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Tracking Homeownership Rates Over the Past Four Decades: The Interplay of Housing Costs, Mortgage Lending Standards and College Debt Burdens

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Abstract

After temporarily rising during the subprime boom, U.S. homeownership rates plunged for young households before slowly rising in the late 2010s. We identify four key drivers of the homeownership rate of the young. The first is the relative cost of owning versus renting. The second is the severity of mortgage credit constraints, which delay the transition to homeownership. The role of credit constraints predated the subprime boom but became prominent in the wake of the subprime boom and bust. The third factor encompasses secular changes in family structure, proxied by the age when mothers first give birth.

A fourth factor is the rising burden of student debt that has delayed the accumulation of downpayments and the transition to homeownership. We create a novel dataset of the average debt service burden ratio from the early 1980s on for each age cohort.

Using a cointegrating model framework, we find that all four factors are significant drivers of the homeownership rate of young households, and that not accounting for college debt gives rise to omitted variable bias. Our study makes two contributions. First, we provide new time series data on the evolution of college debt service burdens. Second, we develop time series models of homeownership that jointly analyze the impact of access to credit, student debt, family factors, and the cost of owning to renting.

Key Words: homeownership, college debt, credit constraints, childbirth, user costs and rent

JEL Classification: C51, C52, E51, G21, R31

*We thank Isha Parmar for research assistance. Duca dedicates this study to the memory of his dissertation advisor Dwight Jaffee and Dwight's seminal work on housing and credit constraints. The views expressed are those of the authors and are not necessarily those of the Federal Reserve Bank of Dallas or the Federal Reserve System.

1. Introduction

Homeownership, a part of the American Dream and long-term financial well-being, has become more elusive for young Americans who have seen homeownership rates oscillate lower since the early 1980s (Figure 1), especially for ages 30 to 34 and ages 35 to 39. For most homeowners, their house is their largest asset and the wealth gained from owning is particularly important for low and middle-income households (Turner and Luea, 2009). They may use this wealth for retirement later in the lifecycle or use it as a means of borrowing during economic downturns like those of the subprime boom (Duca et al, 2010). For young people between the ages of 25 and 35, owning a home is a major means of building wealth, and declining homeownership rates could exacerbate levels of wealth inequality. Indeed, Rognlie (2015) finds that the rise in wealth inequality that Piketty (2014) has noted largely stems from the rich benefitting from capital gains on homeownership (as well as monopoly profits on business equity). Daysal, et al.

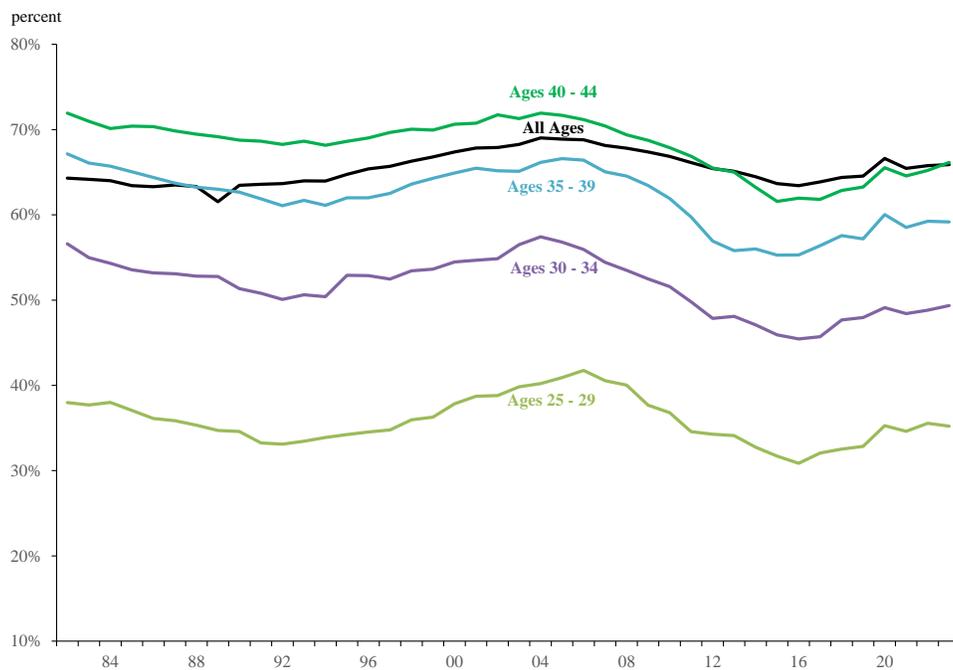
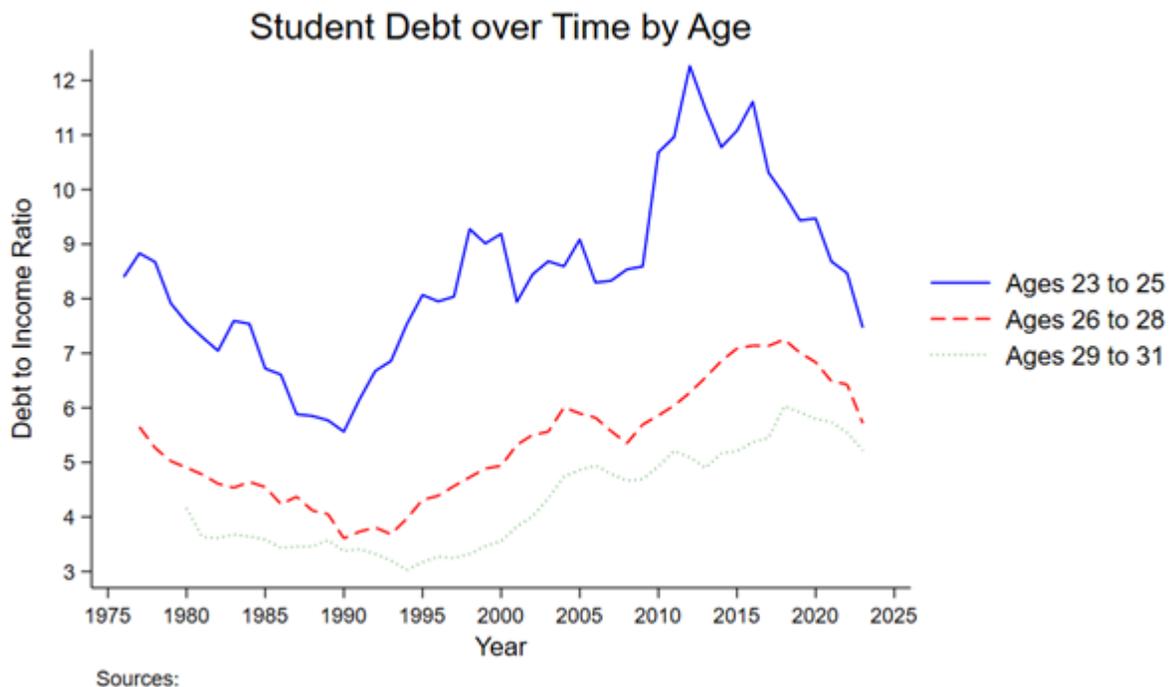


Figure 1: U.S. Homeownership Rates Trending Lower for Ages 30-44
(Sources: IPUMS, Census Bureau Annual Social and Economic Supplement (ASEC) data and authors' calculations)

(forthcoming) find that early household wealth gains have up to a 25% transmission rate on intergenerational wealth. Thus, to address intergenerational inequality, it is critical to understand what drives homeownership for young adults, the focus of this paper.

Constraints on homeownership include rising housing costs, tight mortgage lending standards, and limited affordable options. These challenges to homeownership among younger households have been exacerbated by an increased payment burden of student debt and its significant impact on first-time home buyers. This can be seen in the uptrend in a measure of the average college debt burden for college graduates shown in Figure 2, which plots total scheduled college loan payments since graduation relative to income (see Section 2 for more details).

The literature has examined these two sets of factors separately, and this paper addresses this gap in the literature by analyzing the main drivers of homeownership together and makes two



**Figure 2: The Evolution of College Debt Payment Burdens:
Cumulative College Debt Payments Relative to Income**
(Sources: IPUMS Census Bureau ASEC, Brookings, College Board, and authors' calculations)

general contributions. The first is providing new time series data on the evolution of college debt service burdens for different age groups and cohorts and updating earlier data tracking the credit constraints facing first time buyers (Duca, Muellbauer, and Murphy, 2016). The second is developing time series models of homeownership that allow us to jointly analyze the impact of access to credit, student debt, family factors, and the cost of owning to renting. Much of the current literature on student debt and homeownership is micro-orientated and focuses on a small number of years, whereas we are more macro-orientated and concerned with long-run movements in the homeownership rates of young households.

Our study is organized along the following lines. Section 2 reviews trends in homeownership and the literature on factors affecting homeownership. Building off that discussion, Section 3 presents data and variables that consistently track those factors. Section 4 integrates these variables into an estimable time series model that captures the inter-relatedness of these influences. Estimation results are reviewed in Section 5. We also discuss how one potential form of college debt relief could affect homeownership. The conclusion provides perspective on our findings.

2. Homeownership Trends and the Literature

The U.S. homeownership rate has changed dramatically during the past 100 years (Figure 3), reflecting the interplay between shifts in the availability of mortgages, the relative costs of owning versus renting, demographic factors, and college debt burdens. After fluctuating around 45 percent in the early 20th century, it rose to nearly 50 percent by 1930 before receding during the Great Depression. As stressed by Green and Wachter (2007), a major reason for the latter was the prevalence of non-resilient 5-year balloon mortgages in which borrowers did not repay principal and needed to rollover non-amortizing mortgages with a 50 percent minimum downpayment.

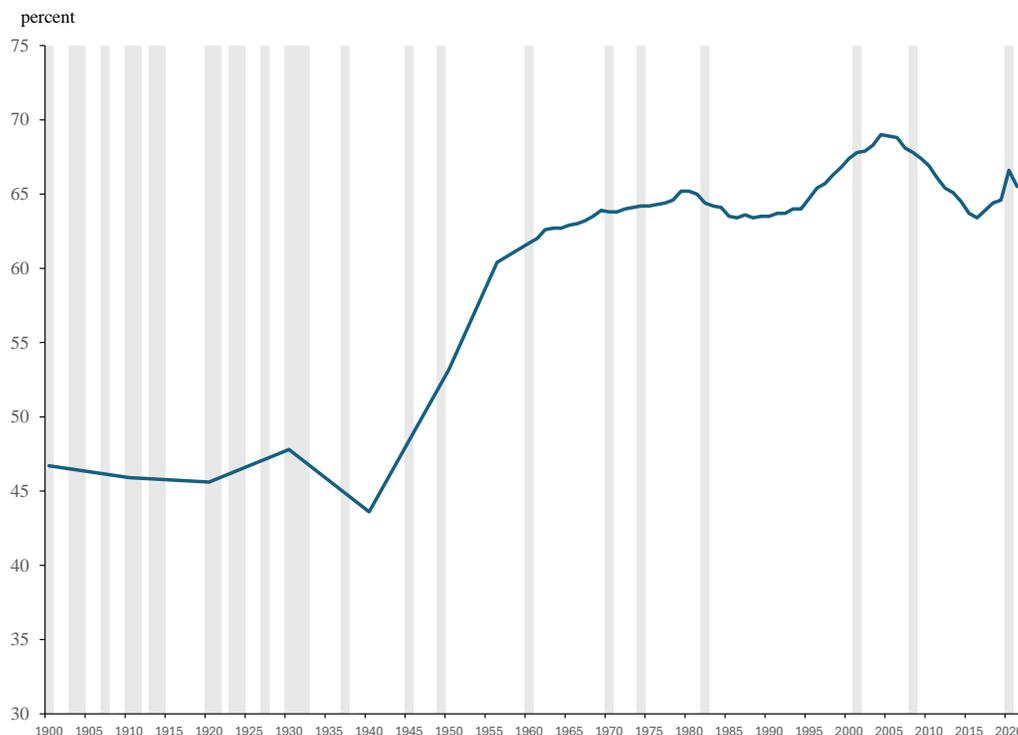


Figure 3: The U.S. Homeownership Rate

(Sources: Census and authors' calculations. Incomplete. Recessions are shaded)

When house prices fell in the Depression, many borrowers were unable to rollover maturing mortgages, forcing fire sales of homes that fueled the collapse of house prices.

After many families lost their homes in the Great Depression, several steps were taken to provide mortgage relief by refinancing troubled mortgages through the Homeownership Lending Corporation (HOLC, Rose, 2011) and several institutional reforms were established in the 1930s to increase the availability of low downpayment mortgages with more predictable payments for borrowers (Green and Wachter, 2007). The latter included developing amortized, fixed payment long-term mortgages, starting with low downpayment mortgages originated by lenders that were guaranteed against default losses by the Federal Housing Administration (FHA). To provide debt relief to homeowners, mortgages were modified and funded by HOLC, and the funding of new FHA mortgages was aided by being purchased by the Federal National Mortgage Association

(FNMA / Fannie Mae, created in 1938). FNMA (and the FHLMC / Freddie Mac) later bought non-FHA fixed-rate mortgages that conformed to FNMA underwriting standards.

Following the Great Depression and WW2, policy bolstered home ownership in two ways (Fetter, 2013). First, WW2 rent controls coupled with the burst of inflation boosted the market value of owner-occupied housing units relative to rental units. This induced many landlords to sell units to former renters. The lifting of rent controls did not reverse this because of a longer-lasting second set of policy actions. In particular, increased access to credit for veterans through the GI Bill and for low- and for middle-income Americans through the Housing Act of 1949 significantly expanded homeownership. Cohorts that entered their prime home-buying years post-WW2 experienced a rapid increase in homeownership, faster in the first five years than any other three-year cohort group as shown in Figure 4. Nevertheless, the overall homeownership rate continued to climb until about 1960 reflecting the drawn-out transition to higher rates of owner-occupation.

Between 1960 and the mid-1990s, mortgage practices, regulation, and government mortgage policies were relatively stable. Minor changes in overall homeownership rates (Figure

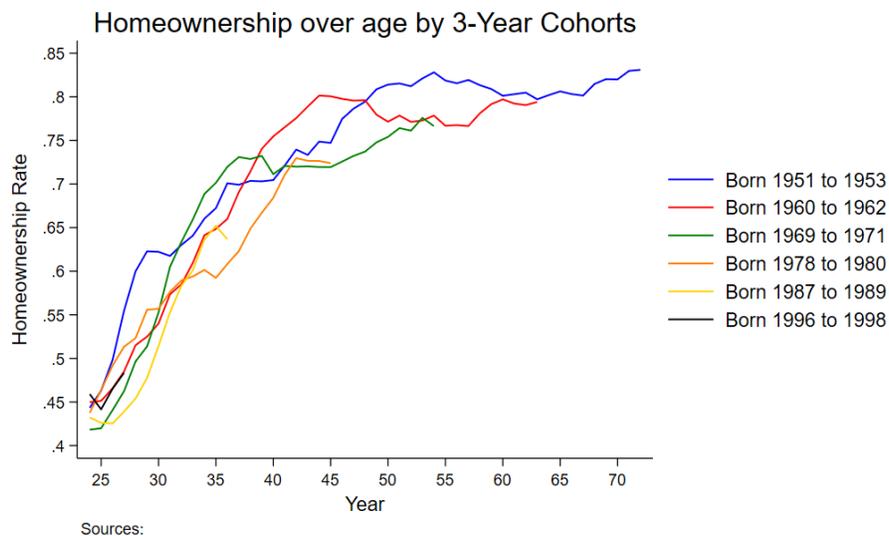


Figure 4: Homeownership Rates Over the Life Cycle Using 3-Year Age Cohorts
(Sources: IPUMS Census Bureau ASEC and authors' calculations)

3) tended to reflect shifts in the relative cost of owning versus renting often associated with changes in real interest rates, as well as more slow-moving changes in family structure. Not surprisingly, the homeownership research from that period emphasized changes in the user cost of housing as a driver of homeownership and housing demand [see, *inter alia*, Hendershott (1980), Hendershott and Slemrod (1982), and Poterba (1984)].¹ As discussed in seminal papers by Rosen and Rosen (1979) and Jaffee and Rosen (1979), under perfect capital markets home ownership rates would primarily depend on demographics and the relative cost of renting versus owning. Indeed, Hendershott and Shilling (1982) argue that demographics and the user cost of housing were the only consistent major drivers of housing tenure choice from the mid-1950s to the late 1970s.

However, if capital markets are imperfect then the homeownership rate is also affected by credit constraints, particularly the downpayment constraint. This was theoretically pointed out by Brueckner (1986) and empirically shown by Jaffee and Rosen (1979) and Kent (1980, 1982), as well as later by Chiuri and Jappelli (2003), Duca and Rosenthal (1991), Linneman and Wachter (1989) and Ortalo-Magne and Rady (2006). Duca and Rosenthal (1994) find that credit constraints affect the housing tenure of younger but not older households. This is consistent with the argument of Goodman and Nichols (1997) that low downpayment FHA mortgages mainly affect homeownership by accelerating the timing of *when* households become owner-occupiers rather than *whether* they would become homeowners at some point in their lifecycle.

From the late-1970s to 1990s, the impact of demographic factors on housing tenure was investigated in some research. Jaffee and Rosen (1979) found that the young and non-married were

¹ The cost of renting has historically exceeded the user cost of owning (Riley et al, 2013), which has boosted homeownership, a significant source of building wealth for low-income households (Wainer and Zabel, 2020). Han et al. (2022) find that raising transactions costs, which feed into the user cost of owning, reduces homeownership and mobility and generates significant deadweight losses.

less likely to become homeowners. Kent (1980) found that larger family sizes were associated with higher homeownership rates, while Clarke et al. (1994) found that expectations of becoming a parent were linked to homeownership. In our time series research, we find that the age when mothers bear their first child (*Age1stBirth*) is more consistently tied to homeownership than are family size or the age of first marriage. As discussed later, we view *Age1stChild* as an overall proxy for correlated changes in family characteristics affecting homeownership.

Starting in the late 1990s through the mid-2000s, the aggregate homeownership rate rose above its prior range (Figure 3) as mortgage credit constraints were eased during the expansion of nonprime mortgages. Duca et al. (2011, 2016) track the overall easing of mortgage credit standards with the combined loan-to-value ratio (LTV) on mortgages used by first-time homebuyers to purchase their first home,² which Tzur-Ilan (2023) and Kinghan et al. (2022) inter alios have linked to the timing of when households become first-time homebuyers. As Chambers et al. (2009) argue, the most plausible explanation for the rise of homeownership rates in the early to mid-2000s were financial innovations that eased first-time buyer credit constraints. Indeed, most of the rise in homeownership rates during the subprime boom of the early 2000s was concentrated among young households who were most affected by easier credit standards (Bardhan, et al., 2009).

After the adjustable interest rates on many subprime mortgages started rising and house prices stopped rising rapidly in the mid-2000s, many nonprime borrowers became unable to pay their mortgages and were no longer bailed out by house price appreciation when they sold their

² Duca et al. (2016) attribute the increased availability of low downpayment loans to several factors boosting the funding of nonprime mortgages that were packaged into private-label (nonprime) mortgage-backed securities (PMBS). First, the Community Reinvestment Act of 1995 pressured Fannie Mae and Freddie Mac to buy more subprime MBS. Two additional factors were better credit scoring technology that improved the sorting of nonprime borrowers funded by PMBS and 2000 legislation that favored credit default swaps which were used to provide illusory default insurance to investors in nonprime MBS. That initial rise turned into a surge when capital requirements on commercial and investment banks for holding investment grade-rated PMBS were greatly eased.

homes. Rising defaults on subprime mortgages then induced a drying up of new nonprime mortgages and a tightening of credit standards facing new potential first-time homebuyers. Coupled with fire sales of repossessed homes, this induced a fall in house prices and set into motion the subprime bust of 2007-11. Other studies such as Fuster and Zafir, (2016) Mian and Sufi (2017) and Acolin, et al. (2016) document the impact of the subprime boom and bust on homeownership and housing. The post-GFC tightening of mortgage credit constraints was also induced by the Dodd-Frank Act, which imposed new “ability to repay” and other regulations to ensure that borrowers' could afford the mortgages they were taking out and thereby prevent another subprime mortgage bust.

The impact of the subprime boom and bust on young homeowners can be observed in the 1969-1971, 1978-1980, and 1987-1989 cohorts. The 1969-1971 cohort had a normal lifecycle rise in homeownership between ages 25 and 35 but experienced a dip in homeownership and a flattening far earlier than the previous two three-year cohorts. The Great Recession and tighter credit constraints lowered the homeownership rate for this group. The 1978-1980 cohort began with a homeownership rate similar to that of previous cohorts but experienced slow growth during the Great Recession, without recovering to the same rate as earlier groups. This likely owed not only to the slow economic recovery and tighter credit constraints induced by the Dodd-Frank Act, but also by the increased burden of college debt on young adults.

Indeed, student debt jumped in the late-1990s and early 2000s, which with further increases mounted to \$1.78 trillion in 2022. One contribution to this increase were sharp rises in college tuition and fees that bolstered indebtedness rather than reductions in education. This, in turn, induced a decline in homeownership and delayed future homeownership [see Bleemer et al. (2021), Mountain et al. (2020), Houle et al. (2015), and Mezza et al. (2020)].

Higher student debt lowers subsequent borrowing in two ways. The first is by raising college debt payments. Figure 2 shows that the student debt burden for young people between ages 23 and 25 rose rapidly and peaked post-recession at about 12 percent in the mid 2010's but has subsequently declined to about 7 percent. While not the same as taking out a mortgage, creditors account for college debt when setting interest rates as well as minimum downpayments and limits on overall debt service. The second way that higher student debt impairs future borrowing is by reducing the ability to save for a downpayment. Paying college loans in lieu of saving for a home slows the accumulation of downpayments. As a result, younger cohorts graduated in the prior decade with higher student debt in a slow economic recovery, which greatly impacted their tenure choice (Bernasek and Long, 2021). Indeed, as a reaction to the second problem, more young adults have returned to live with their parents (De Gayardon et al. (2022), Houle et al. (2017), and Kim (2012).

Biswas (2022) reviews the literature on the impact of student loans on housing tenure over the lifecycle and finds that graduates faced credit constraints that became increasingly more binding over time, preventing future borrowing. Nevertheless, Biswas (2022) views the literature as unclear about the effects of student debt on homeownership and credit outcomes. For example, Gopalan et al. (2024) find that the increased cost of higher education and rises in low-skill wages induces more individuals to forgo more education, while Black, et al. (2023) show increased access to student loans for credit constrained individuals led to an increase in wages and homeownership. Federal loans have a lower interest rate than private loans, but cap borrowing. Raising the cap, however, could increase the future burden of college debt repayments.

More recently, Nilaj and Moore (2023) and Baek and Cho (2024) find that pauses on payments from COVID-19 student loan forbearance led to higher homeownership rates and lower

student debt. That said, there is room for further investigation of the effects student loans on credit constraints. Our research partly addresses this issue, finding that not including student debt introduces omitted variable bias into homeownership models that incorporate LTV information and into counterfactual analysis of homeownership policy changes.

Our initial findings suggest that when combined, the user cost of owning, the LTV, and student debt play a major role in homeownership rates for young people. We find that without student debt, the models of homeownership are suffering from omitted variable bias. Our model gives us the ability to assess counterfactuals and the impact of policy changes, particularly regarding student debt.

3. Data and Variables

Using data from the Census Bureau's Annual Social and Economic Supplement to the Current Population Survey (CPS), we track the average homeownership by age for each year since 1973. To eliminate some of this choppiness from temporary fluctuations in adjacent age groups due to survey measurement errors, we combine the year t readings on age group A with those of age group $A+1$. Our study focuses on five early age groups that are young enough to still have scheduled student debt payments and are old enough to have a reasonable tendency to own. For these reasons, our analysis focuses on the combined homeownership rates for ages: age 28 and 29 (*Age28&29*), 29 and 30 (*Age29&30*), 30 and 31 (*Age30&31*), 31 and 32 (*Age31&32*), and 32 and 33 (*Age32&33*).

One complication is that the pandemic forced the Census to conduct interviews by phone rather than in-person during the early quarters of the COVID pandemic in 2020, resulting in a significant rise in non-response rates. Spader et al. (2022) analyzed the impact of non-response on the reported homeownership rate in the Census Bureau's Homeownership and Vacancy Survey

(HVS), which is closely related to the CPS. The pandemic induced extended families to temporarily live together, which generated a drop in overall survey responses in 2020 Q2 and Q3—particularly from renters—and induced temporary spike in the annual homeownership rate for 2020 that receded in 2021 (see Figure 2). To correct for this, we interpolated the 2020 annual reading for each age group using the average of the 2019 and 2021 readings.

We create variables for four key factors that affect homeownership rates including credit constraints, relative cost of owning versus renting, college student debt, and labour market conditions. To control for the influence of credit constraints, we include the median combined loan-to-value (CLTV) ratio for first time buyers (*LTV*) that Duca, Muellbauer, and Murphy (2016) derived from American Housing Survey data. Major movements in their *LTV* series coincide with changes in the effective capital requirements for low downpayment loans, taking into account changes in the maximum size of FHA mortgages (Duca, et al., 2016). We assume that this series has remained at its 2013 level because of few changes in *LTV* mortgage regulations since then and because of flatness in an alternative measure.

As a robustness check we examined an alternative series which spliced the annual average AHS-based *LTV* series of Duca, Muellbauer, and Murphy (2016) from 1978-2013 onto 2014-2022 readings of the median CLTV ratio for first-time homebuyers from a representative sample from the National Mortgage Database (NMDB), a representative five-percent sample of all mortgages. We create an alternative series (*LTV_{alt}*) that splices the *LTV* series of Duca, et al. (2016) over 1978-2013 with 2014-2022 readings from the NMDB (Figure 5). In regressions not shown in the tables, we obtained similar results. In the future we plan to extend the Duca, et al. (2016) measure when we gain access to readings from the AHS owing to new data access restrictions.

The second factor is the relative cost of owning versus renting, which we gauge by the ratio of a measure of the user cost of owning a home to tenant rent. The latter we track with the Bureau of Economic Analysis (BEA) personal consumption expenditures (PCE) index of rent paid on tenant-occupied housing (*Rent*). Largely following Poterba (1984), we measure the user cost of housing by the product of a house price index and a mortgage interest rate adjusted for taxes, interest, insurance, capital depreciation, and expected house price appreciation. For house prices (*HP*) we follow Duca, Muellbauer, and Murphy (2011, 2016) by splicing the purchase-only, repeat sales index for national house prices from Freddie Mac before 1991 with Federal Housing Finance Administration (FHFA) data on purchase-only prices since 1991 using data from Fannie Mae, Ginnie Mae, and Freddie Mac. Not surprisingly, overlapping data are similar.

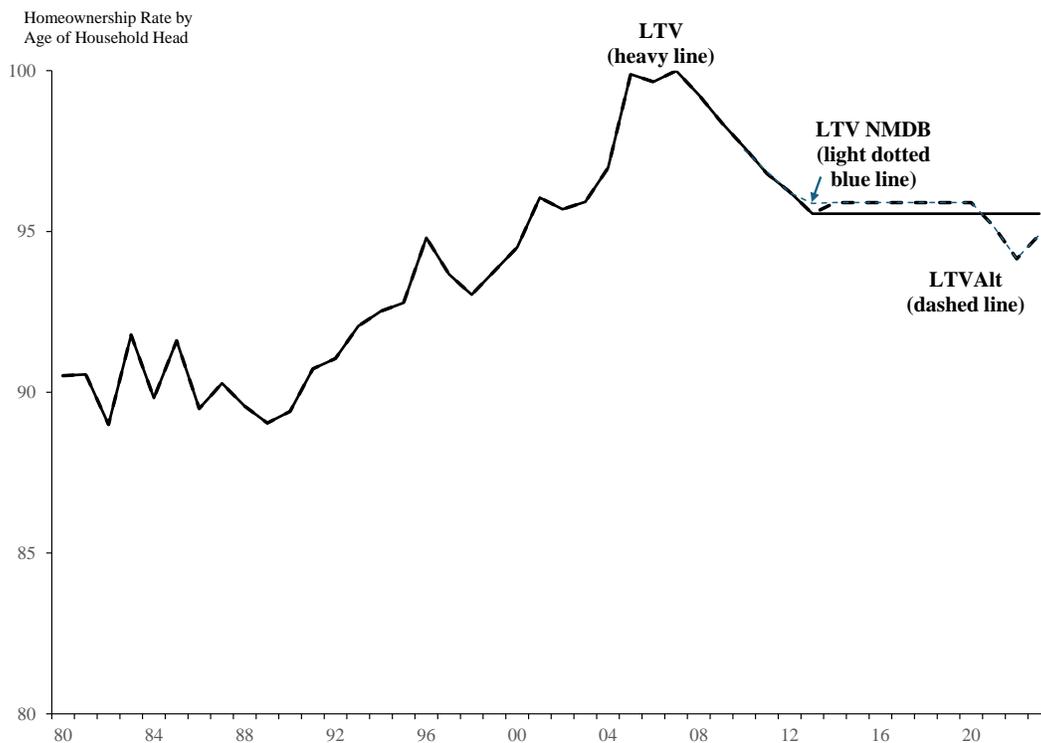


Figure 5: Loan-to-Value (LTV) Ratios for First-Time Homebuyers
(Sources: AHS, NMDB, Duca, et al. (2016) and authors' calculations)

The user cost of housing expressed as a rate of the house price (UCR), is approximated by:

$$UCR = (i + t_p) (i - t_y) + \delta + \sigma + ins - \Delta HP^e / HP \quad (1)$$

where i is the nominal mortgage interest rate, t_p is the property tax rate, t_y is the tax rate for the mortgage interest deduction, δ is the depreciation rate, ins is the proportional property tax rate of 0.75%, σ is a (possibly time-varying) risk premium, and $\Delta HP^e / HP$ is the expected nominal rate of appreciation. UCR reflects the deductibility of mortgage interest and property taxes from U.S. income tax. We use historical tax rates and the contract interest rate on 30-year fixed-rate mortgages from the Federal Reserve's Quarterly Model of the U.S. economy. Our depreciation variable extends the smoothed series of Duca, Muellbauer, and Murphy (2016) based on housing construction and stock estimates. We proxy expectations of house appreciation using the price appreciation rate over the prior five years, assuming a 12% transaction cost (10% for buying and selling, plus 2% for moving costs or a risk premium). Other studies support using a 4-5 year lagged house price appreciation in models (see Duca, Muellbauer, and Murphy, 2021, for references).

We adjust the user cost by multiplying HP and UCR to yield the user cost of owning a home ($UserOwn$), which we divide by rent ($Rent$). Scaling the resulting ratio to equal 100 in 1976 gives us our index of the relative cost of owning versus renting ($OwnVsRent$, Figure 6). As discussed in Duca et al. (2016, 2021), this ratio is driven by large swings in house price appreciation, making owning relatively attractive in the early 2000s and renting more attractive during the subprime bust. While rapid house price appreciation since the pandemic onset has elevated house prices, from an investment perspective and assuming a young household qualifies for a mortgage, it has made owning more attractive. Movements in $OwnVsRent$ have encouraged increased homeownership in recent years.

This effect has been countered by trends in average age of first child (*Age1stBirth*) and student debt. American women have increasingly delayed becoming mothers, by four years on average shown in Figure 7. with the average age of the birth of their first child (*Age1stBirth*) rising by four years over the past four decades. While the declining average number of children born per woman is correlated with *Age1stBirth*, the latter better tracks the timing of such effects on becoming a homeowner. Having children is associated with a higher demand to own as documented by Clark et al. (1994), Goodman and Mayer (2018) and Rosenthal (1988). By implication, the trend toward delayed childbirth is associated with a tendency to delay or avoid becoming a first-time homeowner.

The second major factor delaying the timing of becoming a first-time homeowner is the increased burden of college debt payments. Extending Danziger's (2020) estimated annual college debt payments series through 2023, we calculate the average college debt payments made by

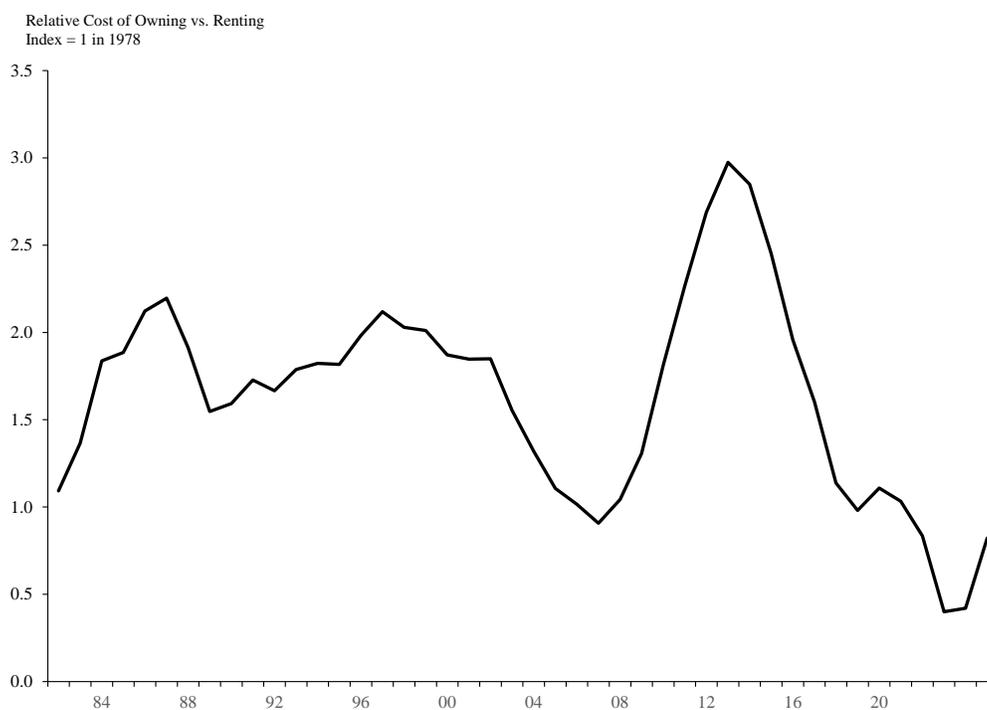


Figure 6: The Relative Cost of Owning Versus Renting
(Sources: BLS, FHFA, Freddie Mac, Federal Reserve Board, and authors' calculations)

college graduates from each cohort in each of the 10 years of scheduled payments following their graduation. The calculations are based on college debt data from Looney (2014) and the College Board Trends in Student Aid (2015-2023), and total income of heads of households who are college graduates. These estimates assume an average of five years to complete college and are based on new aggregate college loans made in a year which are apportioned across five graduating classes and use the interest rate applied to that debt. They also assume that college payments start in the calendar year following graduation and that students graduate at age 23 (a forthcoming appendix will provide more details). For each cohort, we calculate annual average college debt payments and cumulate the total average payments made since the calendar year when they turned 24 years old.³ The lack of historical disaggregated details makes it difficult to consistently track

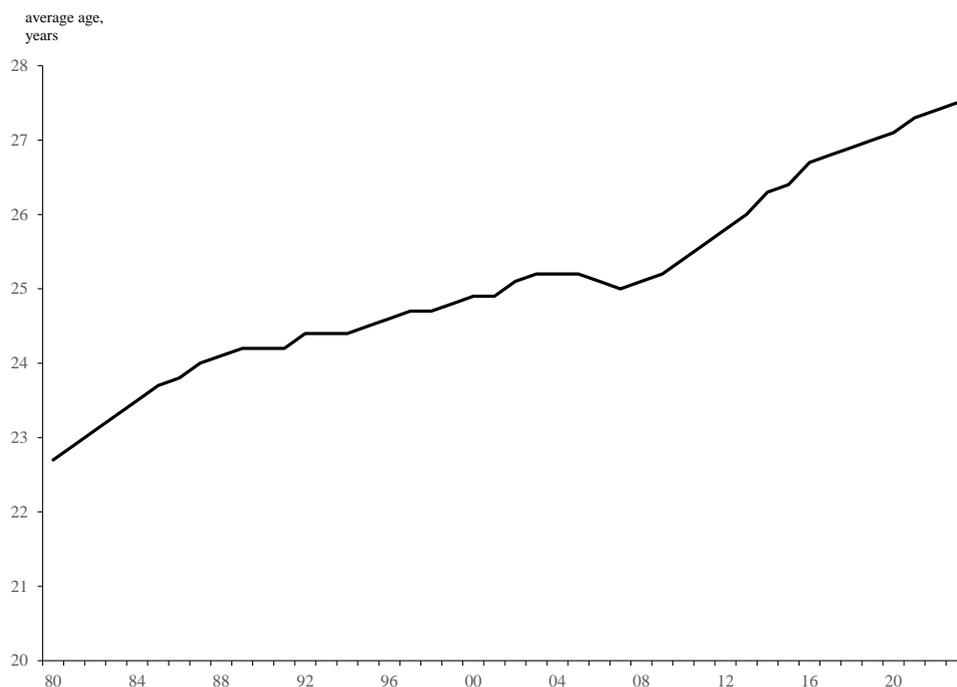


Figure 7: The Average Age of Women at First Birth
(Source: National Center for Health Statistics)

³ Typically, payments start about 6 months following graduation, which we assume on average occurs in the January following the college graduation which for most, but not all students, typically occurs in the month of May.

the precise burden of college payments over time, leaving an aggregate approach as the only feasible option. While one can quibble about the assumptions (e.g., the constant 5-year period for attending college, that scheduled payments are made, and that every borrower graduates) or about using an average measure, our series plausibly tracks the main time series swings in the college debt payment burden which is sufficient for our time series analysis.

For example, a 30-year-old college graduate will have made about 7 years of college loan payments which, as noted before, reduces their ability to qualify for a mortgage in two ways. First, payments collectively reduce a graduate's ability to amass a downpayment, thereby reducing their ability to meet a minimum downpayment ratio to qualify for mortgage. Second, lower downpayments increase the size of a mortgage needed to buy a given home, thereby raising estimated mortgage payments and reducing a graduate's ability to meet a maximum total debt service-to-income (DSTI) ratio. To track these interrelated effects, we construct the ratio of the sum of all college debt payments made divided by the sum of all income earned in all years up through year t when payments were scheduled for a representative X -year old college graduate. The denominator helps account for the average increased earnings of graduating from college and the typical downward tilt of the ratio of scheduled college debt payments to income over time. The resulting ratio, $DSTIYr$, plotted for age 30 in Figure 8, reflects the combination of total average college debt incurred, the interest rate on such debt, and the income earned by college graduates. The upturn since the mid-1990s partly reflects higher fixed interest rates offered to new debt and the tendency for college borrowing to grow faster than the income of college graduates in recent decades.

We include an index of expected job growth based on responses to the University of Michigan's survey of consumer sentiment to capture some short-run effects on housing tenure.

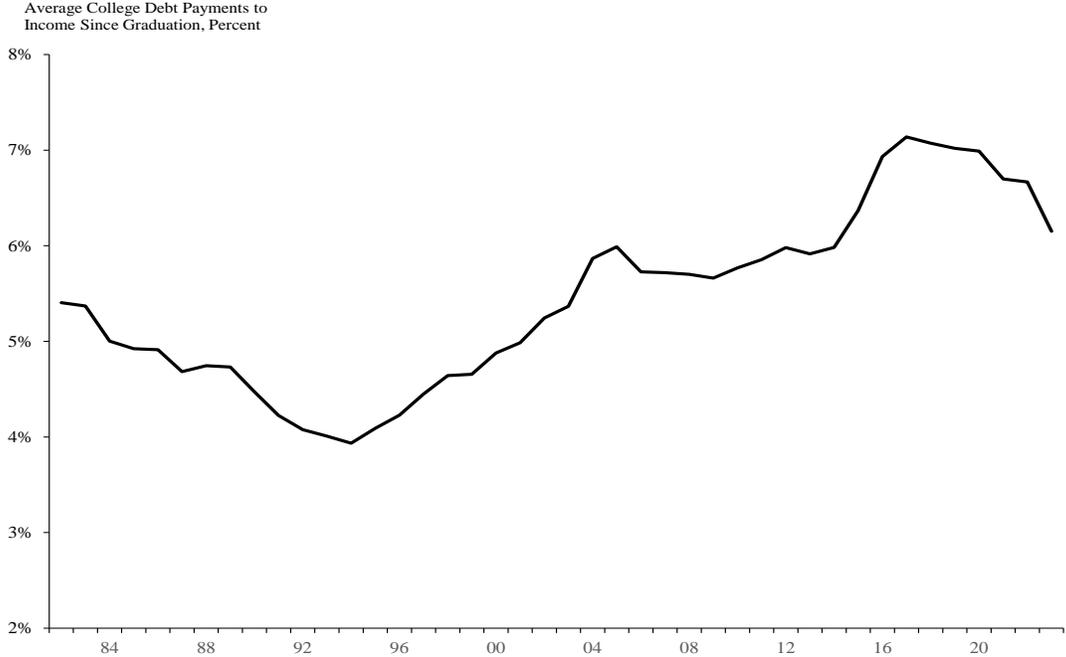


Figure 8: The Rise of College Debt Service Payments to Income for Age 30 Graduates
(Sources: Danziger (2020), Brookings, College Board, CPS, and authors' calculations)

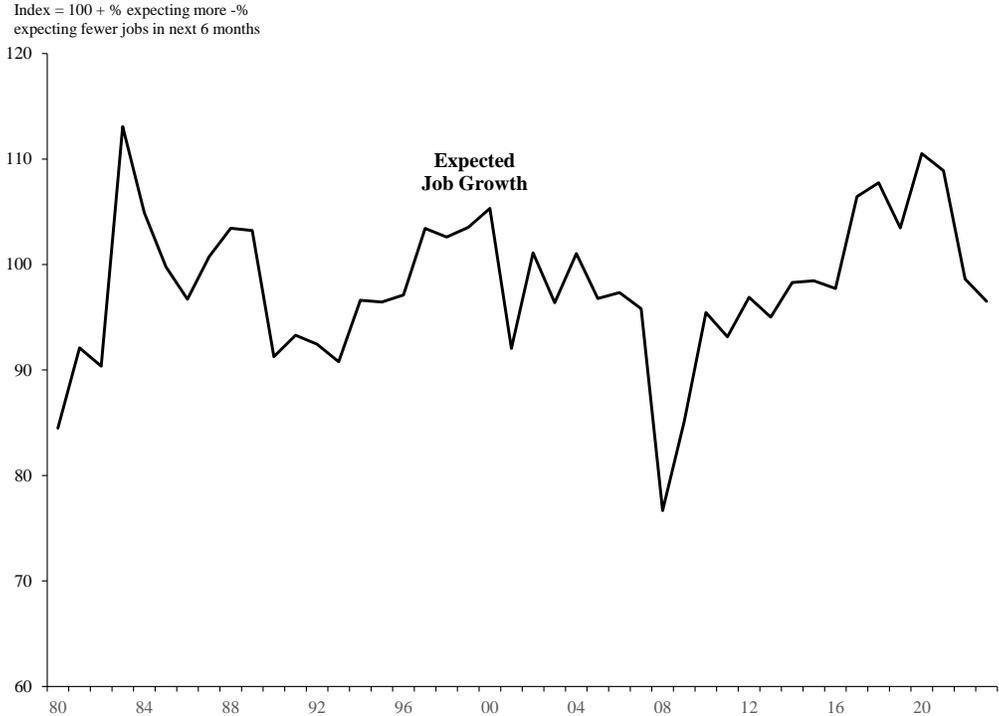


Figure 9: Expected Job Growth
(Sources: Bureau of Labor Statistics and U. of Michigan Survey Research Center)

The index (*ExpJobs*) equals 100 plus the percent of households expecting more jobs over the next six months minus the percent expecting fewer jobs (see Figure 9).

4. Econometric Specification

The homeownership rates that we model and their long-run drivers have unit roots (Table 2), we estimate homeownership rates for the six age groups within a cointegration framework. We use Vector Error Correction (VEC, Johansen 1995) models which jointly estimates the log long-run homeownership rate and their growth rates or log first differences ($\Delta \ln$).

Combining the long-run drivers of homeownership discussed in Section 2, we model the equilibrium (long-run) homeownership rate for an age group as an interactive (natural log) function of several factors. These include credit constraints, tracked by the median combined LTV on mortgages for first-time homebuyers (*LTV*), the ratio of the user cost of owning a home to average tenant rent (*OwnVsRent*), the ratio of average college debt payments to income for college graduates for that age group (*DSTIYr*), and the average age of mothers when their first child was born (*Age1stBirth*). Accordingly, our long-run specification is:

$$\ln HOYr^*_t = \alpha_0 + \alpha_1 \ln LTV_t + \alpha_2 \ln OwnVsRent_t + \alpha_3 \ln DSTIYr_t + \alpha_4 \ln Age1stBirth_t \quad (2)$$

where we expect $\alpha_1 > 0$ and $\alpha_2, \alpha_3,$ and $\alpha_4 < 0$.

The accompanying short-run specification includes lagged first differences of the long-run variables and assumes that the time t change in $\ln HOYr$ error-corrects away the extent (EC_{t-1}) to which the time $t-1$ actual homeownership rate exceeds its estimated long-run equilibrium:

$$\begin{aligned} \Delta \ln HOYr_t = & \delta_0 + \delta_1 EC_{t-1} + \sum \beta_i \Delta (\ln HOYr)_{t-i} + \sum \theta_i \Delta (\ln LTV)_{t-i} + \sum \varphi_i \Delta (\ln OwnVsRent)_{t-i} \\ & + \sum \sigma_i \Delta (\ln DSTIYr)_{t-i} + \sum \Omega_i \Delta (\ln Age1stBirth)_{t-i} + \phi S-runVar_t + \varepsilon_t \end{aligned} \quad (3)$$

where $EC_{t-1} \equiv \ln HOYr_{t-1} - \ln HOYr^*_{t-1}$, δ_1 is expected to be negative, and ε_t is an i.i.d. residual. The

one year lag length was chosen on statistical criteria – it minimized the Akaike information criterion (AIC) and yielded “clean” / non-autocorrelated residuals.

Given the already large size of the cointegrating vector, for each age group, the vector of short-run controls includes the time $t-1$ lag of $\ln \text{ExpJobs}$.⁴ We also included some controls for sampling variability outliers. The short-run controls for the ages 30&31 and 31&32 groups also include a dummy $DD1990$ (= +1 in 1990, -1 in 1991, and 0 otherwise) to control for a large temporary negative outlier in 1990 that fully unwound in 1991. Similarly, the short-run controls for the age 27 and 28 group also include a dummy $DD2015$ (= +1 in 2015, -1 in 2016, and 0 otherwise) to control for a large temporary negative outlier in 2015 that fully unwound in 2016. Similarly, the short-run controls for the age 32 and 33 group also include a dummy $DD1995$ (= +1 in 1995, -1 in 1996, and 0 otherwise) to control for a large temporary positive outlier in 1995 that fully unwound in 1996.

5. Cointegration and Error-Correction Model Estimates

We test two approaches to estimating cointegration models. One estimates vector error correction models (VECMs) which jointly estimates error-correction models for $\ln \text{HOYr}$, $\ln \text{LTV}$, $\ln \text{OwnVsRent}$, $\ln \text{Age1stBirth}$, and $\ln \text{DSTIYr}$. In the future, we will also estimate a set of single equation cointegration models. We modeled the homeownership rate for six age groups: 27 and 28, 28 and 29, 30 and 31, 31 and 32, and 32 and 33. The estimation allows for time trends in long-run variables without adding an independent time effect to the vector.

⁴ We had also considered the unemployment rate for 25- to 34-year-olds (BLS), but the series was possibly nonstationary and likely because it made the cointegrating vector larger, it was harder to consistently identify a unique cointegrating vector across the age groups. Also, the $t-1$ lag of $\ln \text{ExpJobs}$ is negatively correlated with the $t-1$ lag of this unemployment rate and including both created multicollinearity with $\ln \text{ExpJobs}$ being more significant for most age groups. Accordingly, we include $\ln \text{ExpJobs}_{t-1}$ in the model of short-run changes in homeownership.

5.1 Long-Run Determinants of Homeownership Rates of Young Households

While we estimated models with and without $\ln DSTIYr$ and its lagged first differences, in every case a unique and significant cointegrating vector could not be identified when the college debt variables are omitted but could be identified when they were included. Accordingly, we present results for models that include $\ln DSTIYr$ and its lagged first differences.

The upper-panel of Table 3 reports results for the long-run models of homeownership for the six age groups. A significant and unique cointegrating vector is identified for each model with statistically significant and sensibly signed coefficients on the LTV , the relative cost of owning to renting, the average age of new mothers, and the college debt service burden variables. For five of the six age groups, $\ln LTV$ variable has a positive and significant coefficient. The exception is the age 27&28 group, for which the coefficient was positive and for which evidence of a unit root was marginal in contrast to strong evidence that the homeownership rate for each of the other age groups is $I(1)$. Interestingly, for the ages 28&29 through 32&33 groups, the absolute magnitude of the estimated coefficient declines as homeownership rates are estimated for older age groups. This pattern accords with the view that credit constraints tend to have a larger effect on younger households, as implied by earlier findings of Rosenthal, Duca, and Gabriel (1991). For each age group, the relative cost of owning versus renting has a negative and significant effect, and the estimated effect of $\ln Age1stBirth$ is negative and of similar magnitude across the different age categories. For all age groups, the $\ln DSTIYr$ variable has a negative and at least marginally significant coefficient. Finally, the implied estimated long-run equilibrium levels generally line up with the main trends in the actual homeownership rates as is illustrated for the age 30 and 31 group in Figure 10.

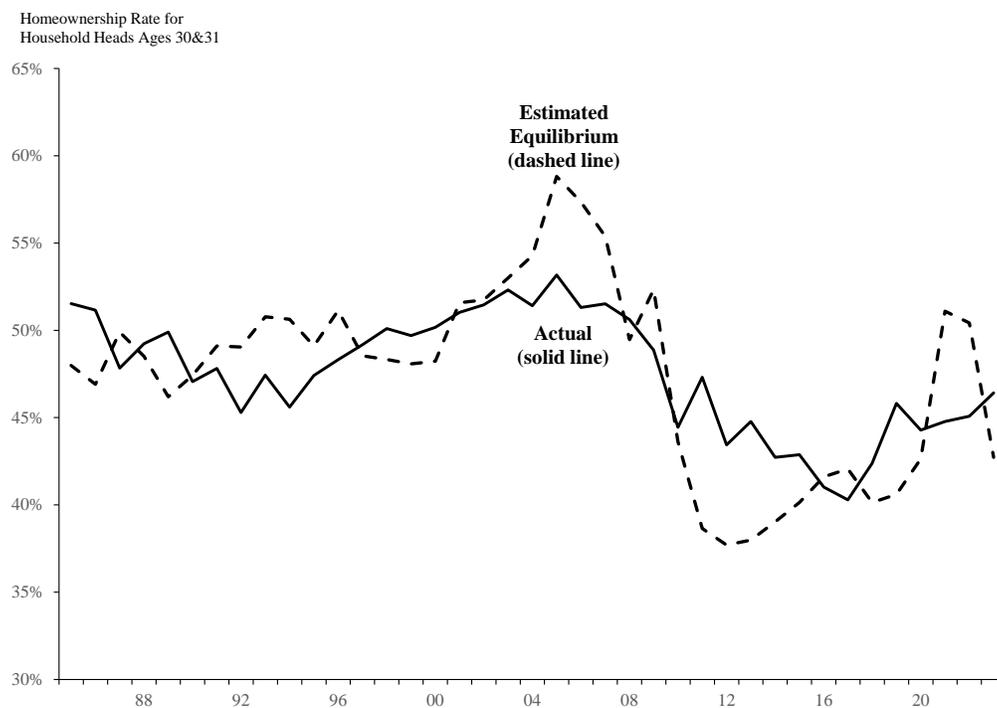


Figure 10: Actual and Estimated Equilibrium Homeownership Rates for Ages 30 and 31
(Sources: CPS and authors' calculations)

5.2 Short-Run Effects

Several other patterns arise across the short-run results that are reported in the lower-panel of Table 3. First, the error-correction terms are negative and statistically significant for each age groups. Second, except for the age 27&28 group, the speed of error-correction (implied by the absolute size of the estimated coefficient) ranges between 20 and 55 percent per year, which is plausible. The slow speed of error correction in the age 27&28 group and the lower fit likely reflects difficulty with modeling homeownership rates for the very young, for whom inheriting or being gifted homes may play a larger role than for older age groups.

The log expected job growth index has a positive coefficient that is highly significant for each age group. Finally, the age-specific outlier dummy variables are significant. Note that the coefficients are economically and socially meaningful since the homeownership rates are scaled in terms of digits, implying that the coefficients on them imply estimated effects whose absolute

magnitudes range between 4 and 12 percentage points on the affected age groups' homeownership rates for the years when the large outliers occurred.

5.3 Simulations of Changes to College Debt

We simulate the impact of two conceivable types of student debt relief. These include forgiving 20% of outstanding student debt at the end of 2023 (“principal forgiveness”) and lowering the student loan interest rate (“interest rate adjustment”). The former would lower the DSTI ratio by 20 percent. With respect to the latter, the federal student loan interest rate for a loan originated in year t equals the 10-year Treasury auction note interest rate on July 1 of year t plus a margin of 2.05 percent. The interest rate reduction scenario lowers that margin to 0, implying a reduction of 2.05 percent in the interest rate assessed on all college debt.⁵ The average 10-year Treasury yield over the past 5 and 10 years are approximately 2.3 percent each, implying an average loan rate of 4.35 percent. A reduction from that to 2.3 percent using the 10-year amortization schedule for a college loan would lower college debt payments by 9.29 percent.

Under both scenarios, the burden of college loan payments is notably lowered. As shown in Table 4, scheduled debt payments as a percent of income would fall by about 0.5 and 1.2 percentage points for each age group, under the “interest rate adjustment” and the “principal forgiveness” scenarios, respectively.⁶ Using the estimated coefficients in Table 3, under the interest rate adjustment scenario these translate into increases of about 1 to 1.5 percentage points in homeownership rates for four of the five age groups, with larger effects for the ages 31 and 32 group that reflect an odd coefficient on student loan burdens that is twice the magnitude for that

⁵ One potential justification for the “interest rate adjustment” is that it would provide loans at the Treasury’s cost of borrowing and higher federal income tax revenues from higher future college graduate earnings would more than compensate taxpayers for default costs. A second argument is that charging the 10-year Treasury rate on past and future borrowing is it is a more permanent adjustment to the federal loan program.

⁶ We omit conducting this exercise for the ages 27 and 28 group because the model estimates looked suspicious. In particular, the speed of error correction is an implausibly low 3 percent per year and the long run coefficients were very large and differed from those for other age groups by a large margin.

of other age groups. The impacts of the 20 percent debt forgiveness scenario are larger, reflecting the bigger reductions in the college debt payments-to-income ratio. For four of the five age groups the effects would boost homeownership rates by 2.2 to 4.3 percentage points, with a larger effect for the ages 31 and 32 group whose estimated sensitivity to college debt payments seems outsized.

There are three important caveats or qualifications about the results to note. First, because these adjustments are retroactive, they overstate the effects on current graduates who would only benefit going forward. In this way the estimates are best viewed as counterfactual exercises. Second, because the relative cost of owning versus renting is not adjusted for the higher demand for owner-occupied housing, which will likely push up the user cost of owning a home in the short to medium run, thereby offsetting part of the projected long-run increase in homeownership among the young. Third, the estimates are for homeownership particularly early in the life cycle. As such, the estimates are more indicative of how college debt relief could speed up when many households become homeowners rather than indicating how much the eventual homeownership rate for the young will eventually rise. This qualification has parallels to Goodman and Nichols' (1997) point that the availability of low downpayment FHA mortgages has more of an effect of speeding up homeownership by the young and much less of an effect on homeownership later in the life cycle.

6. Conclusion

After temporarily rising during the subprime boom, the homeownership rates of younger U.S. households fell before gradually rising again from the mid to late 2010's onwards. The homeownership rates for the young are well modeled over the past four decades using time series models that this study develops. We find that four key factors drive long-run trends in the homeownership rate of the young. The first three factors are the relative cost of owning versus renting, the changing incidence of first-time buyer credit constraints and the average age of the

mother when her first child is born. But without the fourth factor—the burden of student loan payments relative to college graduate income—one cannot find economically meaningful, statistically significant and unique (cointegrating) relationships explaining the longer run trends in homeownership rates by age cohort among the young.

Our study makes three contributions to the literature on homeownership. First, we develop time series models of homeownership rates of younger households over the past 40 years that jointly analyze the impact of access to credit, student debt, family factors, and the cost of owning to renting. Our time series approach is more focused on longer term trends than most of the recent (complementary) literature on homeownership and student debt, which uses micro data and quasi-experiments focusing on time periods of a few years. Second, we construct new time series data on the evolution of college debt service burdens over the past four decades. Third, using our estimated models, we conduct counterfactual simulations about the impact of two possible ways to provide college debt relief on long-run homeownership rates among the young. Specifically, we analyze repricing college loan rates to equal the 10-year Treasury interest rate or reducing the remaining principal at the end of 2023 by 20 percent. Both debt relief options would noticeably raise homeownership rates for households aged 28 to 33. Nevertheless, it is unclear whether these options would mainly speed up when people become homeowners in their lifecycles or whether they also have long-run effects on the homeownership rates of middle and older aged households. We leave more general equilibrium issues like this, as well as separate modelling of the trends in the homeownership rates of graduates and non-graduates, for future work.

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Table 1: Variable Definitions**Long-Run Variables:**

- HOYr* \equiv homeownership rate at a particular age, e.g., HO2930ext = homeownership rates for 29- and 30-year old heads of households.
- LTV* \equiv first-time buyer, CLTV all mortgages, AHS data fitted, extends Duca, et al., 2016
- OwnVsRent* \equiv relative cost of owning versus renting. Equal to user cost of housing / tenant rent. User cost of housing = house prices x [nominal after-tax 30 yr. fixed-rate mortgage (+0.75 insurance) minus lagged 5-year house appreciation assuming 12% transactions costs of buying and selling a home. Tenant rent from the PCE price deflator for rent for tenant-occupied housing. The ratio is indexed to = 100 in 1976.
- DSTIYr* \equiv average college debt payment-to-income ratio over the total payment period since college payments begin in the calendar year when people turn age 24 and end in the year they turn 33. We assume no COVID moratorium effects as scheduled loan payments still count toward the overall debt service to income ratio when lenders reviewed mortgage applications. We assume no debt forgiveness effects as recent actions affected those who were behind on their payments and were making payments 20 years after graduating (exceeding the 10-year schedule of payments).
- Age1stBirth* Average age of mothers on the birth of their first child. Captures other trends in family patterns that affect homeownership.

Short-Run Variables in the vector *S-runVar_t*:

- lnExpJobs* = ln of index = 100 + % expecting more jobs in the next 6 months - % expecting fewer jobs in the next 6 months, U. of Michigan Survey Research Center survey.
- DD1990* = equals 1 in 1990, -1 in 1991, and 0 otherwise. Controls for the temporary plunge of homeownership for *Age30&31* and *Age31&32* in 1990 before they recovered to their 1989 levels in 1991.
- DD1995* = dummy equal to 1 in 1995, -1 in 1996, and 0 otherwise. Controls for the temporary jump of *Age3233* in 1995 before it fell back to its 1994 level in 1996.
- DD2015* = dummy equal to 1 in 2015, -1 in 2016, and 0 otherwise. Controls for the temporary plunge of *Age2728* in 2015 before it fell back to its 2014 level in 2016.

Table 2: Unit Root Tests

Variable	Dicky-Fuller GLS-ERS (lag)	Reject Unit Root?	Variable	Dicky-Fuller GLS-ERS (lag)	Reject Unit Root?
$\ln LTV$	-0.943 (0)	No	$\Delta \ln LTV$	-8.976** (0)	Yes
$\ln OwnRent$	-1.442 (0)	No	$\Delta \ln OwnRent$	-3.514** (0)	Yes
$\ln Age1stBirth$	1.021 (1)	No	$\Delta \ln Age1stBirth$	-3.606* (0)	Yes
$\ln HO2728$	-1.491 (3)	No	$\Delta \ln HO2728$	-1.894+ (0)	Yes
$\ln HO2829$	-1.582 (0)	No	$\Delta \ln HO2829$	-7.177** (0)	Yes
$\ln HO2930$	-1.366 (0)	No	$\Delta \ln HO2930$	-6.078** (0)	Yes
$\ln HO3031$	-0.704 (1)	No	$\Delta \ln HO3031$	-8.376** (0)	Yes
$\ln HO3132$	-1.239 (0)	No	$\Delta \ln HO3132$	-7.039** (0)	Yes
$\ln HO3233$	-1.055 (1)	No	$\Delta \ln HO3233$	-4.505** (1)	Yes
$\ln DSTI2728$	-1.662+ (1)	Yes weak	$\Delta \ln DSTI2728$	-3.463** (0)	Yes
$\ln DSTI2829$	-1.522 (1)	No	$\Delta \ln DSTI2829$	-3.461** (1)	Yes
$\ln DSTI2930$	-1.421 (1)	No	$\Delta \ln DSTI2930$	-3.211** (0)	Yes
$\ln DSTI3031$	-1.121 (1)	No	$\Delta \ln DSTI3031$	-3.597** (0)	Yes
$\ln DSTI3132$	-0.765 (1)	No	$\Delta \ln DSTI3132$	-3.793** (0)	Yes
$\ln DSTI3233$	-0.744 (1)	No	$\Delta \ln DSTI3233$	-3.080** (0)	Yes
$\ln ExpJobs$	-2.745** (0)	Yes	$\Delta \ln ExpJobs$	-4.927+ (1)	Yes

Notes: Lag lengths for the ADF tests were selected using the Schwartz Information Criterion. All tests included an intercept and a time trend. The sample period is 1983-2023.

Table 3: Estimates of Homeownership Rates

Long-Run Relationship (Allowing for a Time Trend in Variables):

$$\ln HOYr_t = \alpha_0 + \alpha_1 \ln LTV_t + \alpha_2 \ln OwnVsRent_t + \alpha_3 \ln DSTIYr_t + \alpha_4 \ln Age1stBirth_t$$

	Age 27&28	Age 28&29	Age 29&30	Age 30&31	Age 31&32	Age 32&33
Sample	1985-2023	1985-2023	1985-2023	1985-2023	1986-2023	1987-2023
Constant	-1.653	-11.196	-6.782	-3.690	-4.659	-0.261
$\ln LTV$	3.750 (1.37)	4.191** (9.08)	2.938** (6.79)	2.245** (4.44)	1.930** (4.56)	1.854** (5.92)
$\ln OwnVsRent$	-1.287** (7.13)	-0.073* (2.18)	-0.152** (4.96)	-0.267** (7.21)	-0.348** (8.28)	-0.308** (8.24)
$\ln Age1stBirth$	-5.776** (3.13)	-2.953** (12.02)	-2.530** (7.86)	-2.544** (5.62)	-2.097** (4.70)	-3.030** (7.10)
$\ln DSTIYr$	-0.995+ (1.82)	-0.278** (3.13)	-0.285** (3.00)	-0.355** (3.17)	-0.567** (5.41)	-0.308** (8.24)
Lag Length	1	2	1	1	2	2
Unique Co-int. Vector?	Yes*	Yes**	Yes*	Yes*	Yes**	Yes**

Short-Run Relationship:

$$\Delta \ln HOYr_t = \alpha_0 + \alpha_1 (EC)_{t-1} + \sum \beta_i \Delta (\ln HOYr)_{t-i} + \sum \theta_i \Delta (\ln LTV)_{t-i} + \sum \varphi_i \Delta (\ln OwnVsRent)_{t-i} + \sum \sigma_i \Delta (\ln DSTIYr)_{t-i} + \sum \Omega_i \Delta (\ln Age1stBirth)_{t-i} + \delta S-runVar_t + \epsilon_t$$

	Age 27&28	Age 28&29	Age 29&30	Age 30&31	Age 31&32	Age 32&33
EC_{t-1}	-0.038* (2.02)	-0.553** (3.11)	-0.441** (4.08)	-0.202** (2.79)	-0.237** (3.10)	-0.317** (2.92)
$\ln ExpJobs_{t-1}$	0.240** (2.79)	0.229* (2.00)	0.301** (3.69)	0.398** (5.99)	0.392** (4.97)	0.257** (2.90)
$D2015_t$	-0.120** (2.79)					
$DD1990_t$				-0.055** (2.80)	-0.071** (3.84)	
$DI995_t$						0.043+ (1.91)
R^2 (corrected)	0.326	0.391	0.433	0.585	0.513	0.449
S.E.	0.0376	0.0380	0.0304	0.0256	0.0226	0.0278
Clean Residuals	Yes	Yes	Yes	Yes	Except for lag 3	Yes

+,*,** denote significant at the 90, 95, and 99 percent confidence levels, respectively. Estimates allow for a linear trend in the VAR and a constant and no trend in cointegrating vector. Lagged first differences of the components of the long-run vector are omitted to conserve space.

Table 4: Counterfactual Long-Run Impact of College Debt Relief on Homeownership Rates of the Young

		College Loan Rate Cut to 10-Year Treasury Rate When Originated		20 Percent Forgiveness Remaining Principal	
	2023 DSTI	Impact on 2023 College DSTI	Impact on Long-Run Homeownership Rate	Impact on 2023 College DSTI	Impact on Long-Run Homeownership Rate
Ages 28&29	.0599	-.0056	+0.9 pp	-.0120	+2.2 pp
Ages 29&30	.0601	-.0056	+1.1 pp	-.0120	+2.6 pp
Ages 30&31	.0606	-.0056	+1.5 pp	-.0120	+4.3 pp
Ages 31&32	.0608	-.0056	+2.6 pp	-.0120	+6.2 pp
Ages 32&33	.0578	-.0054	+1.4 pp	-.0120	+3.3 pp

Notes: “pp” denotes percentage points. See the text on qualifications to these estimated effects. Estimates use the 2023 (natural log) levels of the *LTV*, *OwnVsRent*, *DSTIYr*, and *Age1stBirth* in the long-term log relationship and then convert the estimate 2023 long-run equilibrium log levels with and without college debt relief into percentage levels in calculating the estimates provided.