-occupied market, these households rented for longer, potentially contributing to rental demand pressures. As the supply of rental units is unlikely to adjust quickly enough to the relative increase in demand, rent prices increase for all tenants, including those who may not have wished to buy and those who would have been unable to buy even if interest rates were significantly lower.

Indeed, the change in the share of first-time buyers across cities is negatively correlated with rent price growth, between 2021 and 2023 (Figure A2). To formally test the degree to which rising mortgage rates are responsible for this correlation, I follow a strategy similar to Acharya et al., 2022 and Bosshardt et al., 2024, and exploit regional variation in proportion of potential buyers facing binding borrowing constraints.

Building on the counterfactual analysis developed in the previous section, I measure the share of constrained home-buyers in a given MSA, defined as 2019 or 2021 buyers who would have been pushed above the underwriting MTI threshold by the increase in mortgage rates observed between their survey year and 2023 (i.e. those who have an observed MTI below 31 and a counterfactual MTI above 31). Their relative prevalence exhibits significant geographic variation across US cities (Figure A10), a difference which I exploit in the following cross-sectional regression:

$$\Delta Rent_{im,23} = \alpha + \beta_1 ShareC_{m,19-21} + \gamma_n^N X_{i,23}^N + \theta_n^N \Delta\lambda_{m,23}^N + \varepsilon_{im,23} \tag{2}$$

Where $\Delta Rent_{im,23}$ is the log difference in rent price for unit i, in city m between 2021 and 2023.[25] $X_{i,23}^N$ is a vector capturing characteristics of the unit and its tenants, including size, number of bedrooms and bathrooms, type of build (e.g. condo, house), and building age; as well as age and income decile of its occupants and the number of people living in the unit.

$\Delta\lambda_{m,23}^N$, is a vector of city-level time-varying controls, capturing (log) change in house prices, income levels and population between 2021 and 2023, as well as average incomes and population levels in 2023. In addition, I include controls for city-level housing policy indicators, such as the share of rent-controlled units and the share of housing voucher recipients.

β_1 is the coefficient of interest, capturing the relationship between a city's exposure

[25]Tracking unit-level price changes allows me to hold unit characteristics constant between waves, effectively measuring the effects on the stock of all leases, rather than just the flow of new ones. Indices based on new leases only tend to over-report average rent-price growth experienced by the broad cross-section of consumers Adams et al. (2024).

to constrained first-time buyers ex-ante, $ShareC_{m,19-21}$, and the growth in rental prices ex-post.[26] The inclusion of unit and aggregate (city-level) controls assimilates this to a difference-in-differences setup, comparing changes in rental prices between 2021 and 2023 for similar units across cities, holding other city-level macro-economic developments constant.

The inclusion of unit and city-level controls is key to the causal interpretation of the coefficient β_1. This is because, even if measured ex-ante, the city-level share of constrained home-buyers $ShareC_{m,19-21}$ may be correlated with characteristics of the population or macroeconomic circumstances which may independently drive rental price growth ex-post. For example, Table A3 suggests that, on average, constrained home-buyers tend to be poorer, less likely to have a graduate degree and slightly more likely to belong to racial and ethnic minority groups compared to other first-time buyers. However, these differences seem to reflect within-city variation across buyers rather than cross-sectional variation across MSAs, as the correlations with city-level averages generally have the opposite sign (Figure A11). It is overall reassuring to observe that, an aggregate level, the share of constrained buyers $ShareC_{m,19-21}$ is negatively correlated with the growth in variables which would generally be expected to induce an increase in rental prices ex-post, such as growth in income, population or house values, and positively correlated with the proportion of rent-controlled units (Figure A12). This suggests that the pure cross-sectional relationship would most likely be biased towards underestimating the role of constrained home-buyers on rent price growth. Nevertheless, the wide set of city-level and property-level controls included in equation 2 aims at partialling out for these and other factors which can potentially drive rent price growth above and beyond the role of home-buying constraints induced by the interaction between the change in mortgage rates and MTI limits.

Columns 1-3 of Table 3 show that the change in the share of first-time home-buyers is negatively correlated with hedonic rental price growth between 2021 and 2023. Cities which experienced a larger increase (or a more modest decline) in the share of first-time buyers between the two waves also experienced lower rent inflation. The correlation is robust to the inclusion of a progressively more comprehensive set of controls, corroborating the aggregate evidence presented in A2.

Columns 4-6 present the results of equation 2. The share of constrained home-buyers is associated with a significant increase in hedonic rent prices in 2023. Cities where a

[26] Following the approach used in Bosshardt et al. (2024), I take an average of the 2019 and 2021 shares, to reduce noise and increase the number of observations on which this average is calculated.

larger proportion of the population has been excluded from home-ownership due to the rise in mortgage costs experienced significant price pressures on their rental markets. For one standard deviation increase in the share of constrained buyers (5 percentage points), rent prices on the average unit increase by about 1 percent more (or 4% of a standard deviation the dependent variable). These effects are quantitatively meaningful and robust across specifications, including to the inclusion of the history of unit-level rent price developments (Table A4).

Table A5 tests for the existence of pre-trends, re-estimating Equation 2 on the change in rents observed between 2019 and 2021, before the beginning of the tightening cycle. Finding an effect would be indicative of a systematic association between the share of constrained-home buyers in 2019-2021 and rental price developments, which would invalidate the parallel trends assumption. Reassuringly, the coefficients associated with the share of constrained home-buyers are small and statistically insignificant.[27]

Table A6 shows that a key explanation for these price dynamics lies in the role of rental supply. As the share of constrained buyers increases, there is no significant conversion of owner-occupied units into rental units (column 1), likely a result of significant segmentation between the renter and owner-occupied markets (Dias and Duarte, 2022). Albeit the supply of newly built units increases in response to stronger demand pressures (column 2), rental vacancies overall decline significantly (column 3), indicating rental market tightness. Combined, these results suggest that rent price inflation likely originates from an increasing scarcity of rental units, as tighter credit conditions increase rental demand and supply is unable to fully adjust, in the short run.

[27]This is robust to using the share of constrained buyers measured ex-ante (i.e. in 2019) as a parameter of interest in this specification.

Table 3: *Rent increase and constrained home-buyers*

VARIABLES	(1) $\Delta Rent_{i,23}$	(2) $\Delta Rent_{i,23}$	(3) $\Delta Rent_{i,23}$	(4) $\Delta Rent_{i,23}$	(5) $\Delta Rent_{i,23}$	(6) $\Delta Rent_{i,23}$
$\Delta FTHB_{m,23}$	-0.078***	-0.079***	-0.075***			
	(0.026)	(0.023)	(0.023)			
$\text{ShareC}_{m,19-21}$				0.231***	0.218***	0.226***
				(0.061)	(0.060)	(0.058)
$\Delta HP_{m,23}$	0.229***	0.195***	0.196***	0.275***	0.239***	0.242***
	(0.066)	(0.062)	(0.062)	(0.067)	(0.064)	(0.062)
$\Delta Income_{m,23}$	0.431**	0.423**	0.363**	0.679***	0.653***	0.605***
	(0.190)	(0.179)	(0.180)	(0.213)	(0.210)	(0.202)
$\text{Population}_{m,23}$	0.051**	0.052***	0.051**	0.095***	0.094***	0.094***
	(0.021)	(0.020)	(0.021)	(0.023)	(0.023)	(0.023)
MSA controls	Yes	Yes	Yes	Yes	Yes	Yes
Unit controls	No	Yes	Yes	No	Yes	Yes
Tenant controls	No	No	Yes	No	No	Yes
Observations	5,911	5,911	5,911	5,911	5,911	5,911
R-squared	0.008	0.013	0.019	0.008	0.013	0.020

Notes: AHS 2021-2023. $\Delta Rent_{i,23}$ measures the unit-specific change in (log) rent between 2021 and 2023; FTHB measures the change in the share of FTHB between 2021 and 2023 at the MSA level; $ShareC_{m,19-21}$ measures the share of constrained home buyers in a given MSA (average between 2021 and 2019). MSA level controls average house price growth (2021-2023); population growth (2021-2023); change in average annual income (2021-2023) as well the share of voucher recipients, the share of rent-controlled units and (log) average income and (log)population size in 2023. Unit-level controls include dummies for unit size, n.bedrooms, n.bathrooms, building age in years a dummy for whether the unit is an apartment or a house. Tenant controls include age of the household head, household income decile (relative to the city/year income distribution) and number of people living in the unit. Heteroskedasticity-robust standard errors are clustered at the city-size level.

4.1. Heterogeneity: Tenants and market segments

The rising share of constrained home-buyers have heterogeneous effects across the renters' population. Tenants in the bottom four deciles of the city-year income distribution experience shaper rent increases in response to an increase in the share of constrained first-time buyers while richer renters, particularly those in the top three deciles, are relatively shielded (Table A7, column 1). This effect does not depend on the higher prevalence of voucher recipients among poorer renters (column 2) or on the incidence of rent-controlled units in this segment (column 3). Excluding newly leased units, or units with a short-tenancy span doesn't alter the result significantly (columns 4 and 5), suggesting that relatively higher mobility rates and more frequent lease resets among poorer consumers are not driving these differences.

Instead, this finding is can be explained by the pre-existing degree of market slack in the rental segment most popular among relatively poorer renters. Tenants in the bottom four deciles of the city/year income distribution rent the vast majority of smaller units, those measuring up to 750 square feet, a segment which exhibited significantly lower vacancy rates than average already in 2021 (Figure A13). Pre-existing market tightness in this segment may have contributed to higher price growth in response to rising rental demand pressures. Indeed, Table A8 indicates that rent prices grow more for smaller units than larger ones, in response to the same prevalence of constrained home-buyers (Column 1), while other unit characteristics correlated with size do not seem to matter (columns 2 and 3). Column 4 shows that ex-ante vacancy rates in a given size bucket are indeed key in explaining the differential price response across segments. The higher the degree of slack in a specific rental segment, the less rental prices grow in response to the same share of constrained buyers. Once conditioning for ex-ante vacancy rates in a specific segment, the differential rent price effects across the income distribution disappear (column 5).

Combined, these results suggest that relatively poorer consumers on average faced higher exposure to price increases originating from the decline in first-time buyers between 2021 and 2023, because of their relatively higher exposure to a tighter market segment. This evidence points to second-round distributional consequences of monetary policy via the rental market, most likely exacerbated by the fact that shelter typically accounts for a larger share of the consumption basket among poorer tenants (Molloy, 2024, Jaravel, 2024).

5. Conclusions

This paper studies the joint effects of monetary policy and regulatory lending standards in shaping tenure choices and rental market dynamics. I derive two key takeaways. First, the large decline in first-time home-buyers between 2021 and 2023 can in great part be attributed to rising mortgage rates, which pushed many potential buyers above pre-existing mortgage-to-income underwriting thresholds.

Second, the reduction in first-time home-buyers increased pressure on some segments of the rental market, driving a steep increase in average rent prices. Rent price inflation was more pronounced for units occupied by lower-income renters, highlighting the potential for unintended distributional consequences of monetary policy.

More broadly, this paper also contributes to the debate on role of rents as drivers of sticky inflation during the recent monetary tightening cycle (Bolhuis et al., 2022, Adams et al., 2024). Given that rents and owner-equivalent rents currently account for about 33% of the US Consumer Price Index (CPI) basket, the channels identified here likely contributed to the persistence of elevated headline inflation in the post-pandemic tightening phase.

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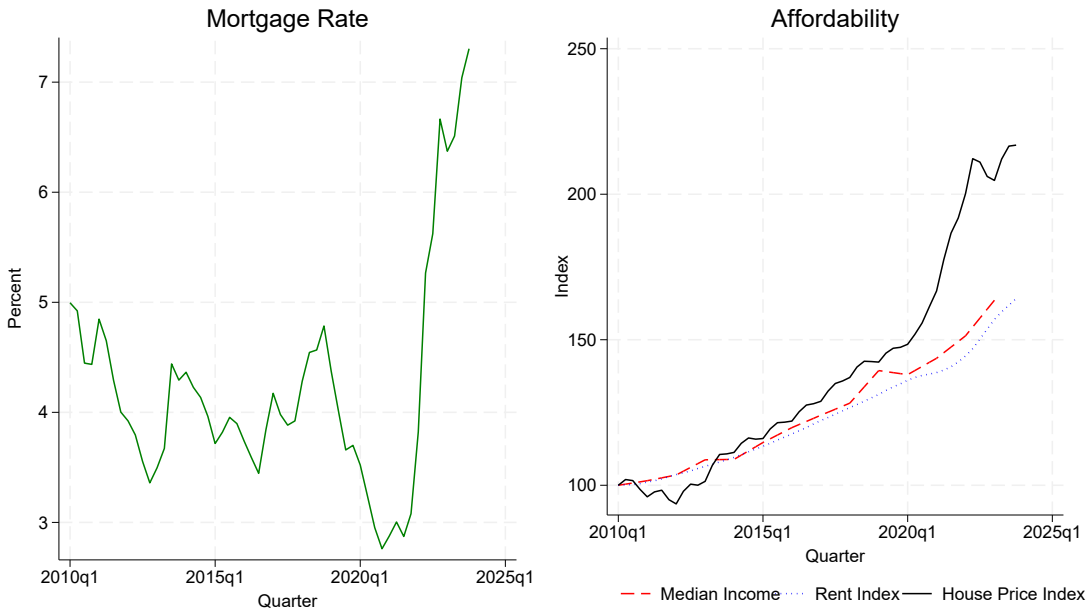
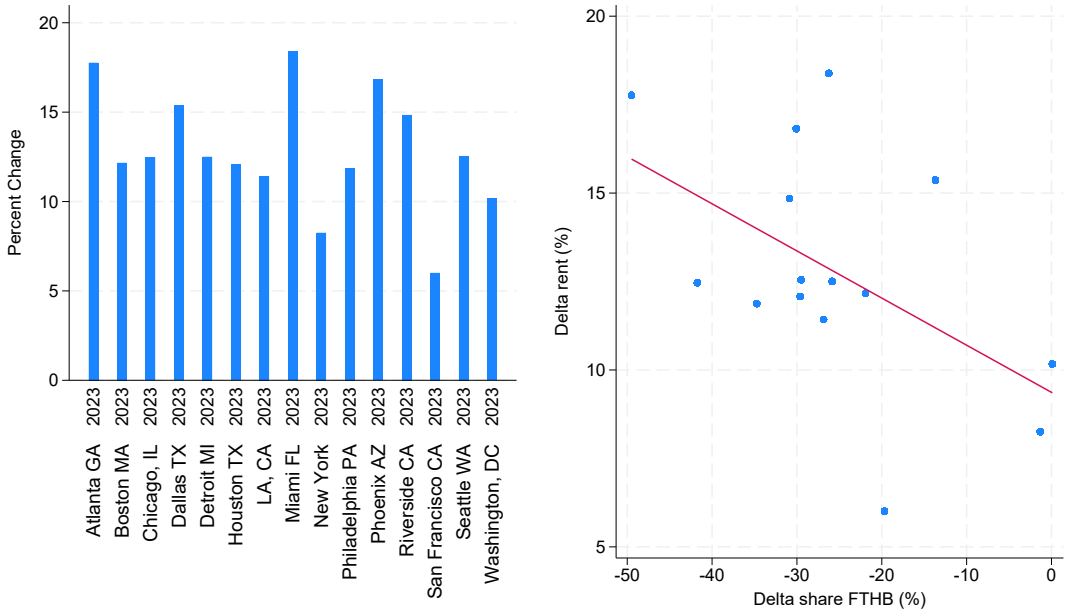
A. Appendix A: Figures

Figure A1: *Housing affordability over time*



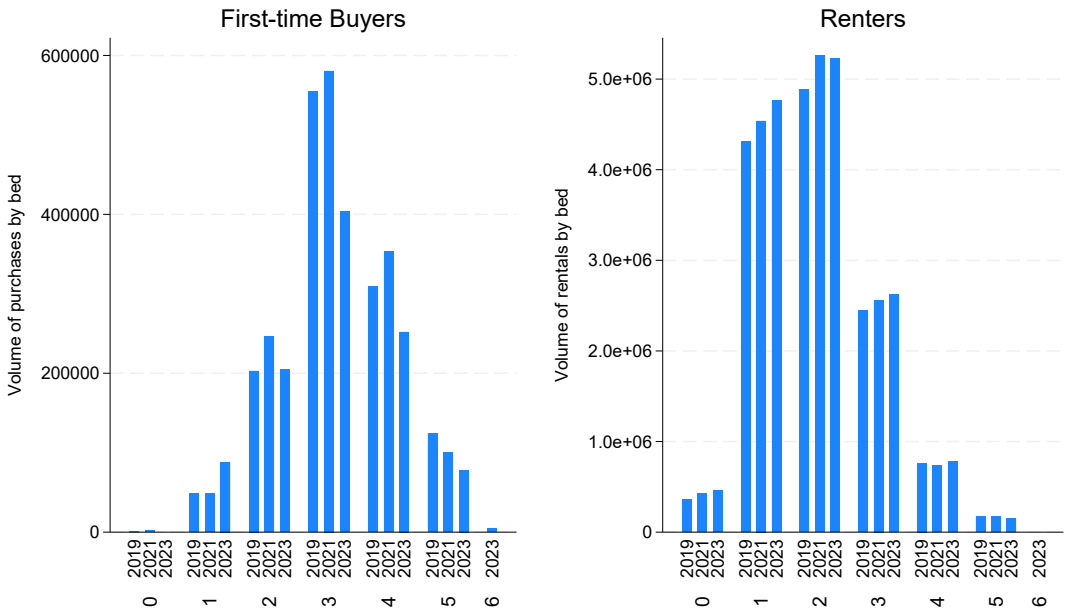
Sources: FRED. Mortgage rates are the average rates on newly originated 30-year FRMs. House Prices Index measures changes in value of the owner-occupied housing stock; Rental Index the change in rents of primary residences. Median household income (nominal) is interpolated to obtain quarterly frequencies. All three series are rescaled to be expressed as percentages of 2010 values (2010 q1=100).

Figure A2: *Change in average rents by city, 2021-2023*



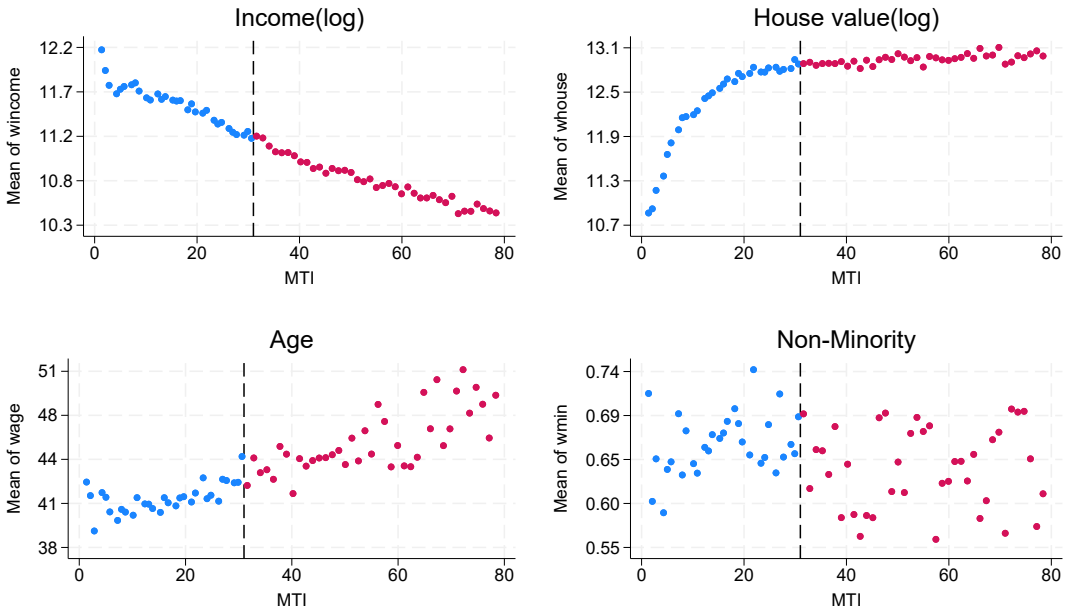
Sources: American Housing Survey, 2021-2023. LHS: Change in average rent by city: existing and new tenancies. The change in rent is computed as the frequency weighted log difference in rents charged on any given housing unit between the 2021 and the 2023 survey. RHS: Correlation between city-level change in rent prices and change in the share of first-time home-buyers between 2021 and 2023

Figure A3: *Volume of units by size: renters VS first-time buyers*



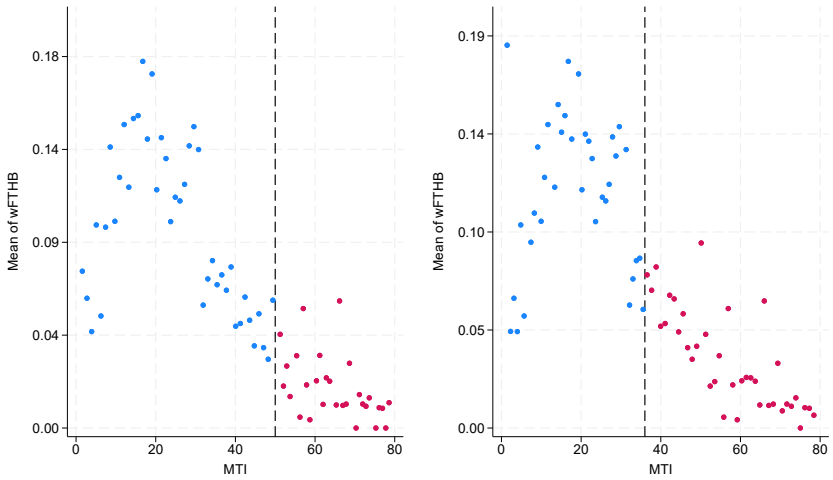
Sources: American Housing Survey , 2019-2023. The chart displays the volume of housing units by number of bedrooms and occupation status (renter VS first-time buyers). Observations are weighted by frequency weights.

Figure A4: *Share of first-time home-buyers by MTI: placebo tests*



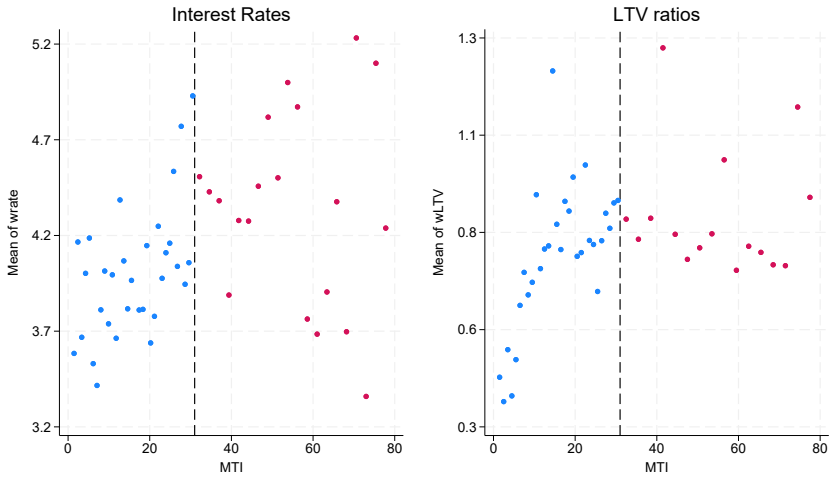
Sources: American Housing Survey, 2021-2023. The sample include first-time homebuyers and renters. The figure plots, clockwise: average income by MTI; average house value; 1- share of racial and ethnic minority groups; age of household head. MTIs are rounded up to the closest integer. Observations are weighted by frequency weights.

Figure A5: *Share of first-time home-buyers by MTI: placebo tests*



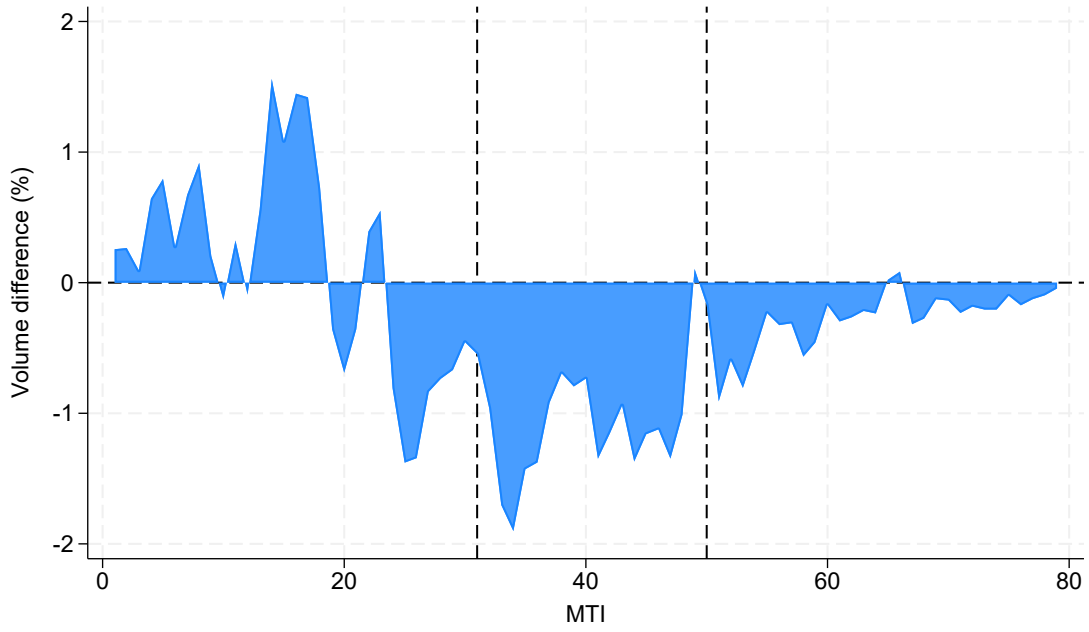
Sources: American Housing Survey, 2021-2023. The figure plots the share of FTHB by MTI; it splits the sample at MTI=36 and MTI=50, corresponding to FHA back-end ratio and overall DTI ratios. MTIs are rounded up to the closest integer. Observations are weighted by frequency weights.

Figure A6: *Interest rates and LTVs for first-time buyers at different levels of MTI limits*



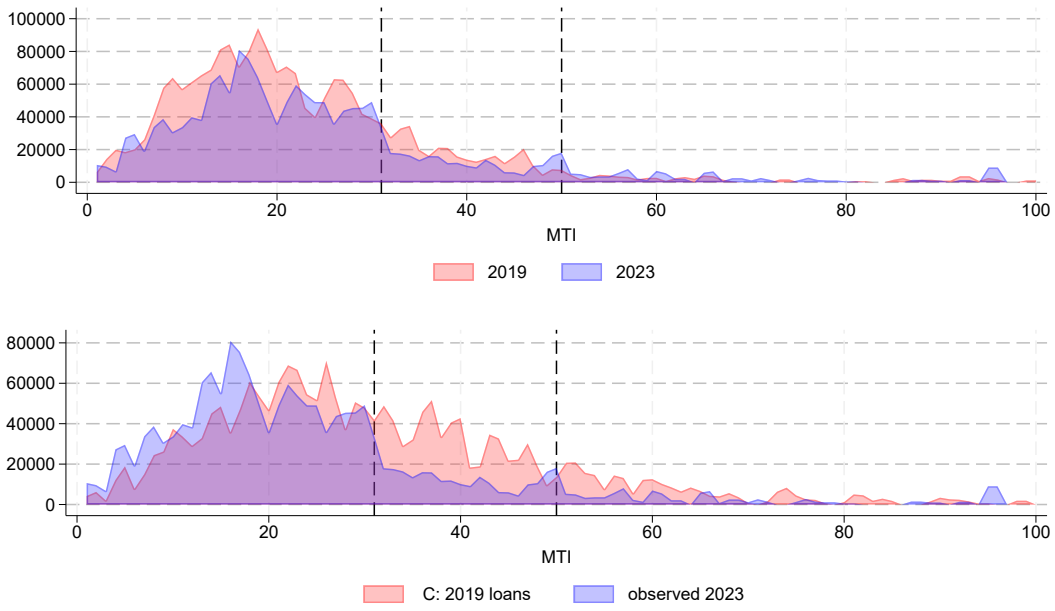
Sources: American Housing Survey, 2021-2023. The figure plots the average interest rate and average LTV ratio for first-time homebuyers at different points in the MTI distribution. MTIs are rounded up to the closest integer. Observations are weighted by frequency weights.

Figure A7: *Difference between 2023 and counterfactual distribution: percent of 2021 originations*



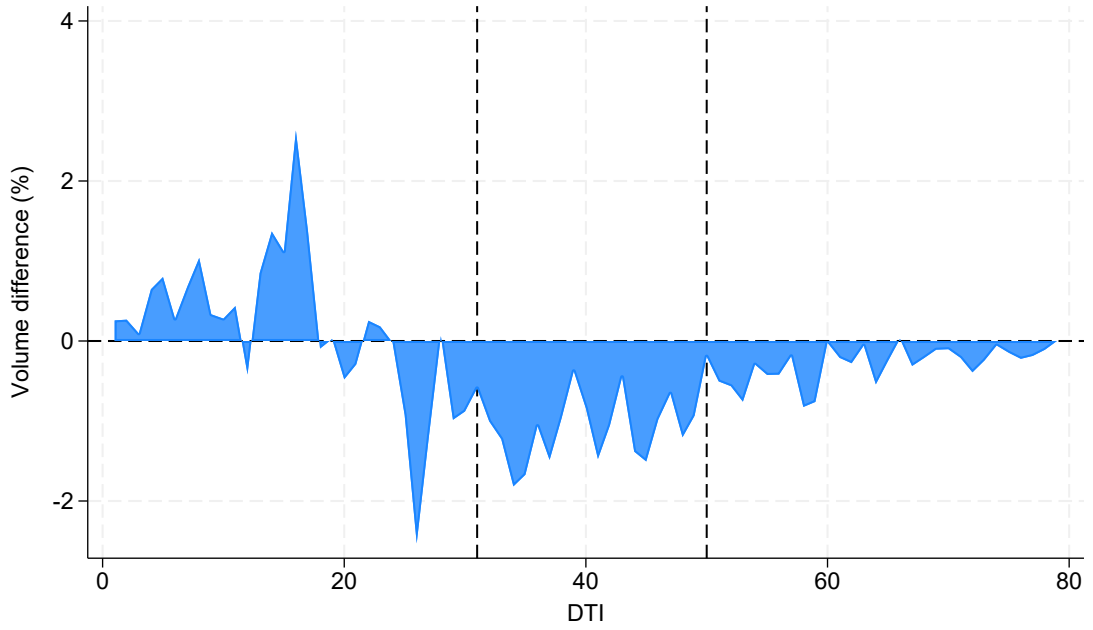
Sources: American Housing Survey , 2021-2023. The chart displays the difference between the observed 2023 distribution and the counterfactual distribution, built using 2021 data. Volumes are expressed in percentage points of 2021 volumes, by MTI value. MTIs are rounded up to the closest integer. Observations are weighted by frequency weights.

Figure A8: *2023 and 2019 distributions: Observed and counterfactual*



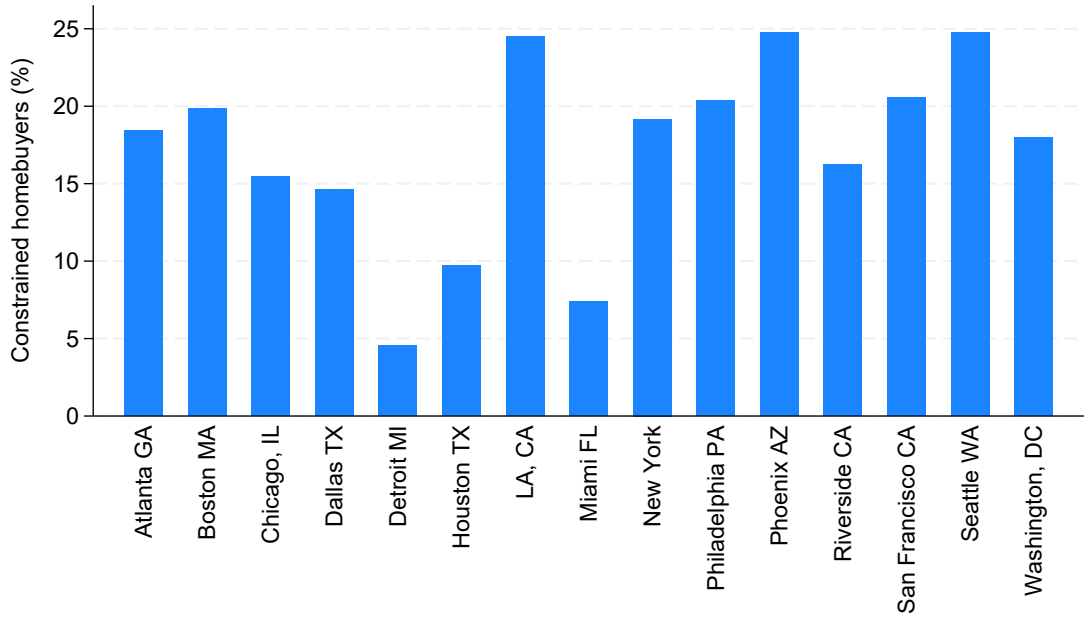
Sources: American Housing Survey , 2019-2023. The chart displays the observed MTI distributions for first-time buyers in 2019 and 2023 (top chart); and the counterfactual distribution for 2019 buyers relative to the observed 2023 distribution (bottom chart). Counterfactual distributions for 2019 buyers assume a 3.5 percentage points increase in mortgage rates, corresponding to the average increase between the first semester of 2019 and the first semester of 2023. MTIs are rounded up to the closest integer. Observations are weighted by frequency weights.

Figure A9: *Demand-adjusted counterfactual, percent of 2021 distributions*



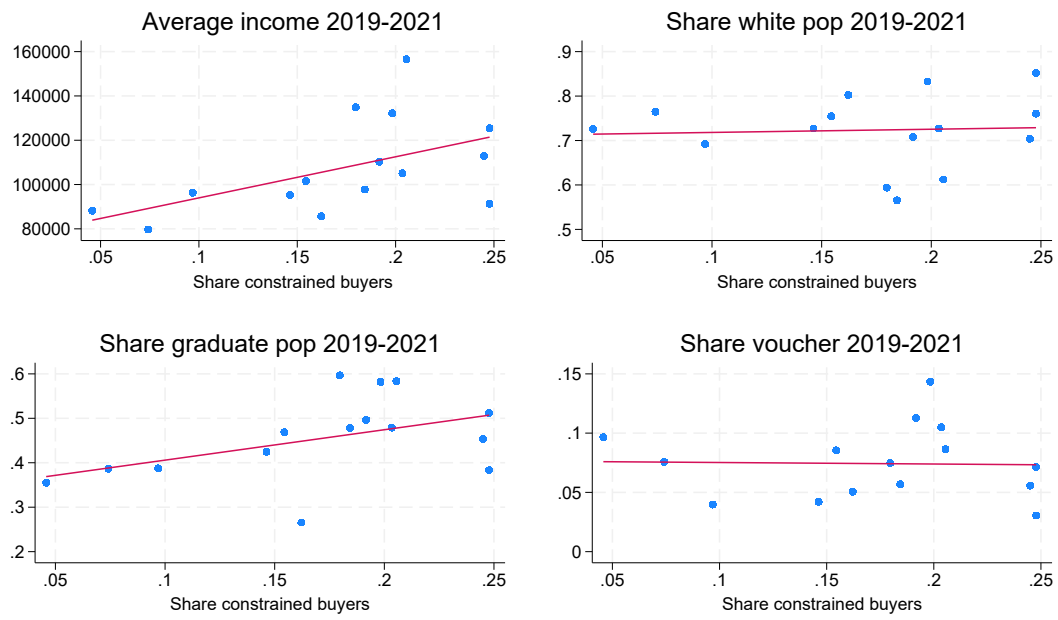
Sources: American Housing Survey , 2021-2023. The chart displays the difference in MTI distributions for first-time buyers in 2023 vs the demand-adjusted counterfactual relative to 2021 volumes. Following the methodology in Bosshardt et al. (2024), I adjust the extensive margin of loan demand in the counterfactual distribution by assuming (i) 2 percent reduction inloan size for each percentage point increase in interest rates; (ii) adjusting loan demand to average changes in income and house prices between 2021 and 2023, by multiplying average city-level growth in income and house prices by the average elasticity between loan size and income/house values conditional on city and year fixed-effects obtained across the 2019-2023 waves of the survey. MTIs are rounded up to the closest integer. Frequency weights are assumed.

Figure A10: *Share of constrained home-buyers by city: percent of 2021 buyers*



Sources: American Housing Survey , 2021. The chart displays the relative prevalence of constrained home-buyers in 2021 across US MSAs. Constrained home-buyers are defined as first-time buyers with an observed MTI below 31 and a counterfactual MTI above 31, in 2021. MTIs are rounded up to the closest integer. Observations are weighted by frequency weights.

Figure A11: *Share of constrained home-buyers ex-ante and city-level demographic characteristics*

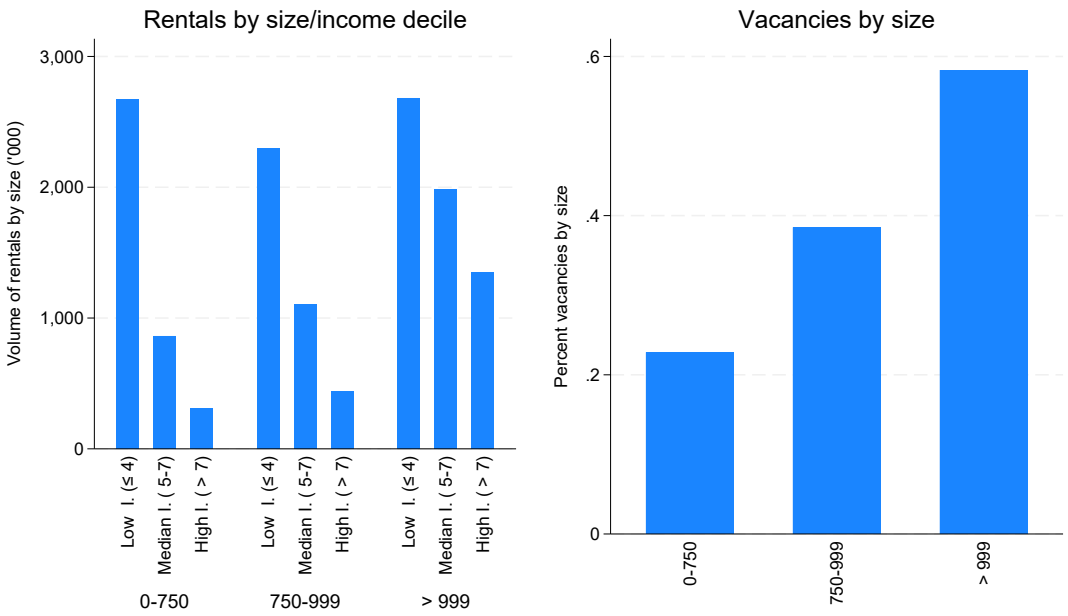


Sources: American Housing Survey, 2019-2021. The chart displays the correlation between the share of constrained home-buyers in 2019-2021 and MSA level average income, share of graduates, share of housing voucher recipients and share of White population measured contemporaneously. Constrained home-buyers are defined as first-time buyers with an observed MTI below 31 and a counterfactual MTI above 31. MTIs are rounded up to the closest integer. Observations are weighted by frequency weights.

Figure A12: *Share of constrained home-buyers ex-ante and city-level outcomes in 2023*

Sources: American Housing Survey, 2019-2023. The chart displays the correlation between the share of constrained home-buyers in 2019-2021 across MSAs and growth in income, population, house prices in 2023, as well as the 2023 share of rent-controlled units. Constrained home-buyers are defined as first-time buyers with an observed MTI below 31 and a counterfactual MTI above 31. MTIs are rounded up to the closest integer. Observations are weighted by frequency weights.

Figure A13: *Income decile of occupants and vacancy rates by unit size*



Sources: American Housing Survey, 2019-2021. The chart displays the average size of renter-occupied housing units (LHS) by income decile of its occupants; and the proportion of units which are vacant for rent as a share of total available units in the same market segment (RHS). Observations are weighted by frequency weights.

Table A1: *Regression discontinuity: quadratic polynomial*

VARIABLES	(1) FTHB 0-100	(2) FTHB 0-50	(3) FTHB 25-37
Threshold	-0.017*	-0.034**	-0.069**
	(0.010)	(0.015)	(0.030)
MTI	-0.000	0.000	0.010
	(0.001)	(0.001)	(0.010)
Threshold* MTI	-0.000	0.005	0.014
	(0.001)	(0.004)	(0.021)
MTI2	-0.000***	-0.000***	-0.000
	(0.000)	(0.000)	(0.002)
Threshold*MTI2	0.000***	-0.000	-0.002
	(0.000)	(0.000)	(0.003)
Observations	23,181	18,268	4,768
R-squared	0.108	0.104	0.136
MSA by Year FE	Yes	Yes	Yes
HH and Unit controls	Yes	Yes	Yes

Notes: AHS 2019-2023. FTHB is a dummy taking value 1 if a household switches from renting to buying, 0 otherwise. The sample includes first-time home-buyers and renters. MTIs are measured as mortgage service to income ratios: these are reported for homebuyers and imputed for renters. Controls include age, race and educational attainment of household head, annual household income, family composition, and unit characteristics (size, n.bedrooms, n.bathrooms, unit type). MSA by year FE included. Heteroskedasticity-robust SEs in parentheses.

Table A2: *Descriptive statistics for first-time buyers by survey year*

	(1)	(2)	(3)
	2019	2021	2023
HH income (2019 USD)	135,323	134,821	135,178
Age	40	40	41
Graduate degree (Percent)	54	60	60
White population (Percent)	70	69	69
LTV (Percent)	86	84	76
MTI (Percent)	23	22	25
Observations (weighted)	1,239,685	1,330,602	1,031,170

Notes: American Housing Survey, 2019-2023. Observations are weighted using frequency weights. Household income is expressed in 2019 USD.

Table A3: *Demographic characteristics of constrained home-buyers (2019-2021)*

Variable	Constrained	Not constrained
White population (Percent)	67	73
HH Gross Income (2019 USD)	108,130	163,001
Head graduate (Percent)	55	65
LTV (Percent)	88	78
Percent of total	25	75

Notes: American Housing Survey, 2021. Constrained buyers are defined as 2021 first-time home-buyers with MTI below 31 and counterfactual MTI above 31. Observations are weighted by frequency weights. Household income is expressed in 2019 USD.

Table A4: *Rent increase and constrained home-buyers: including lag rents*

VARIABLES	(1) $\Delta Rent_{i,23}$	(2) $\Delta Rent_{i,23}$	(3) $\Delta Rent_{i,23}$
$\text{ShareC}_{m,19-21}$	0.217***	0.212***	0.217***
	(0.070)	(0.069)	(0.069)
$\Delta Rent_{i,21}$	-0.327***	-0.327***	-0.326***
	(0.019)	(0.020)	(0.019)
MSA controls	Yes	Yes	Yes
Unit controls	No	Yes	Yes
Tenant controls	No	No	Yes
Observations	3,975	3,975	3,975
R-squared	0.119	0.124	0.132

Notes: AHS 2021-2023. $\Delta Rent_{i,23}$ measures the unit-specific change in (log) rent between 2021 and 2023, and $\Delta Rent_{i,21}$ measures the change in the same unit's rent between 2019 and 2021. $ShareC_{m,19-21}$ measures the share of constrained home buyers in a given MSA (average between 2021 and 2019). MSA level controls average house price growth (2021-2023); population growth (2021-2023); change in average annual income (2021-2023) as well the share of voucher recepients, the share of rent-controlled units and (log) average income and (log)population size in 2023. Unit-level controls include dummies for unit size, n.bedrooms, n.bathrooms, building age in years a dummy for whether the unit is an apartment or a house. Tenant controls include age of the household head, household income decile (relative to the city/year income distribution) and number of people living in the unit. Heteroskedasticity-robust standard errors are clustered at the city-size level.

Table A5: *Pre-trends: Rent increase and constrained home-buyers in 2021*

VARIABLES	(1) $\Delta Rent_{i,21}$	(2) $\Delta Rent_{i,21}$	(3) $\Delta Rent_{i,21}$	(4) $\Delta Rent_{i,21}$	(5) $\Delta Rent_{i,21}$	(6) $\Delta Rent_{i,21}$
$\Delta FTHB_{m,21}$	-0.037	-0.034	-0.034			
	(0.023)	(0.023)	(0.023)			
$\text{ShareC}_{m,19-21}$				-0.068	-0.064	-0.061
				(0.089)	(0.083)	(0.085)
MSA controls	Yes	Yes	Yes	Yes	Yes	Yes
Unit controls	No	Yes	Yes	No	Yes	Yes
Tenant controls	No	No	Yes	No	No	Yes
Observations	6,614	6,614	6,614	6,614	6,614	6,614
R-squared	0.006	0.010	0.013	0.006	0.010	0.013

Notes: AHS 2019-2021. $\Delta Rent_{i,23}$ measures the unit-specific change in (log) rent between 2019 and 2021; FTHB measures the change in the share of FTHB between 2019 and 2021 at the MSA level; $ShareC_{m,19-21}$ measures the share of constrained home buyers in a given MSA (average between 2021 and 2019). MSA level controls average house price growth (2019-2021); population growth (2019-2021); change in average annual income (2019-2021) as well the share of voucher recipients, the share of rent-controlled units and (log) average income and (log)population size in 2021. Unit-level controls include dummies for unit size, n.bedrooms, n.bathrooms, building age in years a dummy for whether the unit is an apartment or a house. Tenant controls include age of the household head, household income decile (relative to the city/year income distribution) and number of people living in the unit. Heteroskedasticity-robust standard errors are clustered at the city-size level.

Table A6: *Rental supply and share of constrained buyers*

VARIABLES	(1) Converted Units	(2) New Units	(3) Rental Vacancies
$\text{ShareC}_{m,19-21}$	0.040	0.073**	-0.048***
	(0.035)	(0.035)	(0.016)
MSA Controls	Yes	Yes	Yes
Unit controls	Yes	Yes	Yes
Tenant controls	Yes	Yes	Yes
Observations	15,096	8,901	11,778
R-squared	0.016	0.047	0.010

Notes: AHS 2021-2023. Converted units is a dummy taking value 1 if a housing unit was owner-occupied in 2021 and is renter-occupied (or vacant for rent) in 2023, 0 if it is owner-occupied. New units is a dummy taking value 1 if a (occupied) rental unit was built in the survey year or the year prior, 0 otherwise. Rental vacancies is a dummy taking value 1 if a unit is vacant for rent, 0 if it is rented. $ShareC_{m,19-21}$ measures the share of constrained home buyers in a given MSA (average between 2021 and 2019). MSA level controls average house price growth (2021-2023); population growth (2021-2023); change in average annual income (2021-2023) as well as (log) average income and (log) population size in 2023. Unit-level controls include size, n.bedrooms, n.bathrooms, a dummy for whether the unit is an apartment or a house and whether there is a new lease in place. Bootstrapped SEs in parentheses are robust to heteroskedasticity.

Table A7: *Heterogeneity: income deciles*

VARIABLES	(1) $\Delta Rent_{i,23}$	(2) $\Delta Rent_{i,23}$ No Voucher	(3) $\Delta Rent_{i,23}$ No Rent Control	(4) $\Delta Rent_{i,23}$ No new leases	(5) $\Delta Rent_{i,23}$ No recent lease
ShareC$_{m,19-21}$	0.369***	0.363***	0.404***	0.352***	0.452***
	(0.064)	(0.082)	(0.064)	(0.074)	(0.109)
Decile 4-6	0.100***	0.081**	0.099***	0.105***	0.114***
	(0.028)	(0.036)	(0.028)	(0.029)	(0.033)
Decile 7-10	0.151***	0.125***	0.158***	0.122***	0.136**
	(0.030)	(0.033)	(0.029)	(0.032)	(0.056)
Decile 4-6*ShareC$_{m,19-21}$	-0.251*	-0.257*	-0.246*	-0.254*	-0.427**
	(0.129)	(0.155)	(0.126)	(0.136)	(0.171)
Decile 7-10* ShareC$_{m,19-21}$	-0.584***	-0.515***	-0.646***	-0.421***	-0.645***
	(0.133)	(0.141)	(0.130)	(0.139)	(0.239)
MSA Controls	Yes	Yes	Yes	Yes	Yes
Unit controls	Yes	Yes	Yes	Yes	Yes
Tenant controls	Yes	Yes	Yes	Yes	Yes
Observations	5,911	4,760	5,613	5,386	3,778
R-squared	0.021	0.026	0.022	0.021	0.021

Notes: AHS 2021-2023. $\Delta Rent_{i,23}$ measures the unit-specific change in (log) rent between 2019 and 2021; FTHB measures the change in the share of FTHB between 2019 and 2021 at the MSA level; $ShareC_{m,19-21}$ measures the share of constrained home buyers in a given MSA (average between 2021 and 2019). Column 2 excludes voucher recipients; column 3 excludes units subject to rent control; column 4 excludes leases signed during the survey year or the previous year; column 5 excludes tenancies lasting less than three years. MSA level controls average house price growth (2019-2021); population growth (2019-2021); change in average annual income (2019-2021) as well the share of voucher recipients, the share of rent-controlled units and (log) average income and (log)population size in 2021. Unit-level controls include dummies for unit size, n.bedrooms, n.bathrooms, building age in years a dummy for whether the unit is an apartment or a house. Tenant controls include age of the household head, household income decile (relative to the city/year income distribution) and number of people living in the unit. Heteroskedasticity-robust standard errors are clustered at the city and size level.

Table A8: *Heterogeneity: market segment*

VARIABLES	(1) $\Delta Rent_{i,23}$	(2) $\Delta Rent_{i,23}$	(3) $\Delta Rent_{i,23}$	(4) $\Delta Rent_{i,23}$	(5) $\Delta Rent_{i,23}$
ShareC$_{m,19-21}$	0.336***	0.242***	0.203***	0.370***	0.418***
	(0.069)	(0.076)	(0.064)	(0.118)	(0.127)
Median size*ShareC$_{m,19-21}$	-0.142**				
	(0.066)				
Large size*ShareC$_{m,19-21}$	-0.168*				
	(0.098)				
House		-0.006			
		(0.030)			
House*ShareC$_{m,19-21}$		-0.055			
		(0.157)			
Recent			-0.065		
			(0.044)		
Recent *ShareC$_{m,19-21}$			0.206		
			(0.223)		
Vacancy Rate 21				0.032	0.007
				(0.024)	(0.026)
Vacancy Rate 21*ShareC$_{m,19-21}$				-0.272**	-0.099
				(0.133)	(0.152)
Decile 4-6*ShareC$_{m,19-21}$					-0.091
					(0.186)
Decile 7-10*ShareC$_{m,19-21}$					-0.240
					(0.295)
Decile 4-6*ShareC$_{m,19-21} * Vacancyrate21$					-0.291
					(0.288)
Decile 7-10*ShareC$_{m,19-21} * Vacancyrate21$					-0.694*
					(0.370)
Observations	5,911	5,911	5,911	5,911	5,911
R-squared	0.020	0.020	0.020	0.020	0.022

Notes: AHS 2021-2023. $\Delta Rent_{i,23}$ measures the unit-specific change in (log) rent between 2019 and 2021; FTHB measures the change in the share of FTHB between 2019 and 2021 at the MSA level; $ShareC_{m,19-21}$ measures the share of constrained home buyers in a given MSA (average between 2021 and 2019). Column 1 interacts these shares by a dummy, taking values from 1 to 3 corresponding to different buckets of unit size (0-750; 750-999; more than 999 sqft); in column 2 the dummy taking value 1 if the rental is a house, 0 if an apartment; in column 3 the dummy takes value 1 if the building has been developed in the previous 20 years, 0 otherwise. Columns 4 and 5 use vacancy rates, defined as the share of vacant rental units by size bucket (small, medium large) in any given city, in 2021. MSA level controls average house price growth (2019-2021); population growth (2019-2021); change in average annual income (2019-2021) as well the share of voucher recipients, the share of rent-controlled units and (log) average income and (log)population size in 2021. Unit-level controls include dummies for unit size, n.bedrooms, n.bathrooms, building age in years a dummy for whether the unit is an apartment or a house. Tenant controls include age of the household head, household income decile dummies (relative to the city/year income distribution) and number of people living in the unit. Heteroskedasticity-robust standard errors are clustered at the city and size level.

B. Appendix B: Imputing Renter's MTI

To impute renters' MTI, I mirror the approach used in the imputation of Owner Equivalent Rents, used by the Bureau of Labor Statistics to estimate the shelter component of CPI.

I start by imputing the current market value of renter property i, based on value of similar (owner-occupied) properties in the same MSA m in year t, based on an hedonic regression which includes a large set of unit-specific covariates:

$$\widehat{HousePrice}_{imt} = \alpha + \gamma_n^N X_{imt} + \theta_n^N(\lambda_t * X_{imt}) + \phi_{mt} + \varepsilon_{imt}$$

Where X_{imt} is a large vector of unit-specific controls, specifically: type of building (apartment, or house); age of unit and square of age; size in square feet; fixed effects for the number of bedrooms and bathrooms; and whether the household is reporting significant crime in the neighborhood. Each characteristic X_{imt} is also interacted with year fixed-effects, to allow for the effect of these parameters to change over time (for example, preferences shift in preferences regarding size or location). ϕ are MSA-by-year fixed-effects, capturing parameters common to all properties in a given MSA and year which could affect property values. The coefficients $\gamma_n; \theta_n; \phi$, estimated for the owner-occupied sample, allow me to impute the current market value of renter-occupied units with the same characteristics X_{imt} in the same MSA and year.

In a second step, I impute the cost of financing the acquisition of property i. To do so, I proceed in two steps. First, I impute the mortgage amount needed to finance the property acquisition, based on the mortgage amounts borrowed by first-time buyers purchasing properties of similar value in the same city and year. Formally:

$$\widehat{Mortgage}_{imt} = \alpha + \beta_1 \widehat{HousePrice}_{imt} + \gamma_n^N X_{imt} + \theta_n^N(\lambda_t * X_{imt}) + \phi_{mt} + \varepsilon_{imt}$$

Based on a similar approach as the one described in Equation **??**, with the only addition of a control for the imputed house value. Finally, I impute the borrower-specific interest rate which could potentially be paid on the mortgage, by using the interest rates reported by first-time buyers purchasing a property of similar characteristics and value, with a similar loan size, in the same city and year:

$$\widehat{Rate}_{imt} = \alpha + \beta_1 \widehat{HousePrice}_{imt} + \beta_2 \widehat{Mortgage}_{imt} + \gamma_n^N X_{imt} + \theta_n^N(\lambda_t * X_{imt}) + \phi_{mt} + \varepsilon_{imt}$$

For simplicity, the calculations of MTI assume that the mortgage has 30 year maturity, as this is the most typical mortgage maturity in the US.[28] Thus, the annual imputed

[28] I also assume a constant amortization schedule. This is a simplification, as a typical fixed-rate mort-

mortgage payment in the first year of the loan (including principal and interest) for unit i in city m and year t is:

$$\widehat{Payment}_{imt} = [\widehat{Mortgage}_{imt}/30] + [\widehat{Mortgage}_{rimt} * Rate_{imt}]$$

And the MTI for renter's family R living in unit i is:

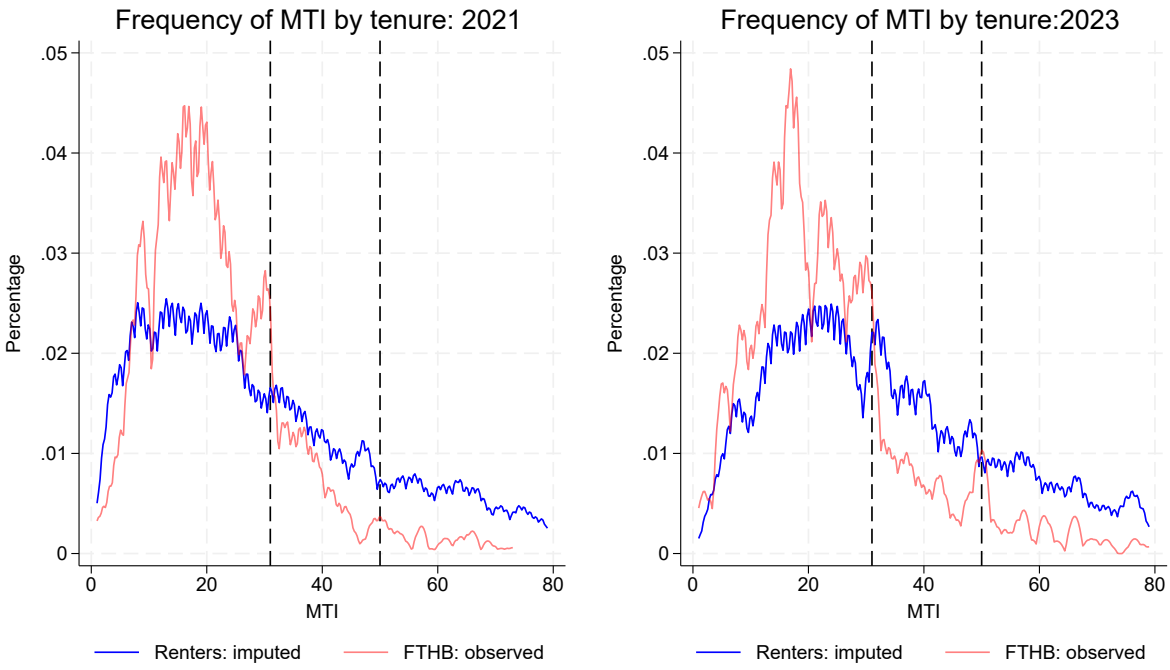
$$\widehat{MTI}_{Rimt} = \widehat{Payment}_{imt} / AnnualIncome_{Rimt}$$

Figure B1 plots the distributions of owner (observed) and renters'(imputed) MTIs for 2021 and 2023. Renters' MTIs are overall higher than first-time buyers', as renter households tend to be poorer, on average. Renter's imputed MTI distribution shift decisively to the right in 2023, consistently with higher interest rates and rising house prices. There is also a visible spike in the proportion of renters with imputed MTI at or just above the front-end threshold, suggesting that a number of potential home-buyers may indeed have been pushed above underwriting limits by the change in interest rates between the two waves.

This methodology also offers some insights on the relative cost of buying VS renting across US cities. Figure B2 shows that, in 2021, a renter living in DC or Miami would generally have benefited from the acquisition of the same property they live in, as this would have reduced their monthly housing costs. This is not the case in New York, where the costs were comparable. However, the same renter in San Francisco would have typically faced a higher housing cost if they chose to buy, due to higher average property valuations relative to rent prices. In 2023, the sharp increase in mortgage rates combined with rising or stable property prices increased the cost of buying in many US cities, often aligning these average costs with the cost of renting a similar unit.

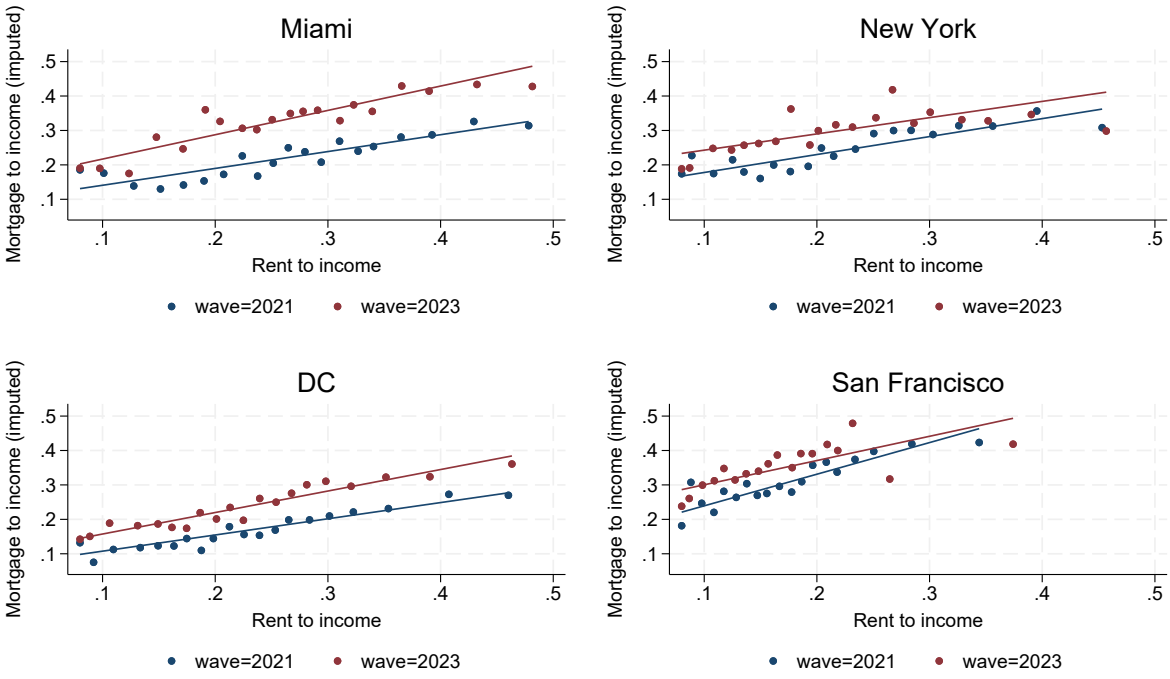
gage amortizes less at the beginning and more towards the end. Given that most mortgages in the US are issued with fixed nominal payments at least for the first year of the loan (true ARMs are rare), this simplification is irrelevant towards the calculations of MTIs in the first year.

Figure B1: *Renters' and first-time buyers MTIs by year*



Sources: American Housing Survey, 2021-2023. The figures plot the kernel densities of owners' MTIs and renters' imputed MTIs by year. Observations are weighted by frequency weights.

Figure B2: *Cost of renting VS buying by city*



Sources: American Housing Survey, 2021-2023. The figures plots the imputed MTI ratios for renters assuming they wanted to finance the acquisition of the same property they live in, using a 30 year FRM at prevailing market rates with 20 percent down-payment. Observations are weighted by frequency weights.

PUBLICATIONS

Missing Home-Buyers and Rent Inflation: The Role of Interest Rates and Mortgage Underwriting Standards

Working Paper No. WP/2025/090