



# US Housing: Cooling down

January 2019

Peter Hooper, Matthew Luzzetti, Brett Ryan, Justin Weidner, Torsten Slok,  
Suvir Ranjan and Avik Chattopadhyay  
60 Wall Street  
New York, New York 10005  
Tel: 212 250 7275



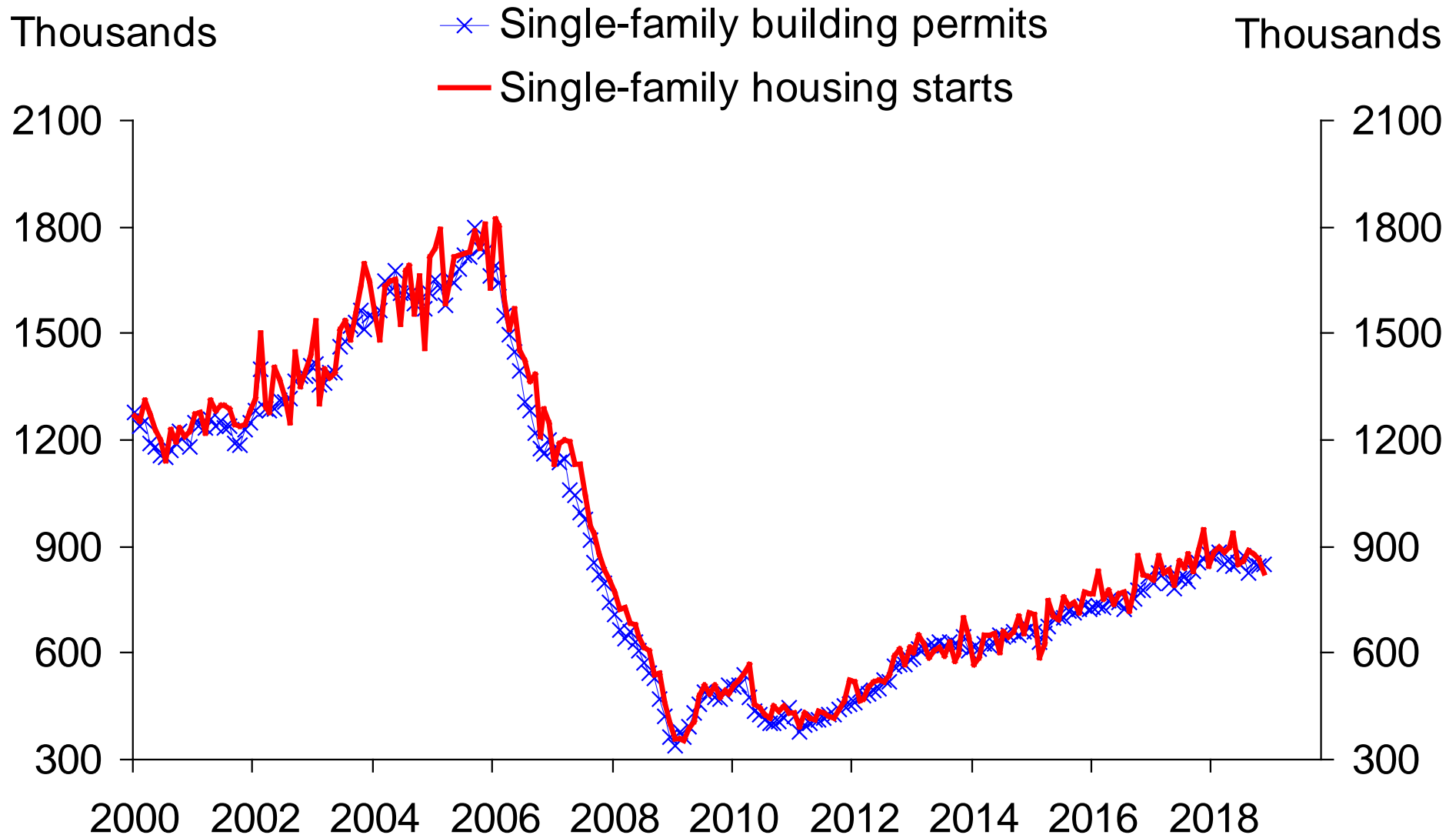
Distributed on: 07/01/2019 19:18:08 GMT

DISCLOSURES AND ANALYST CERTIFICATIONS ARE LOCATED IN APPENDIX 1. MCI (P) 091/04/2018



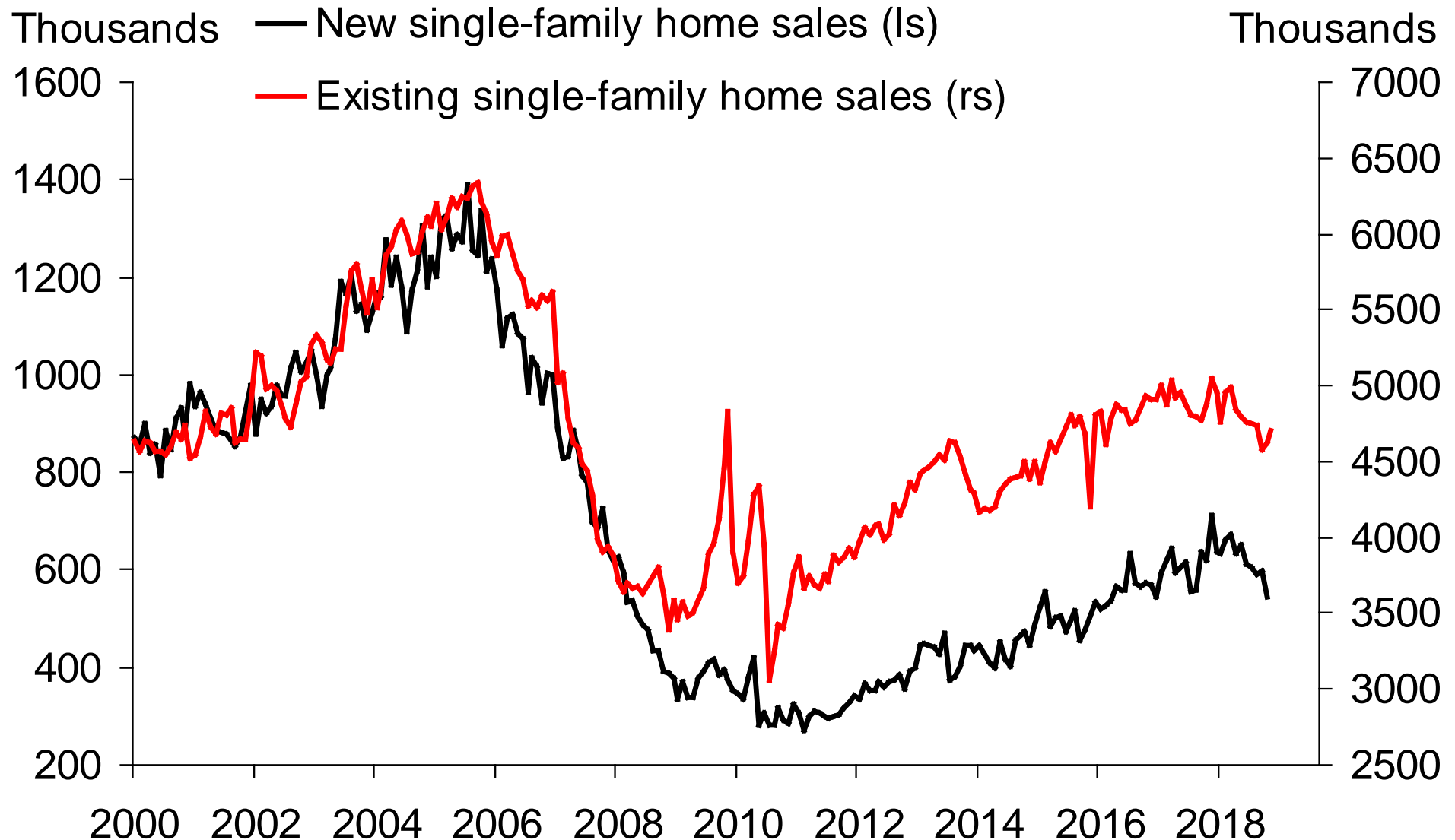
# Overview

# Single-family starts and permits rolling over



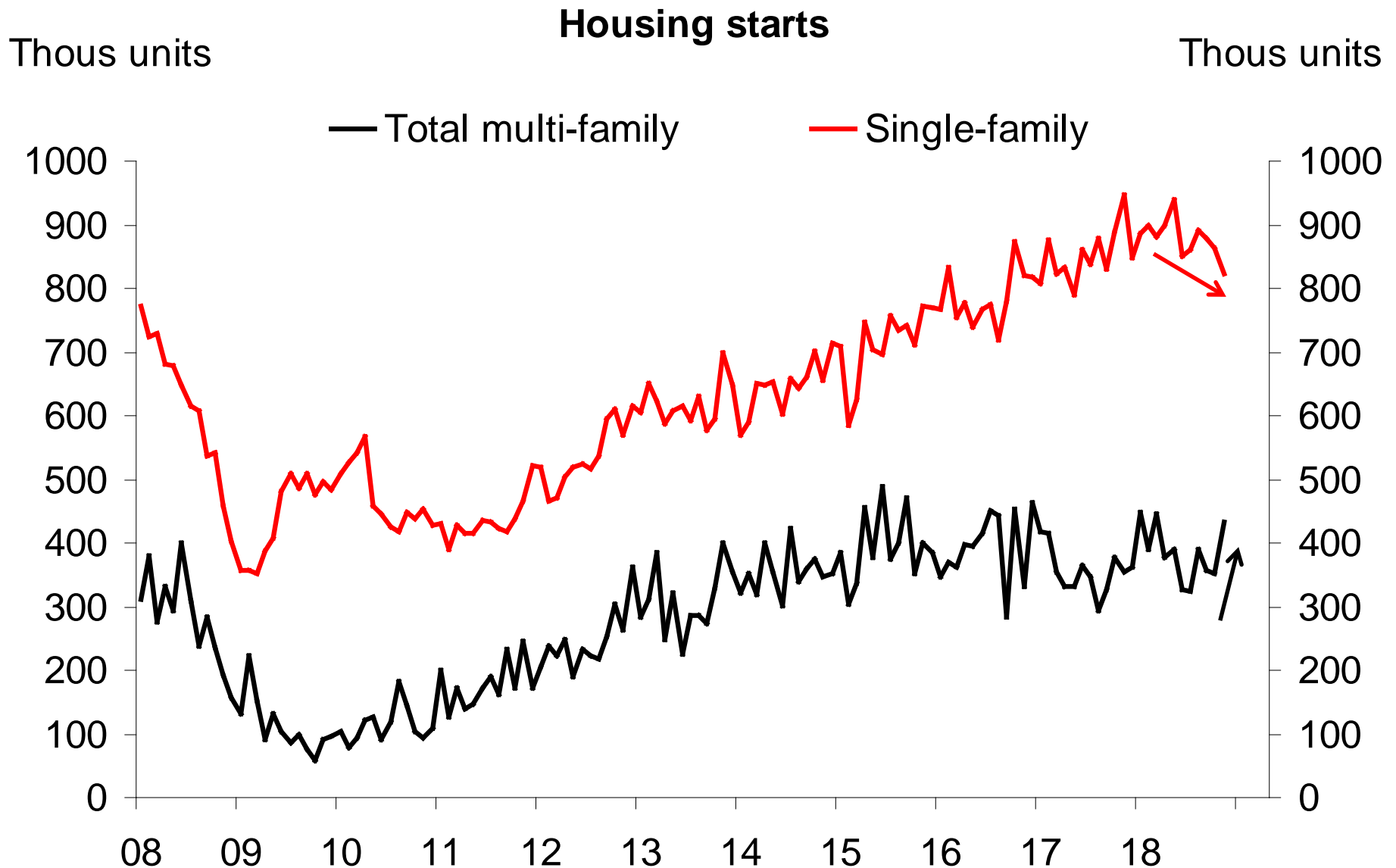
Source: Census, Haver Analytics, DB Global Research

# Both existing single-family home sales and new single family home sales down recently



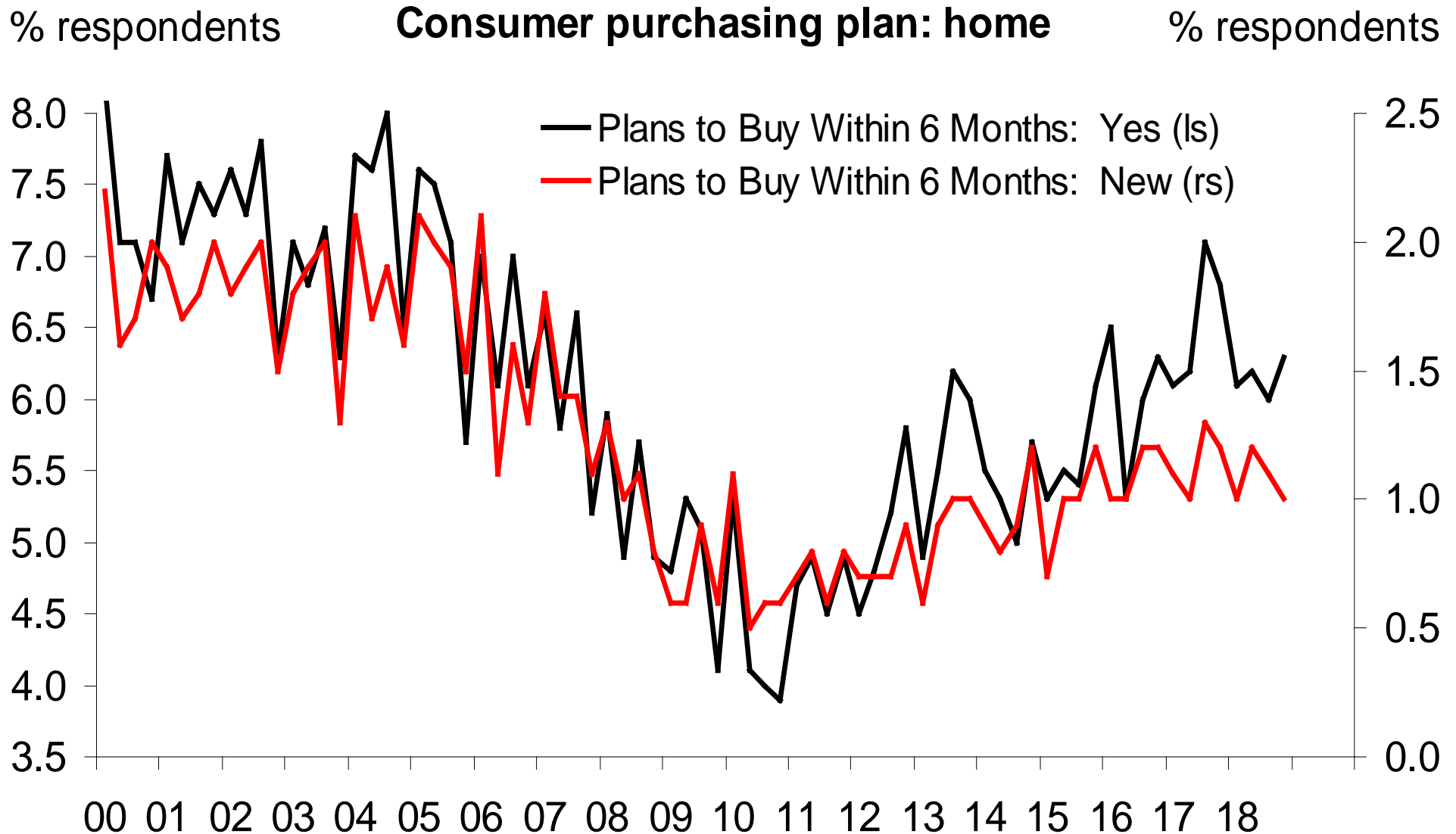
Source: NAR, Haver Analytics, Census, DB Global Research

# Single-family cooling down, multi-family accelerating



Source: Census, Haver Analytics, DB Global Research

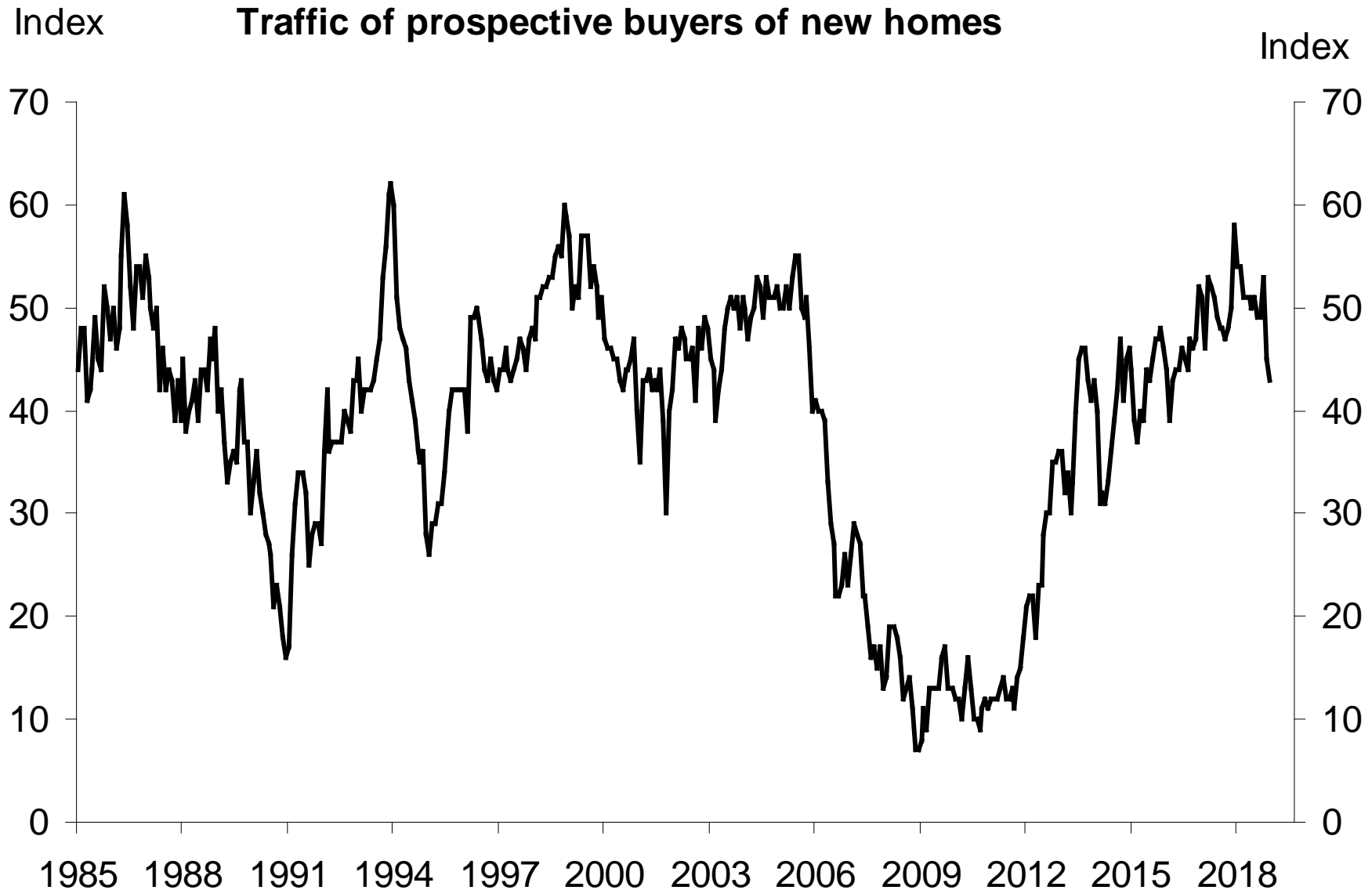
# Consumer housing moving sideways



Source: The Conference Board, Haver Analytics, DB Global Research

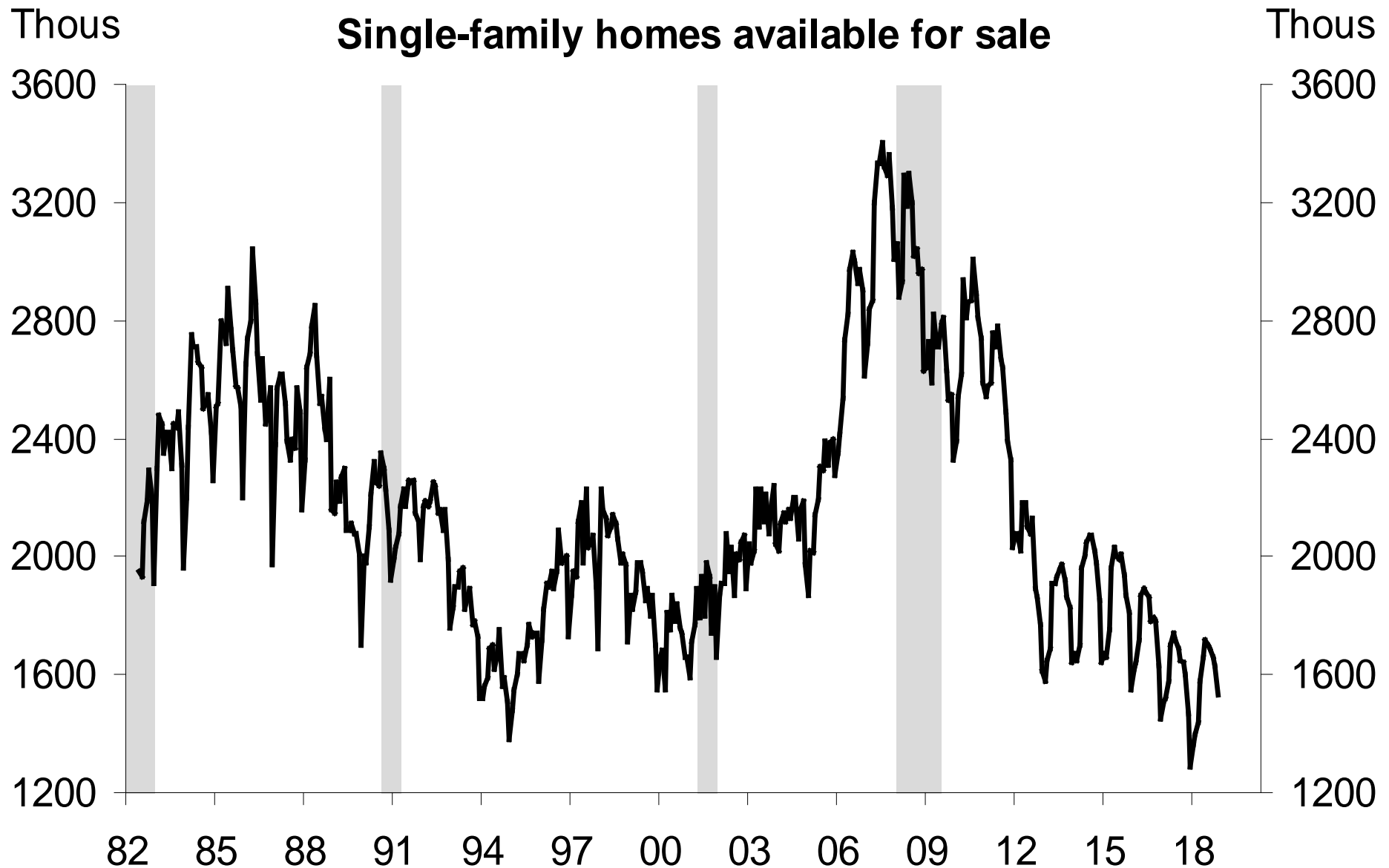


# Interest in home buying coming down



Source: NAHB, Haver Analytics , DB Global Research

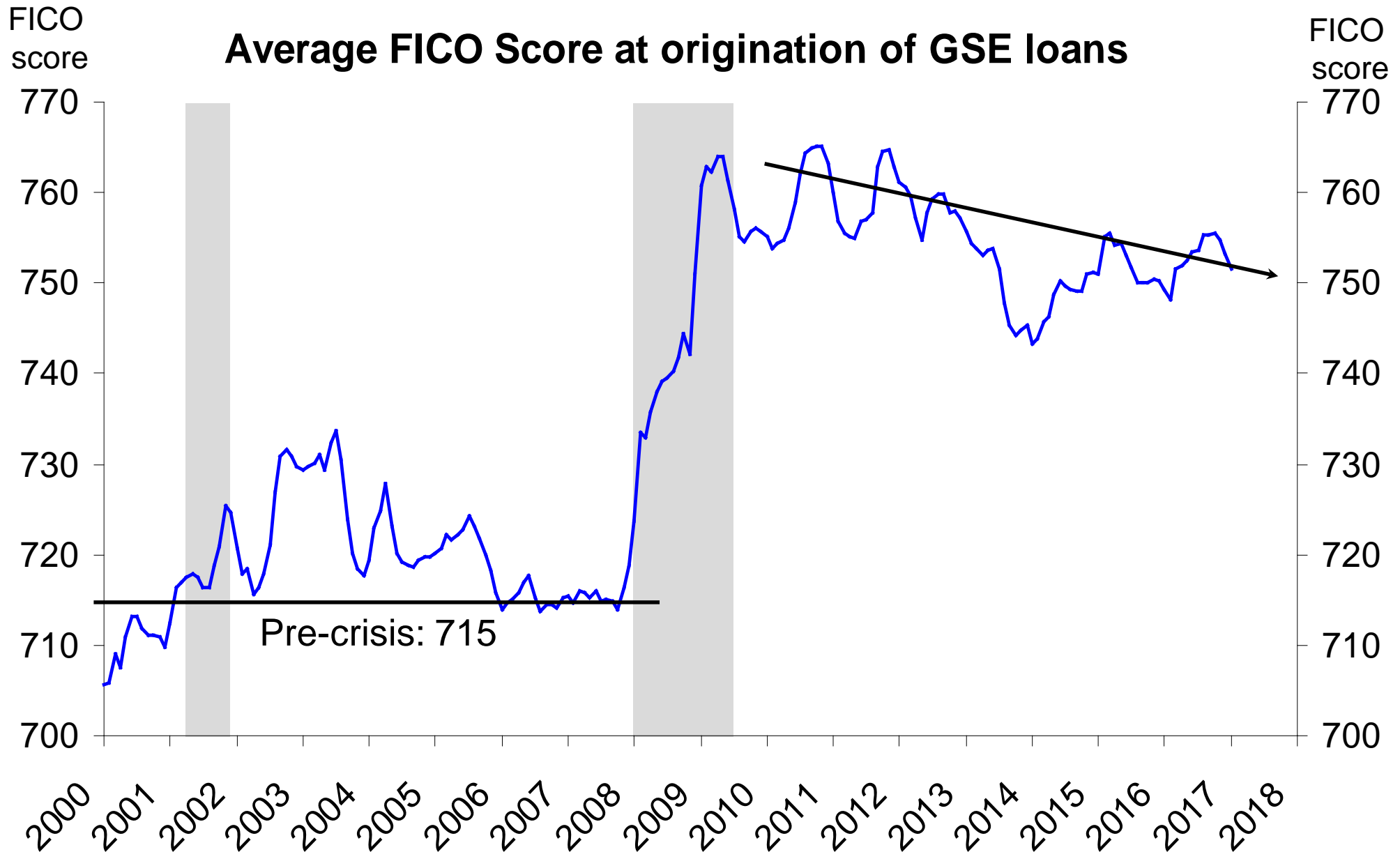
# The number of single-family homes for sale near historic lows



Source: NAR, Haver Analytics, DB Global Research

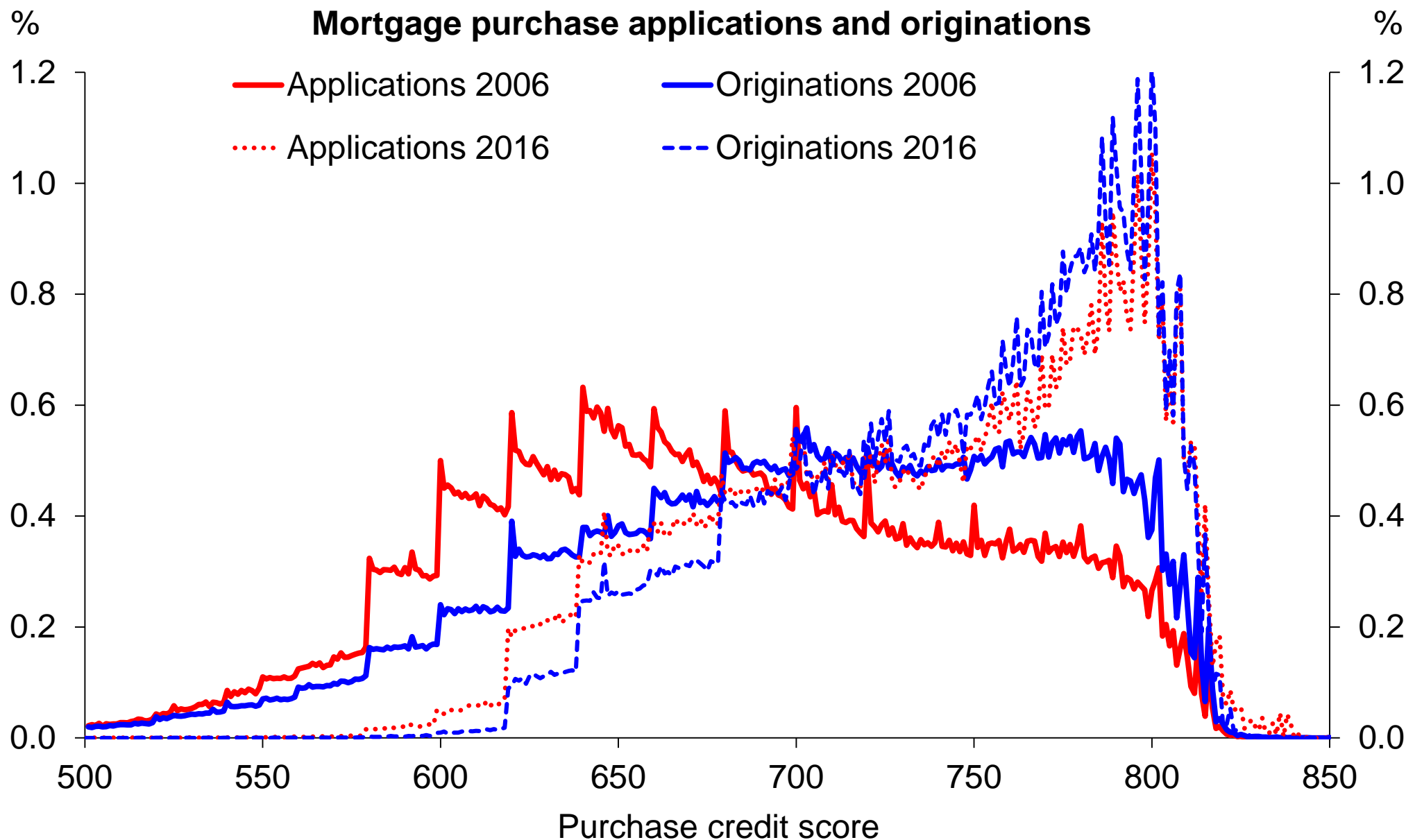


Mortgage credit conditions have eased a bit recently but still much tighter than before the crisis



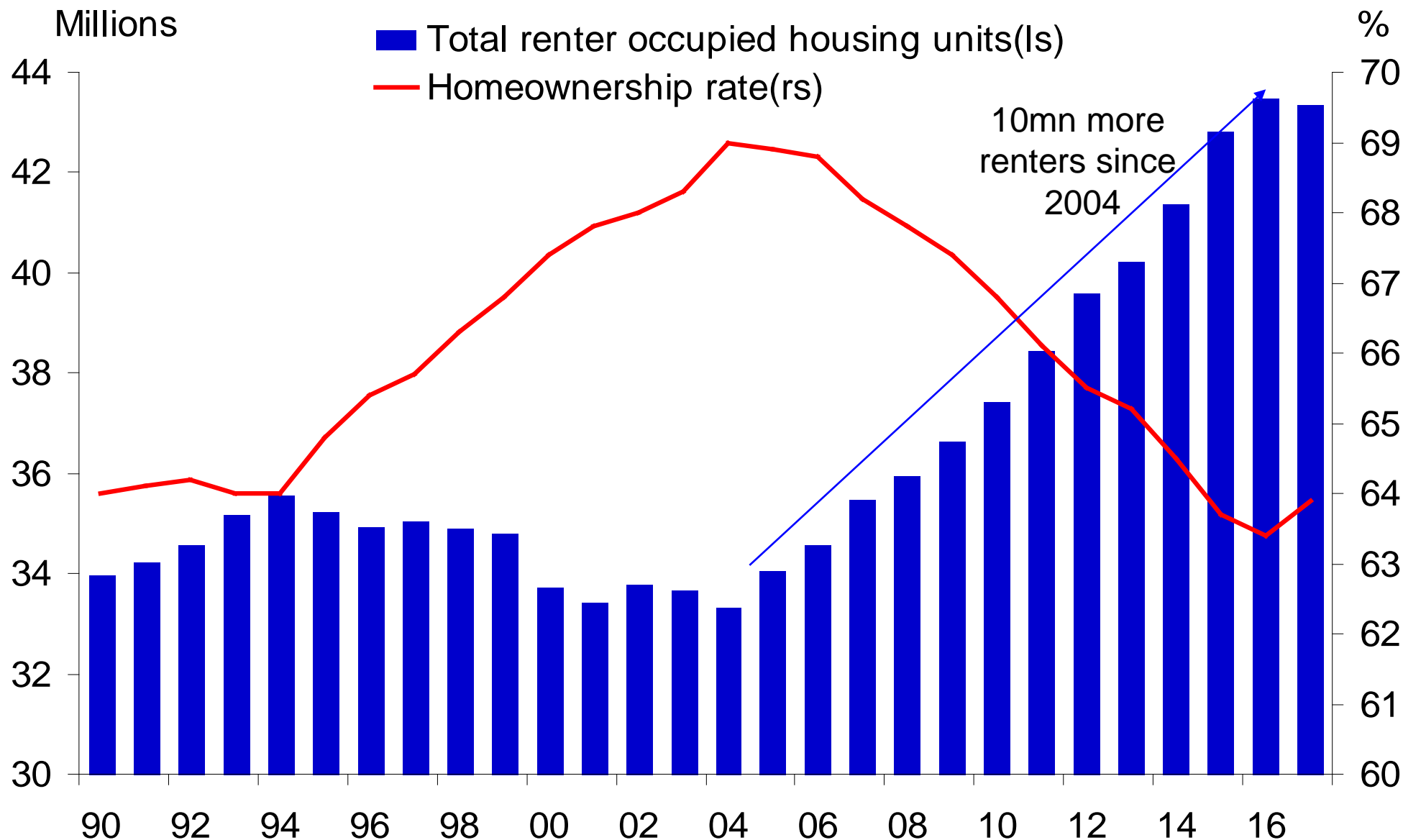
Source: Ying Shen, GSE, FICO, DB Global Research

# Much more difficult to get a mortgage than in 2006



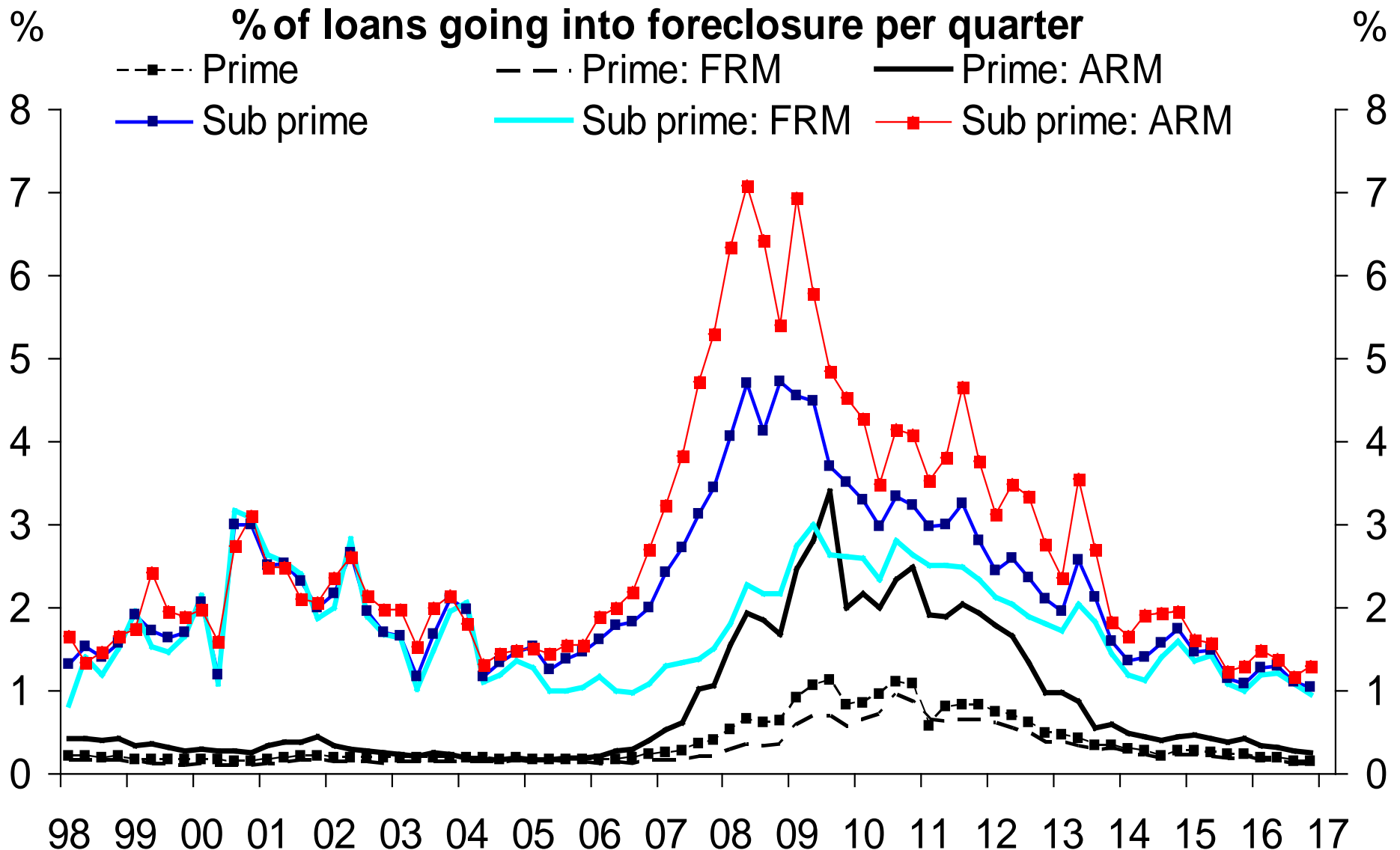
Source: CoreLogic, DB Global Research

Since the homeownership rate peaked in 2006 the number of households renting has increased by roughly 10 million



Source: US Census Bureau, Housing Vacancy Surveys, Haver Analytics, DB Global Research

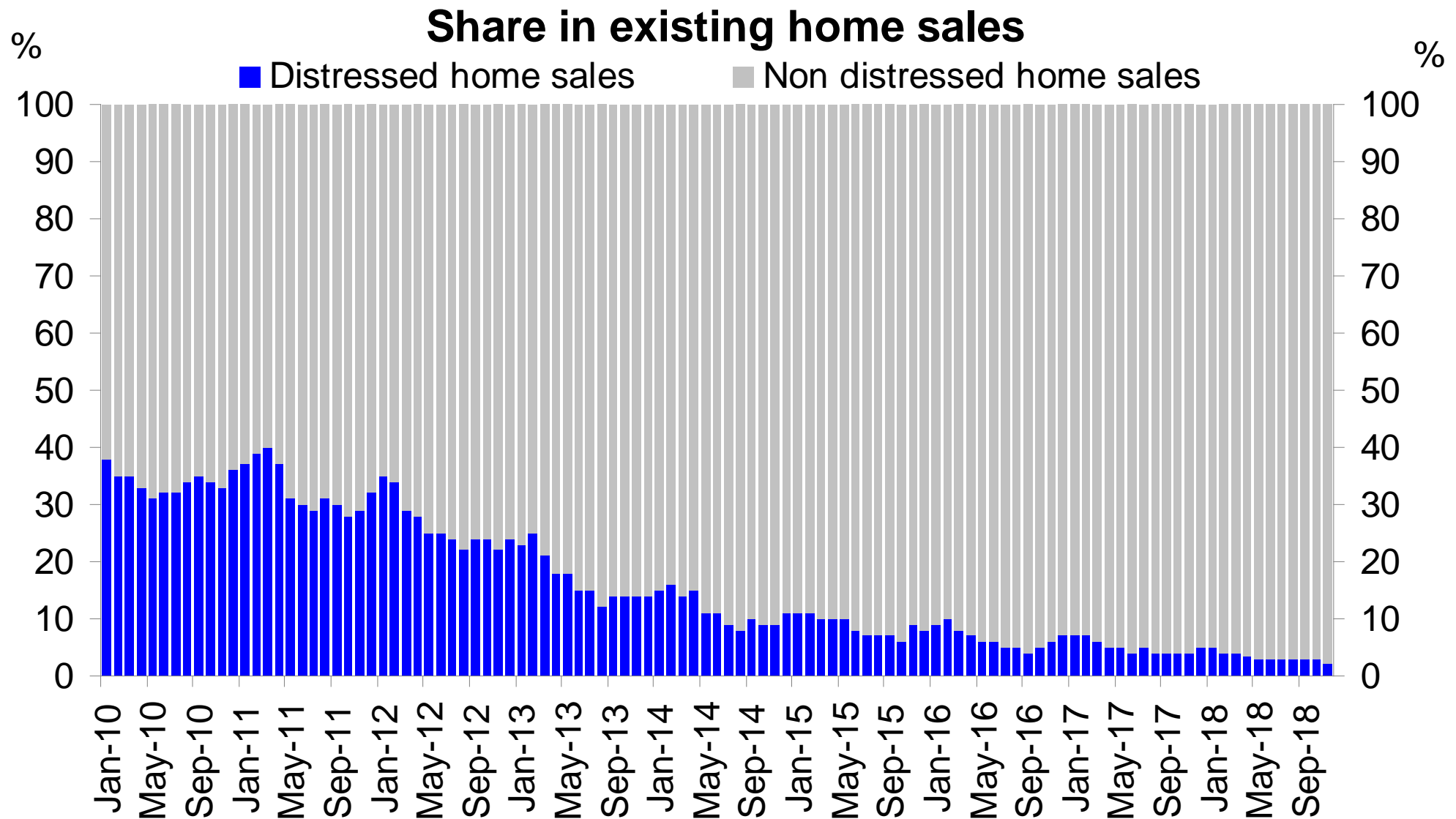
# The % of loans going into foreclosure per quarter at 2005-2006 levels



Note: ARM=Adjustable Rate Mortgage, FRM=Fixed Rate Mortgage \*Data has discontinued since 2017

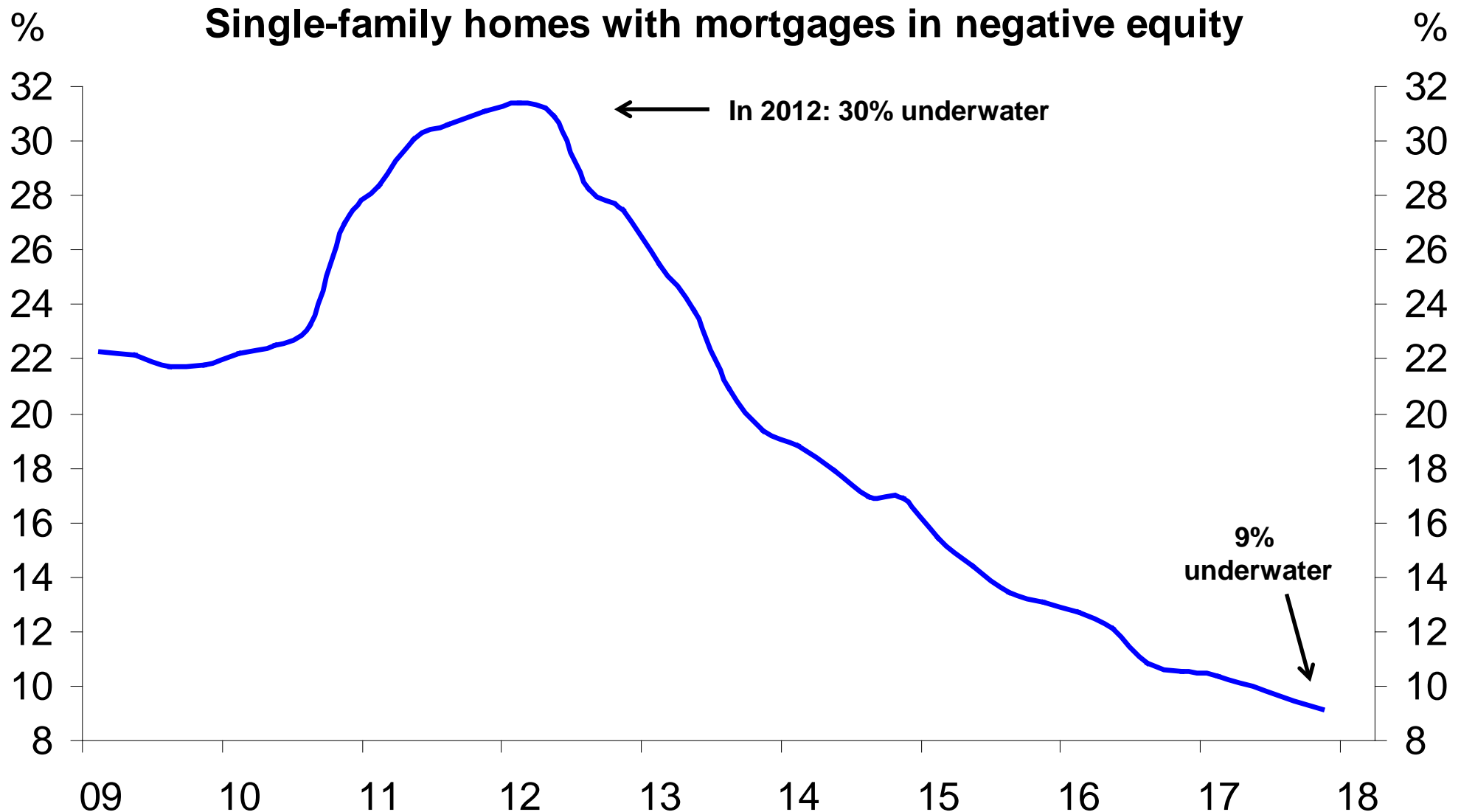
Source: MBA, Datastream, DB Global Research

# Distressed home sales at lowest levels since October 2008



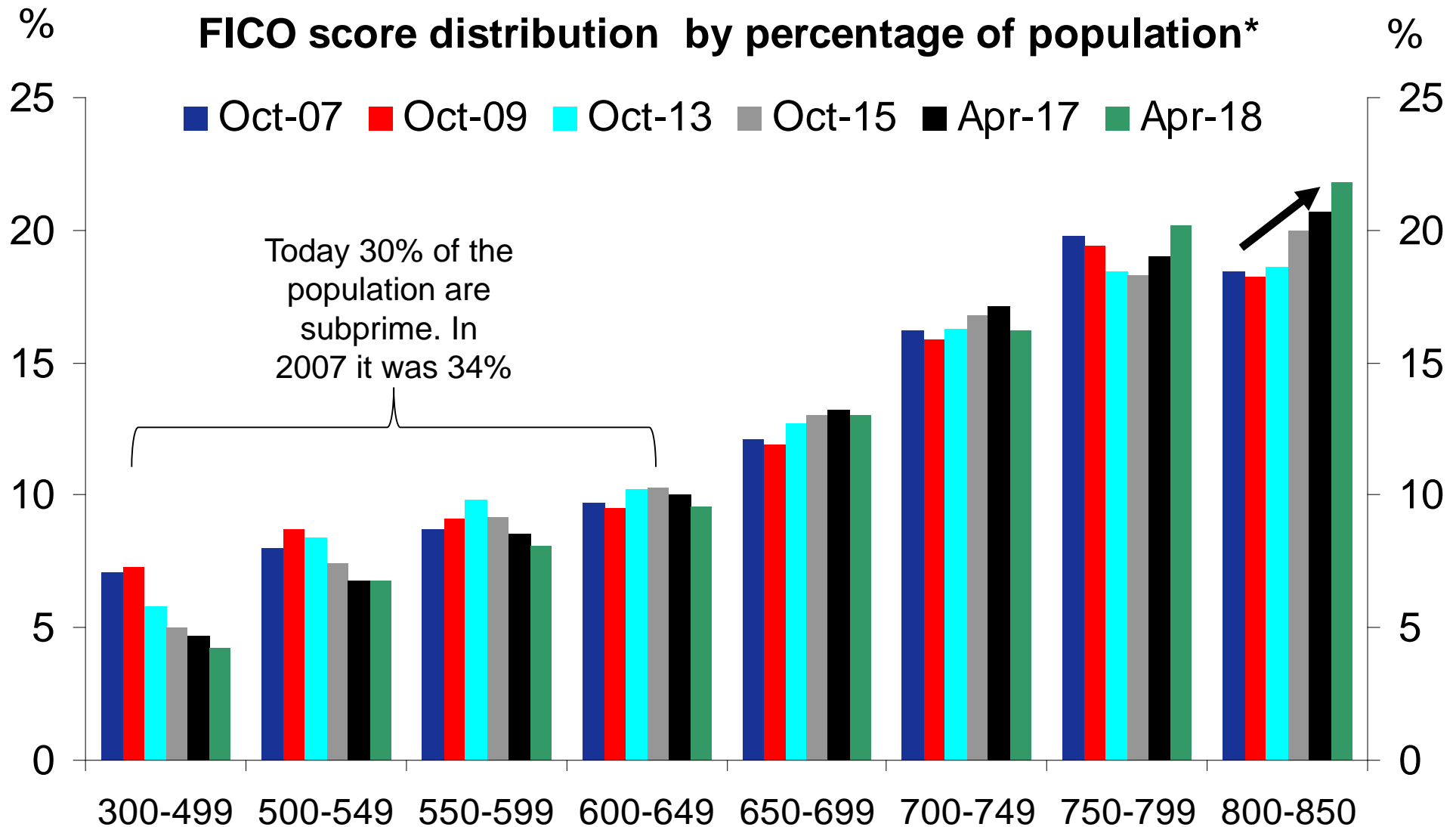
Source: National Association of Realtors, DB Global Research

# Share of single-family homes with negative equity: 9%



Source: Zillow, Haver Analytics, Deutsche Bank Global Market Research

# Fewer subprime borrowers today. And more people with top credit scores



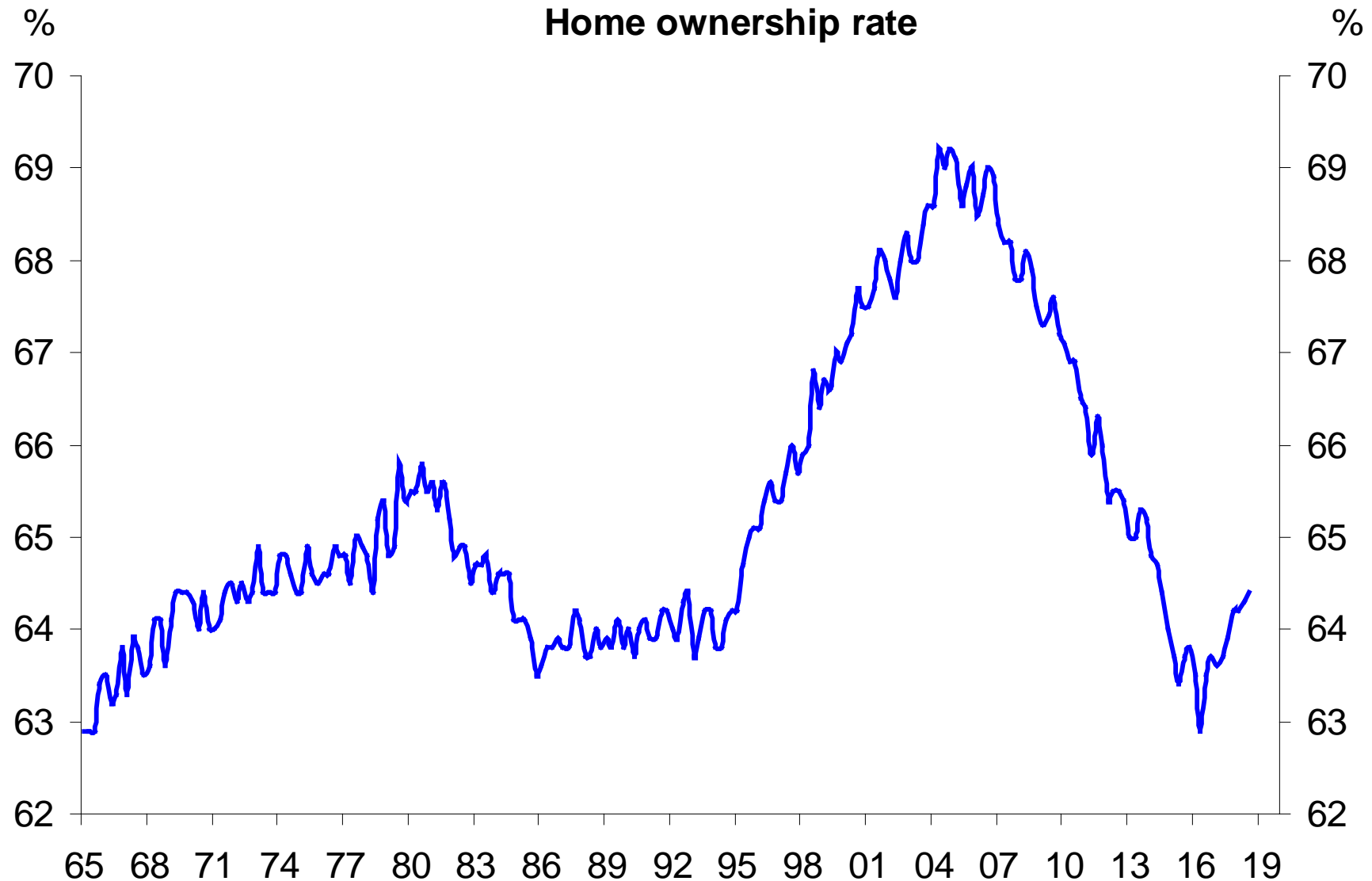
\* Columns may not add up to 100% due to rounding

Source: FICO, DB Global Research





# Homeownership rate has bottomed



Source: Census, Haver Analytics, DB Global Research

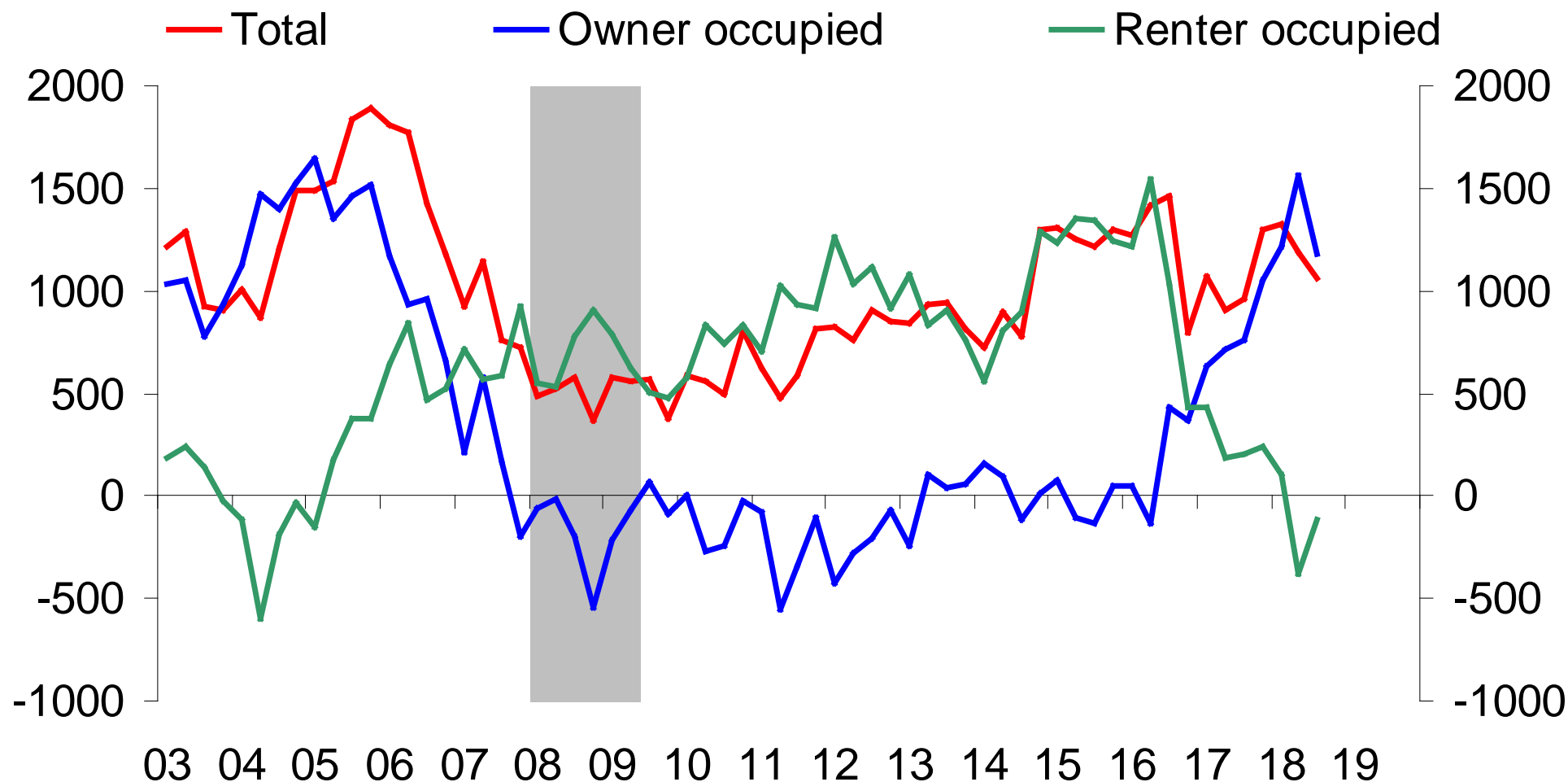
# Household formations: Fewer renters and more buyers



2 yr avg  
change

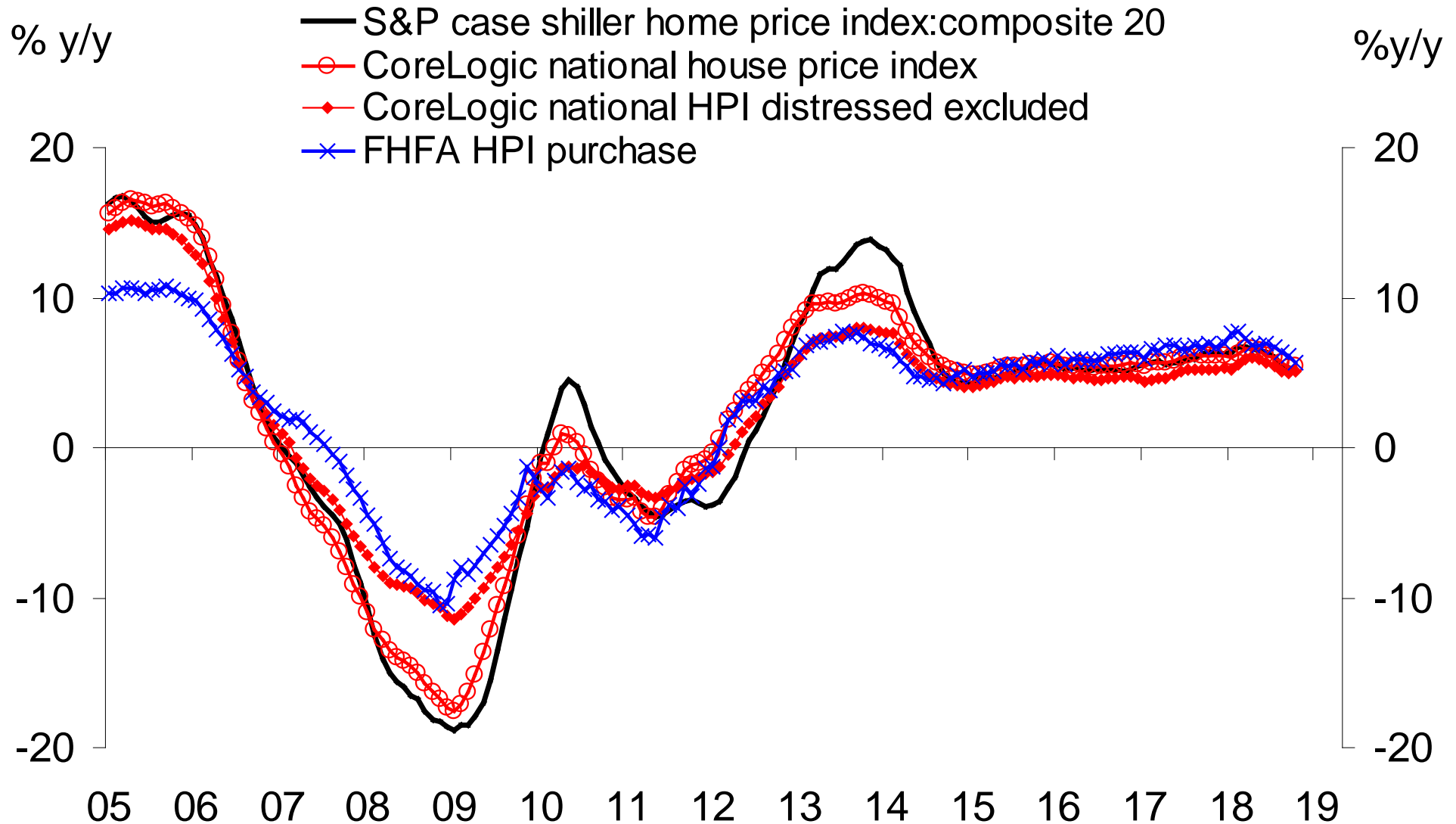
## Household Formations by Type

2 yr avg  
change



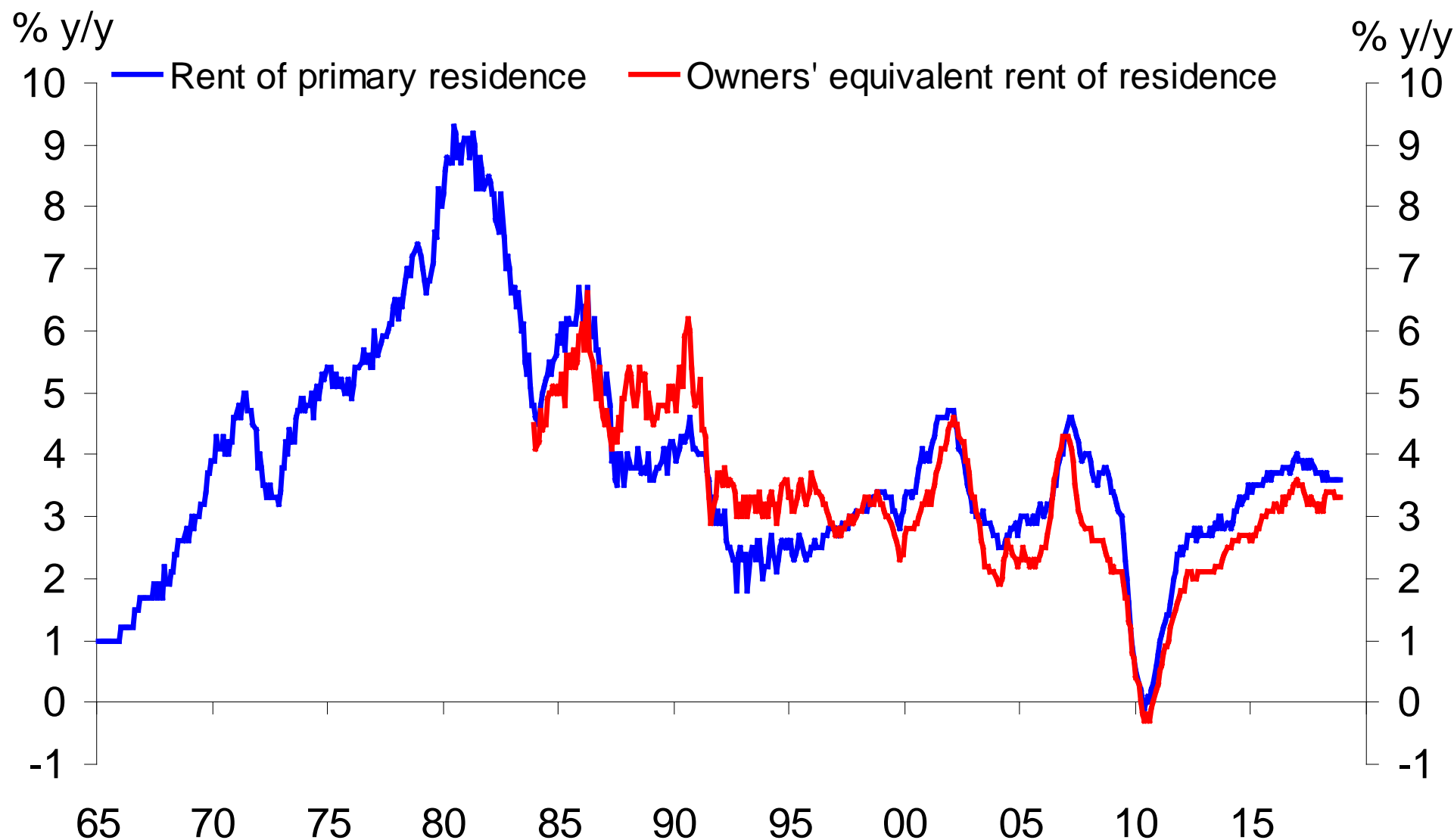
Source: Census, Haver Analytics, DB Global Research

# Home price appreciation coming down a bit



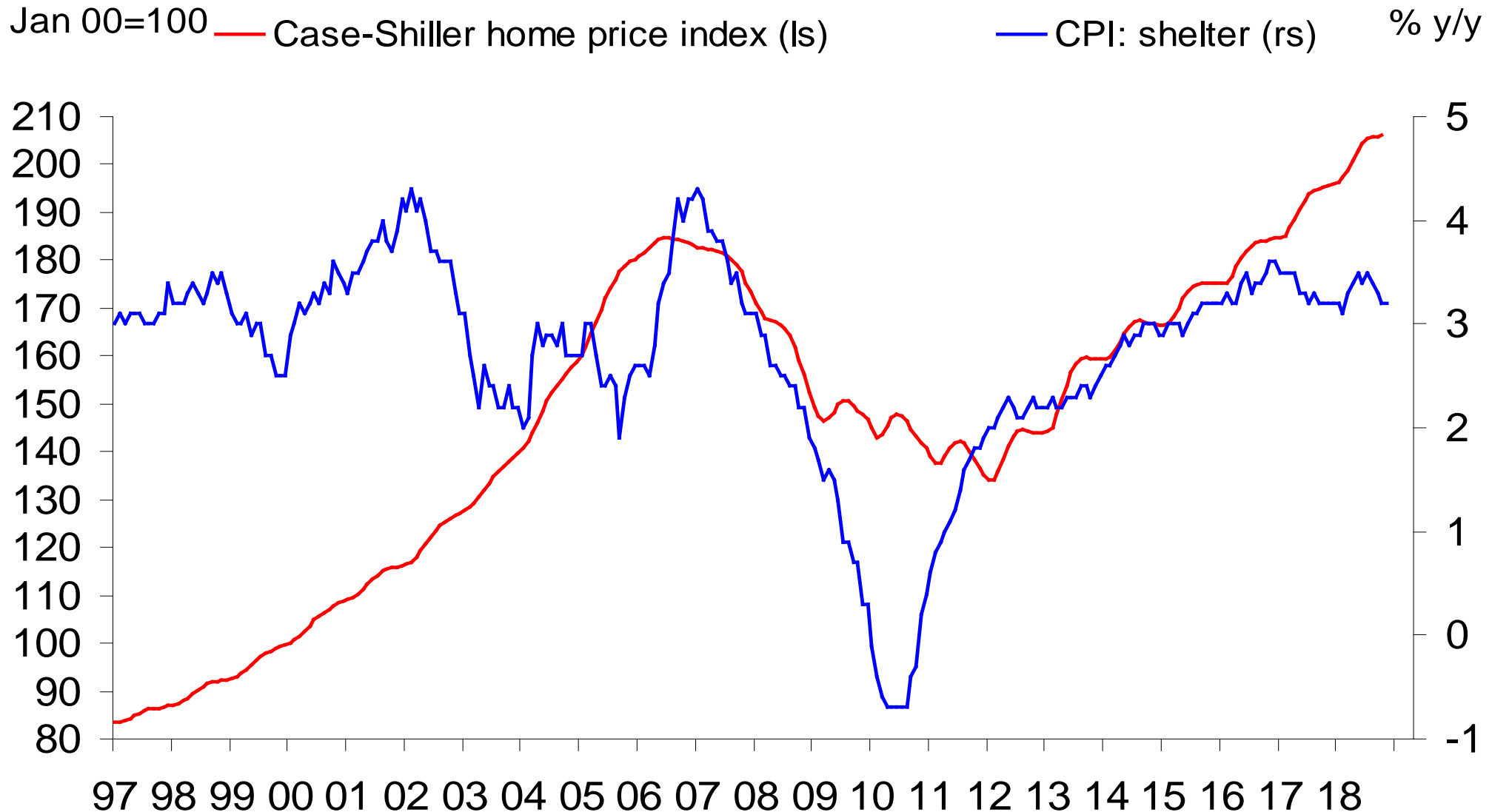
Source: S&P, CoreLogic, FHFA, Haver Analytics, DB Global Research

# Housing's contribution to consumer price inflation near 2007 levels but OER has moved sideways recently



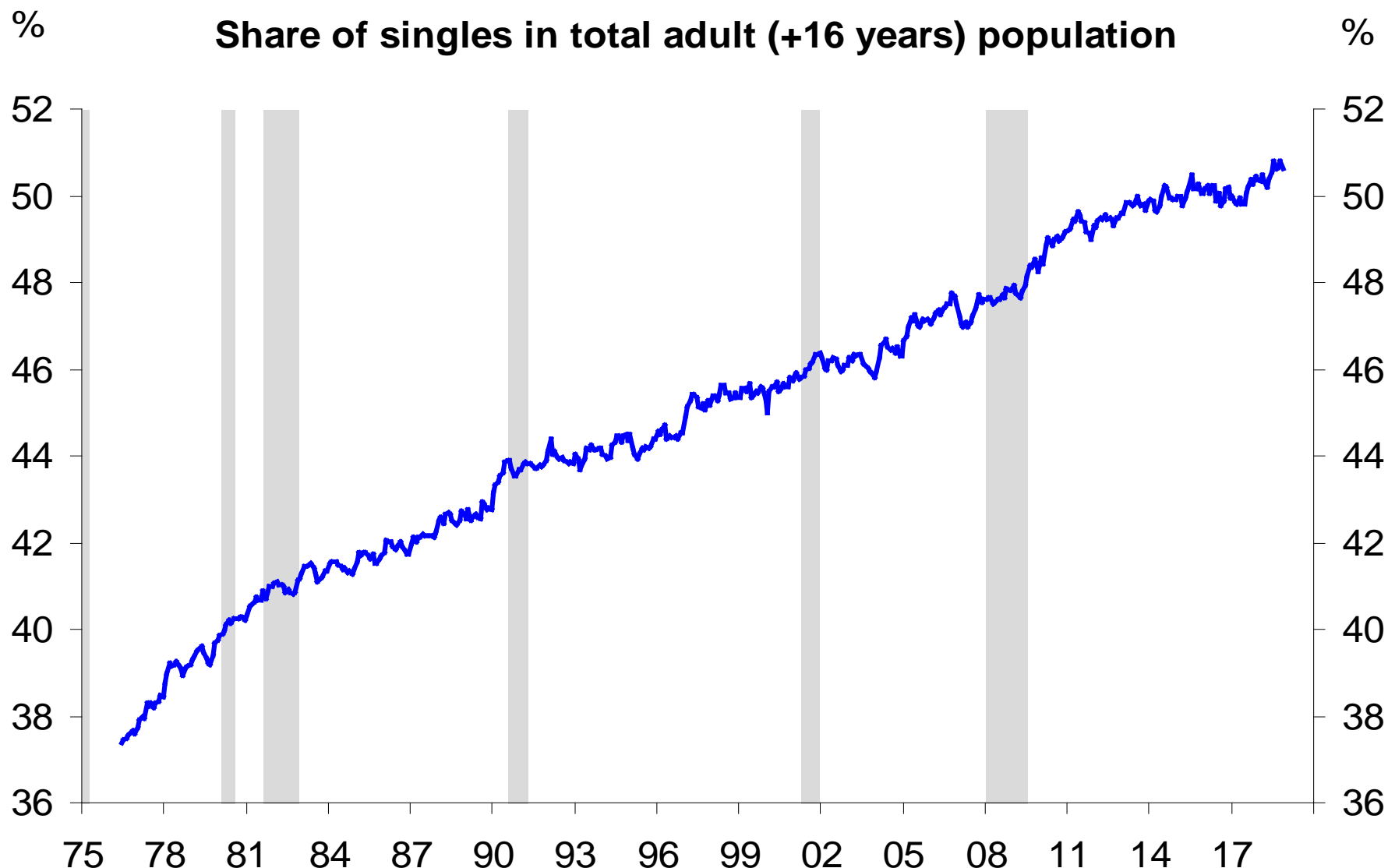
Source: BLS, Haver Analytics, DB Global Research

# Has housing become so unaffordable that inflation in home prices and rents are slowing?



Source : S&P, BLS, Haver Analytics, DB Global Research

# 51% of US adults are single



*Note: Single adults pertains to population above 16 years. This has been calculated by subtracting sum of married men and women population (16+) from the total civilian non-institutional population above 16 years.*

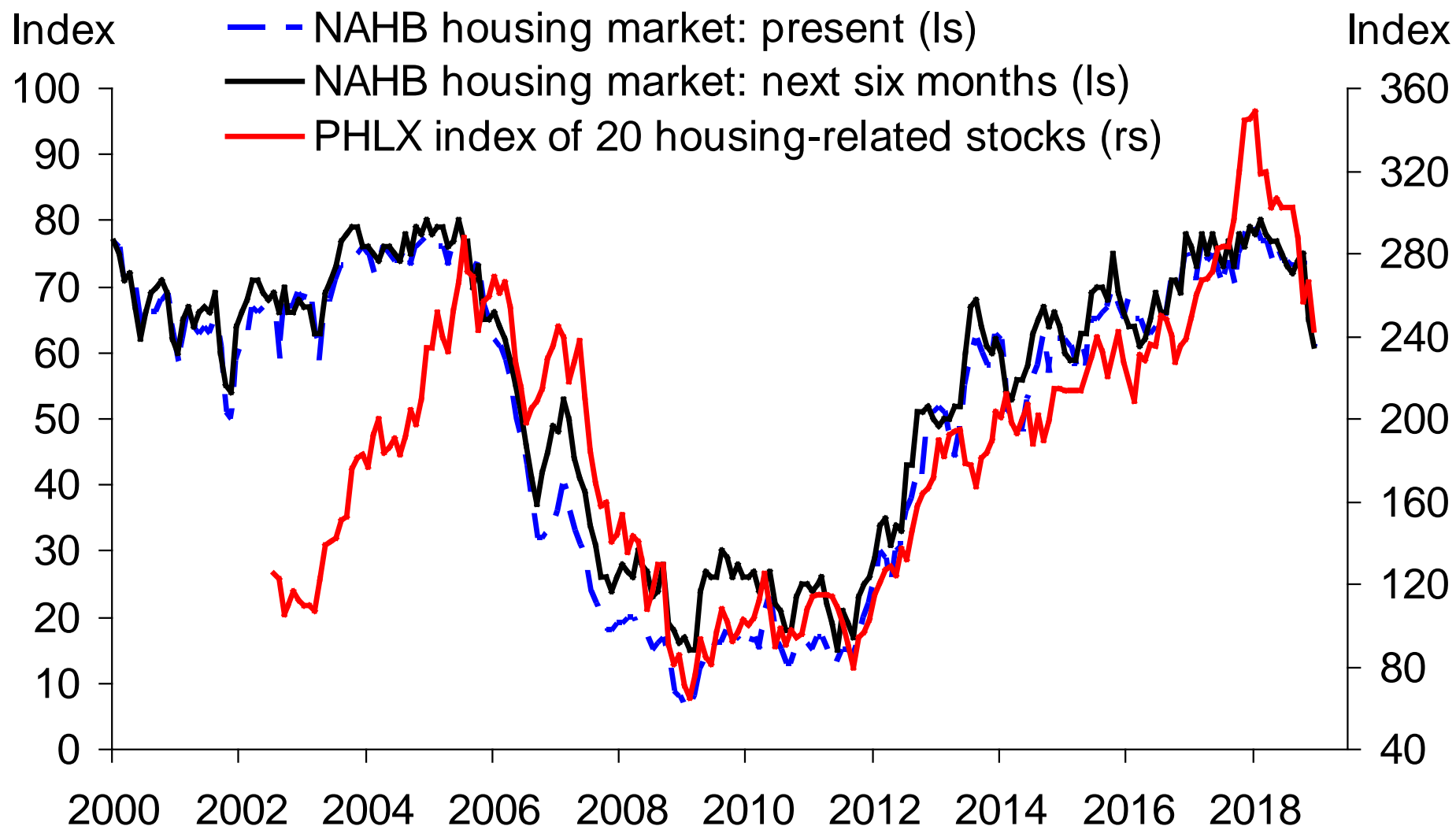
Source: BLS, Haver Analytics, DB Global Research



# Leading Indicators for Housing

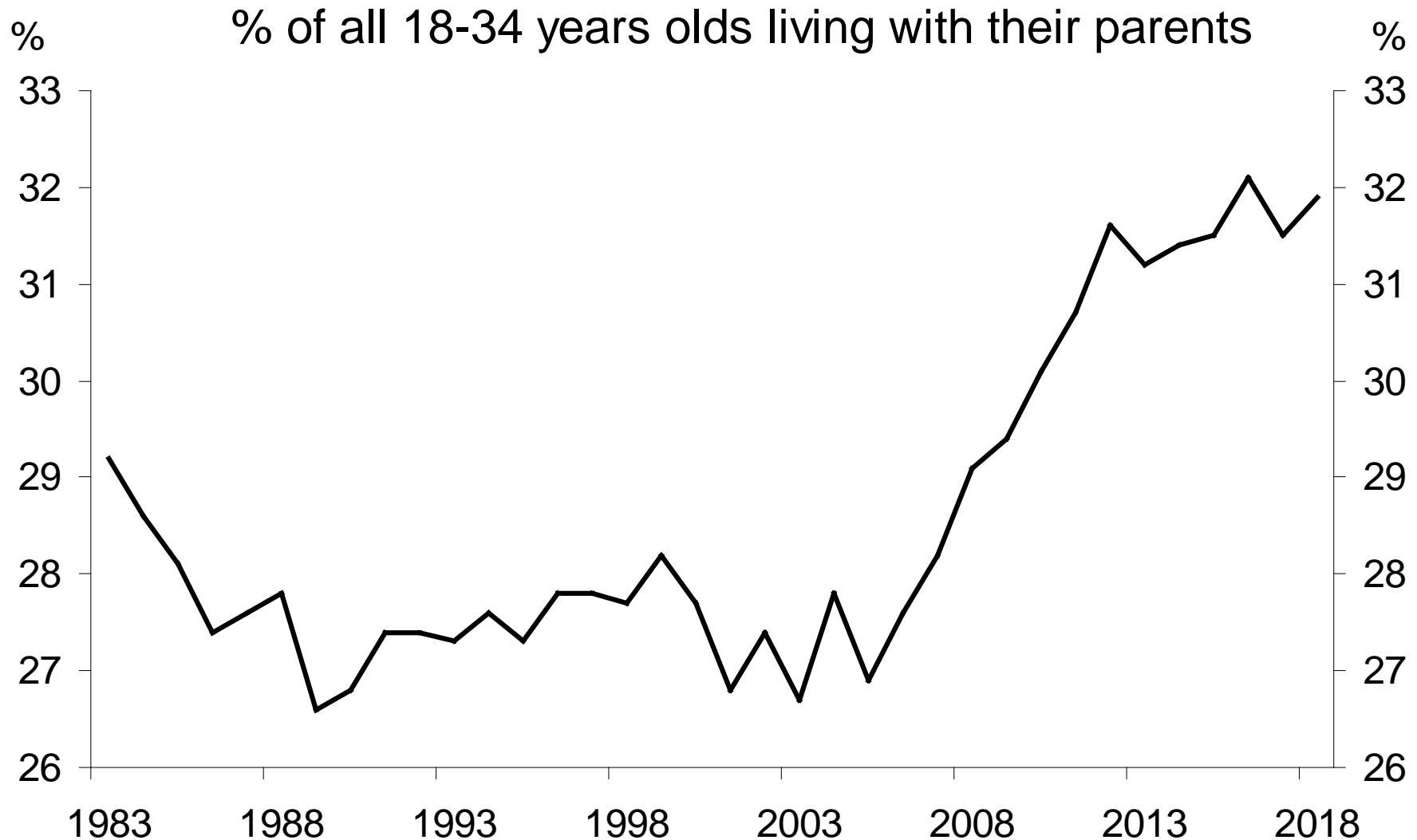


# Industry sentiment indicators falling sharply



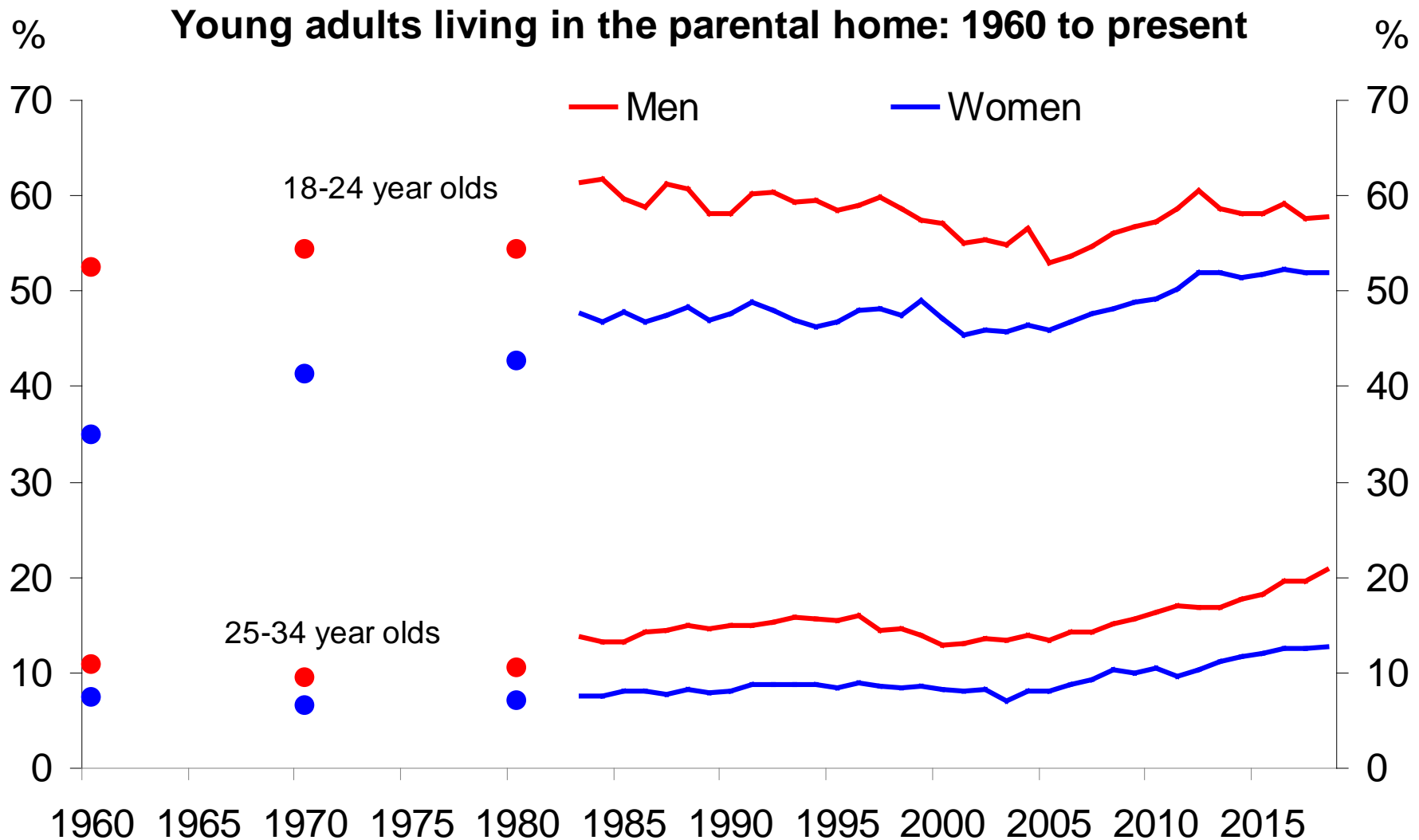
Source: NAHB, Haver Analytics, Bloomberg Finance LP, DB Global Research

# Substantial pent-up demand for housing: Almost 1/3 of 18-34 year olds living with their parents



Source: Census, DB Global Research

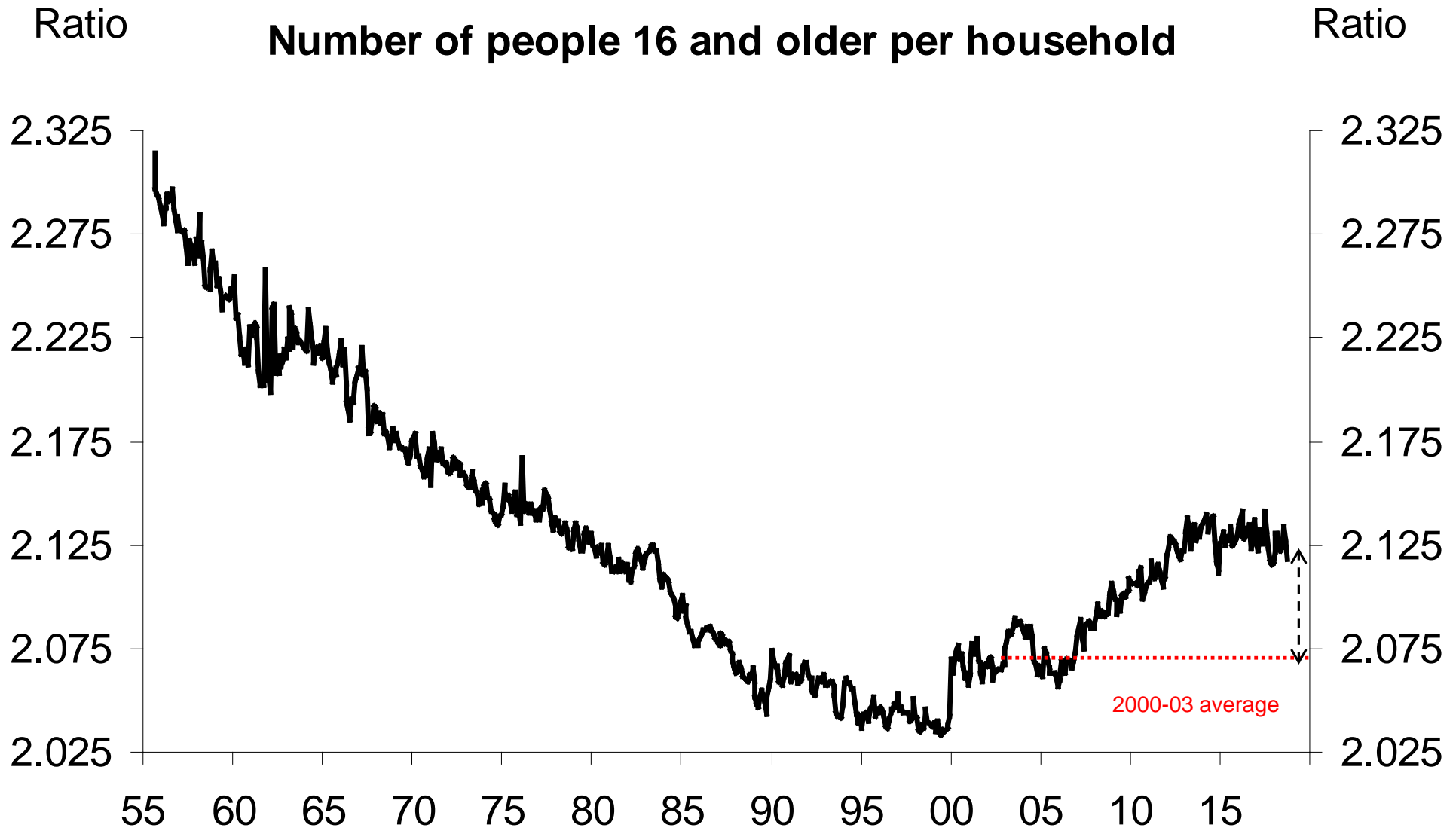
# Substantial pent-up demand for housing: More than 50% of 18-24 year olds living with their parents



Source: Census, DB Global Research

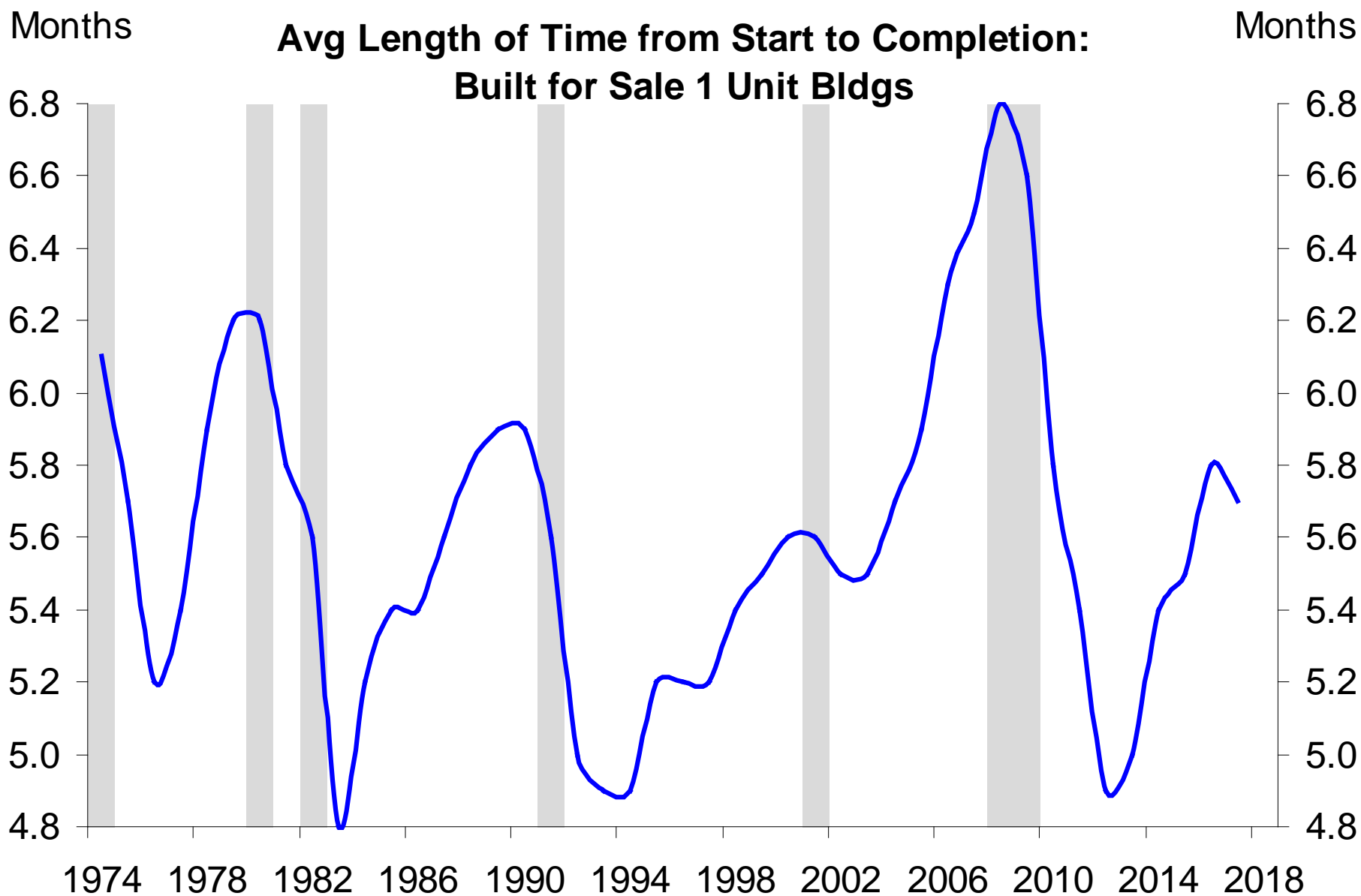


Significant pent-up demand:  
If the number of people per household returns to the  
2000-2003 level it would add almost 3mn new households



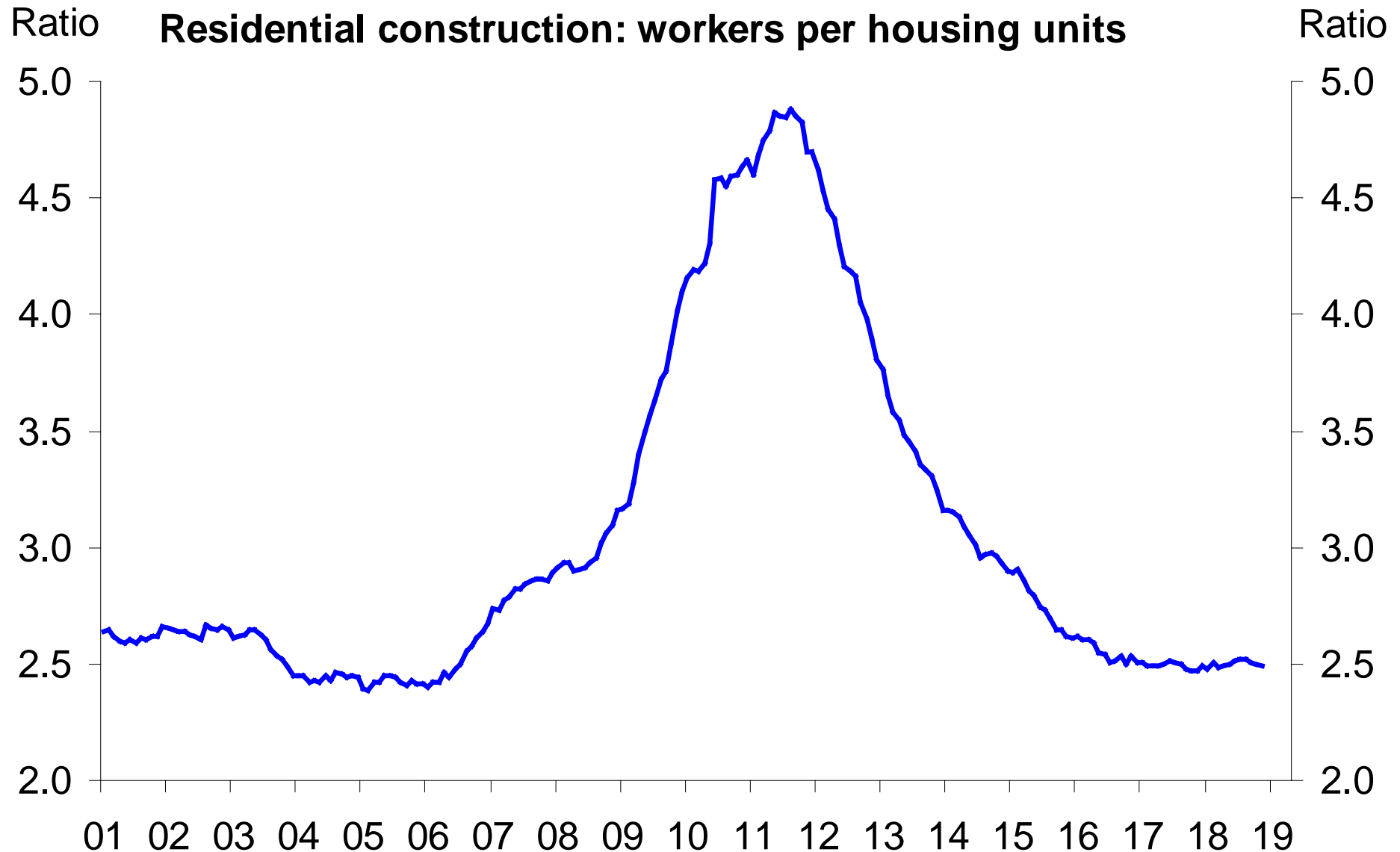
Source: Census, BLS, Haver Analytics, DB Global Research

# It takes 5.7 months to build a home



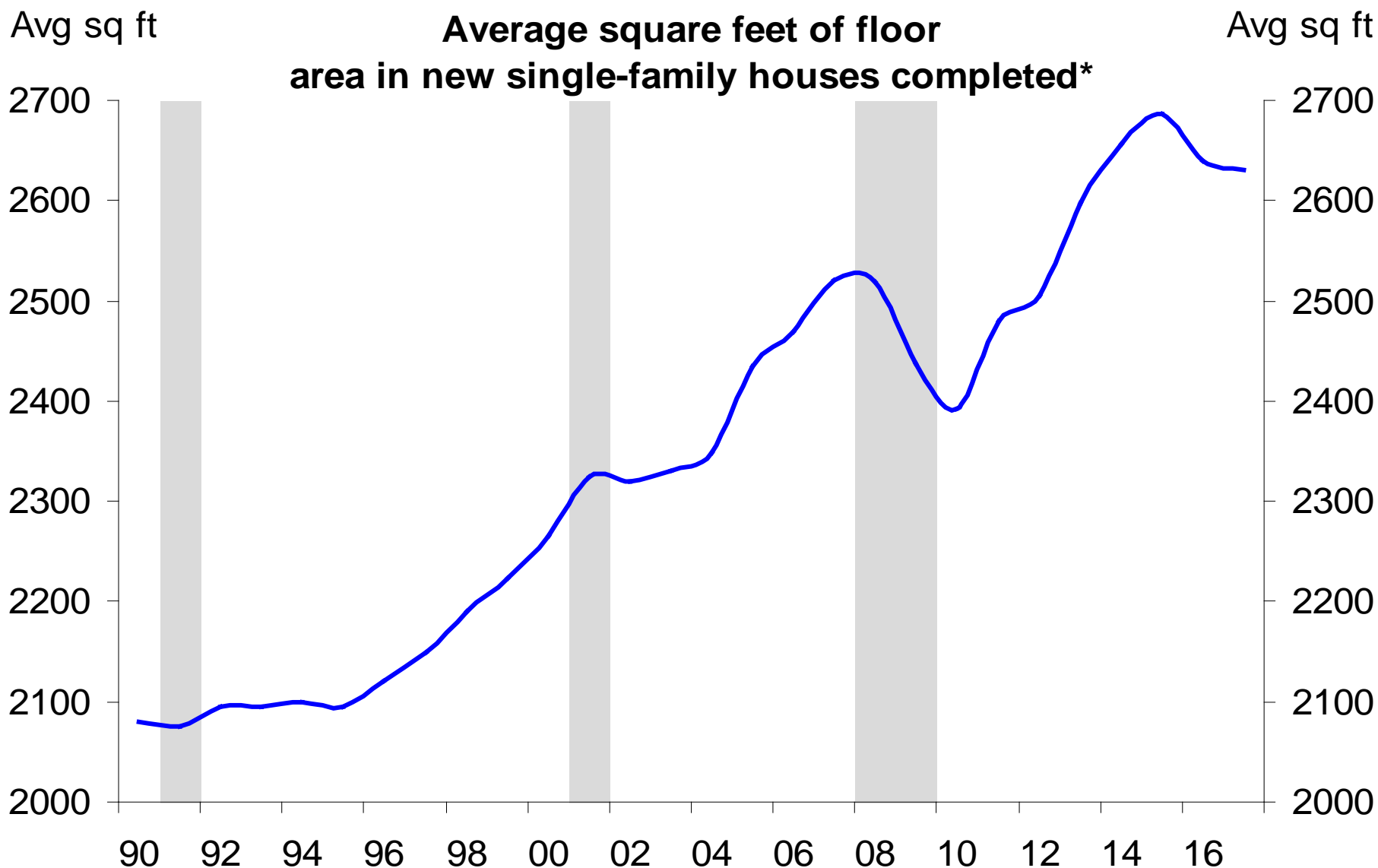
Source: Census, Haver Analytics, DB Global Research

# Construction more efficient: Fewer workers per housing unit under construction



Source: BLS, Census, Haver Analytics, DB Global Research

# New homes are smaller because of higher home prices

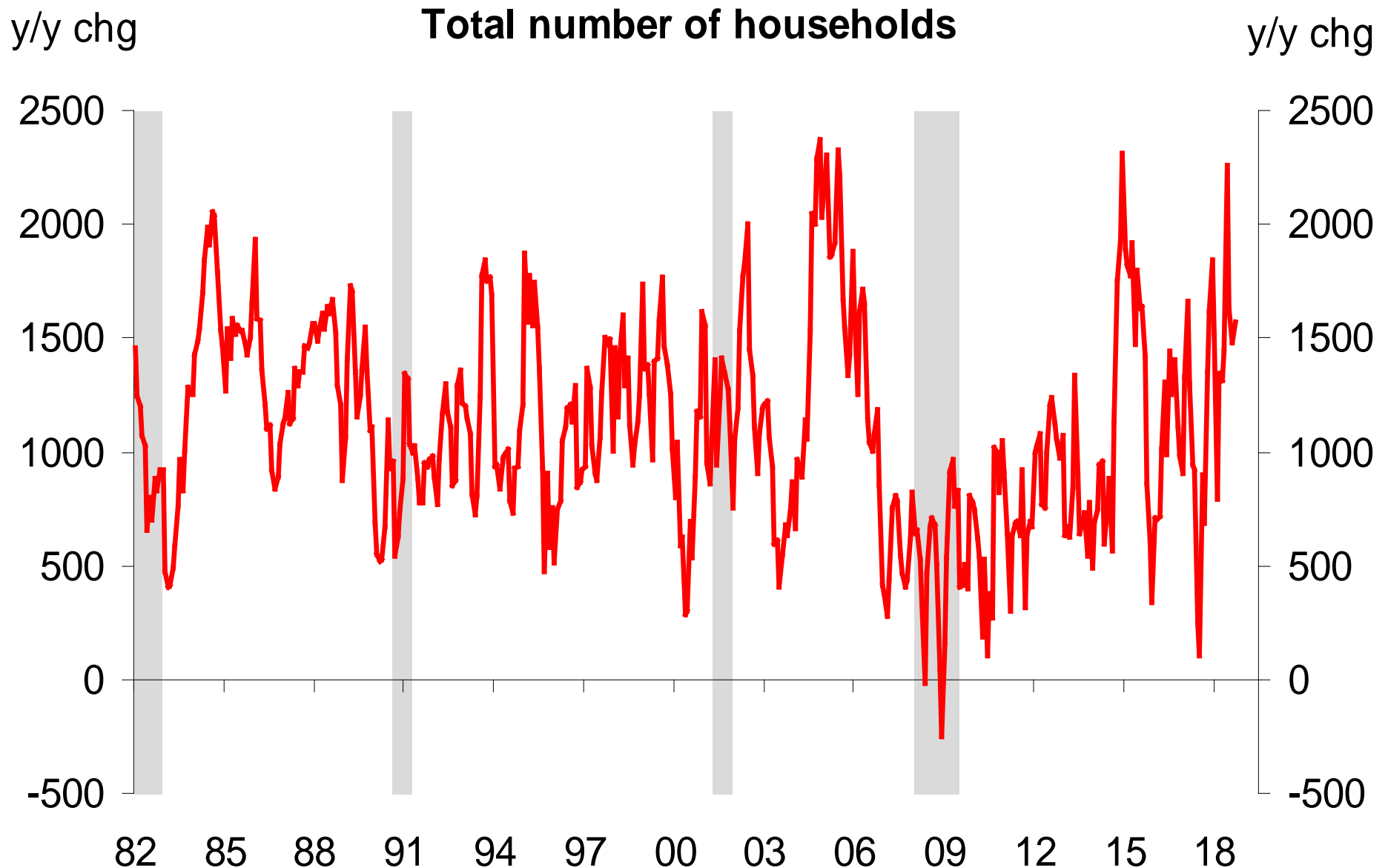


*\*Includes houses built for rent (not shown separately).*

Source: Census, DB Global Research



# Household formation trending higher recently

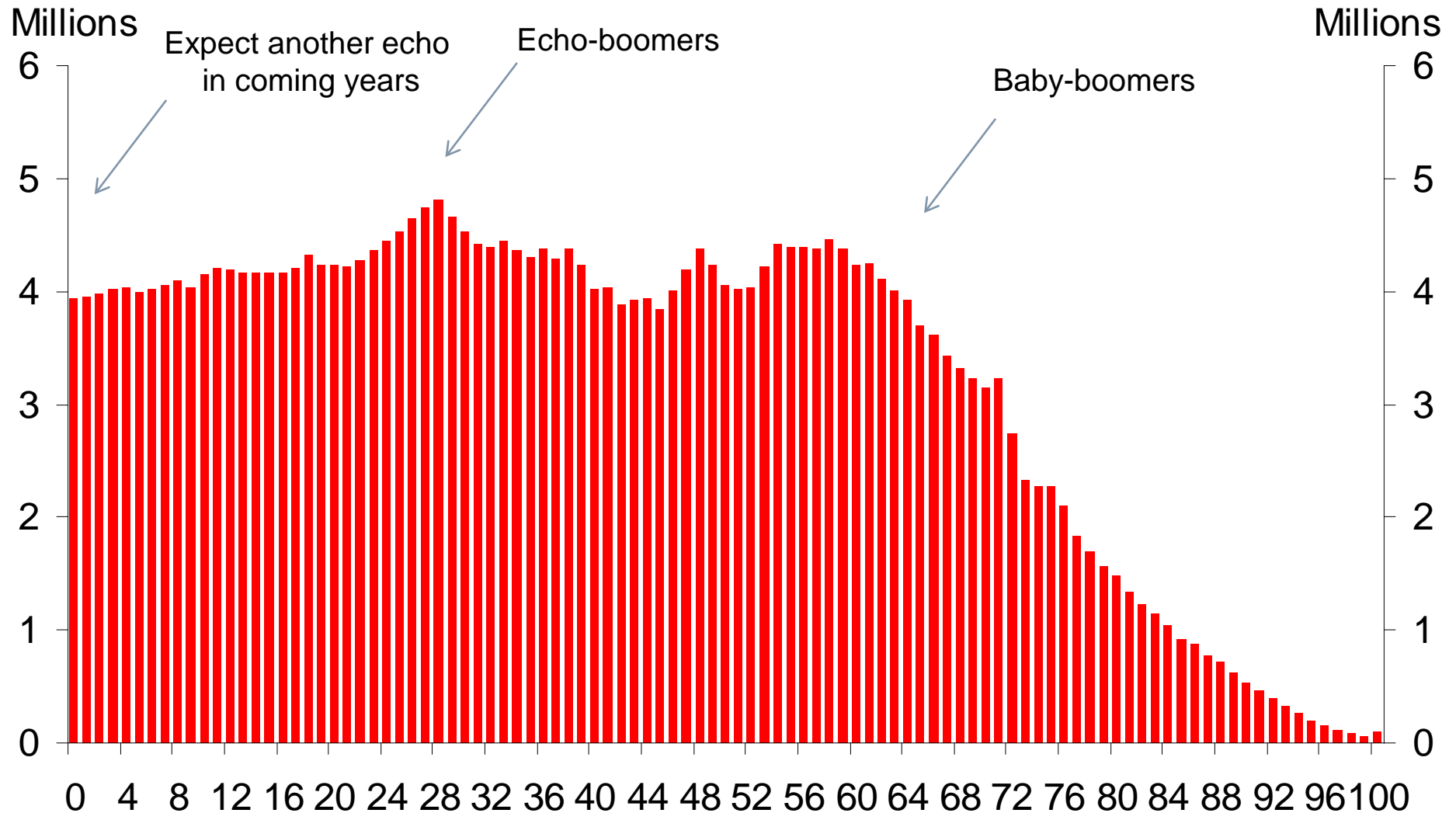


Source: Census, Haver Analytics, DB Global Research

There are 4.6mn 28-year olds in the US,  
more than any other age group



## U.S population by age, Dec 2018

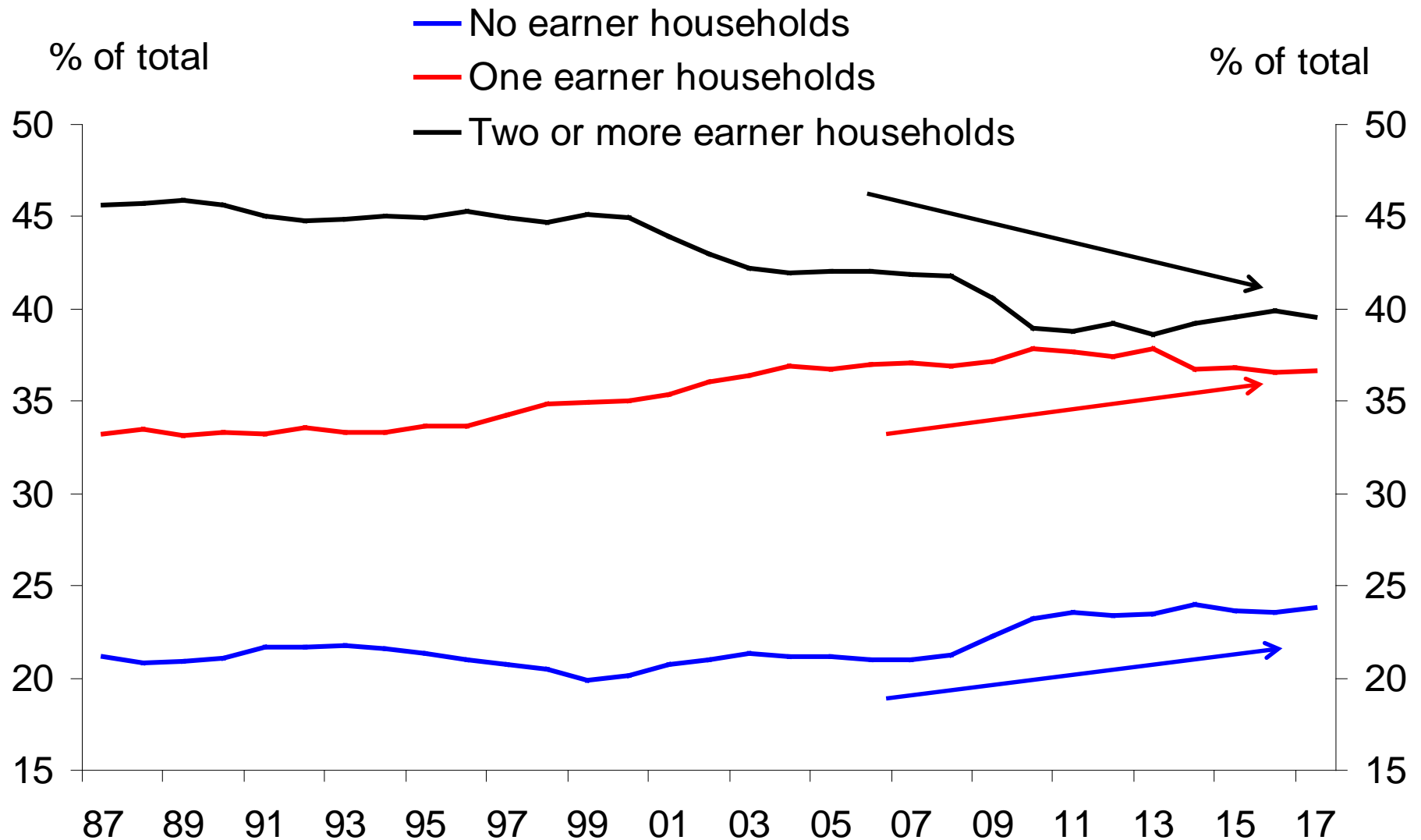


Source: Census, Haver Analytics, DB Global Research

# The composition of the “median household” today is different from what it was in the 1980s



## Household shares by number of earners



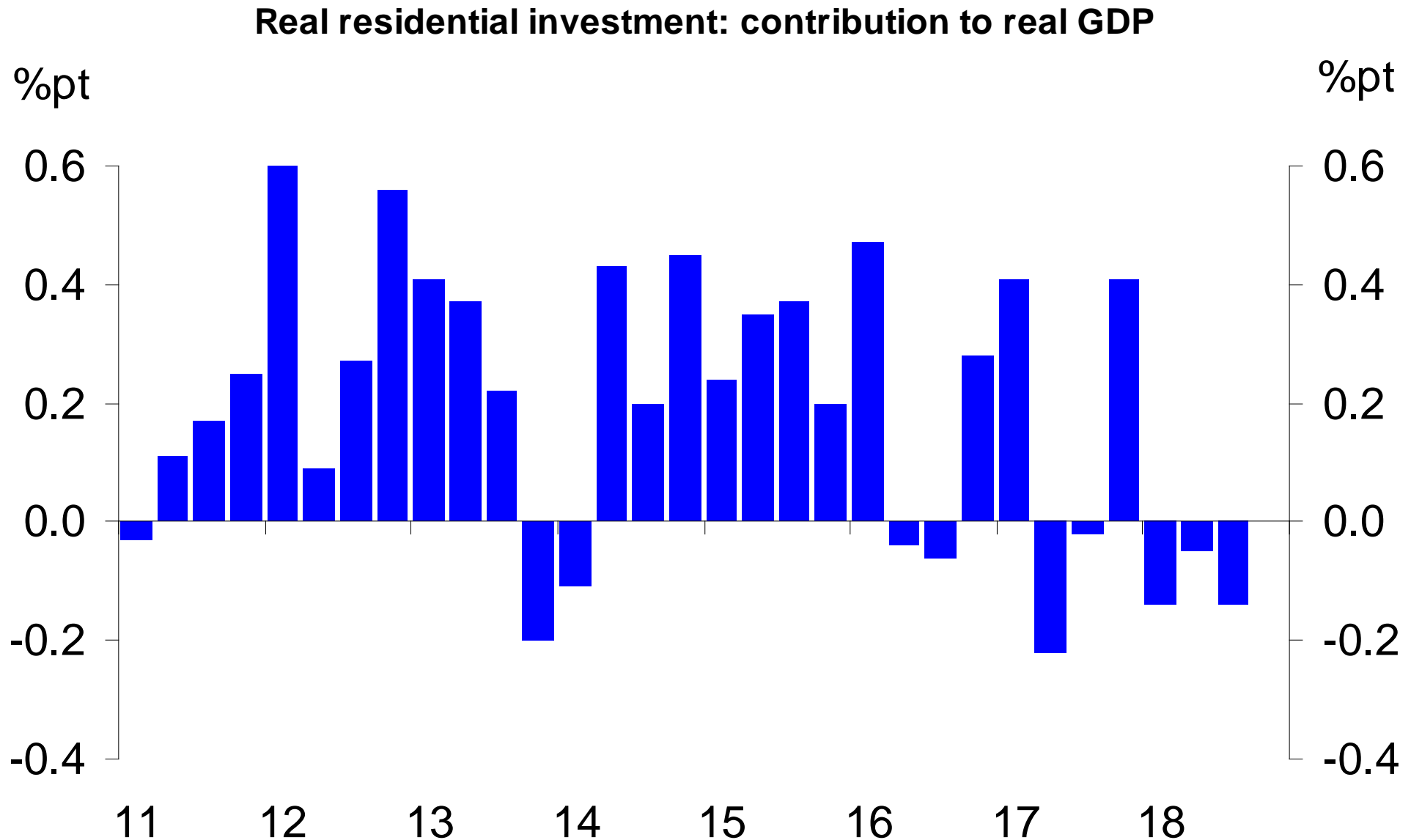
Source: Census, DB Global Research



# Housing Activity

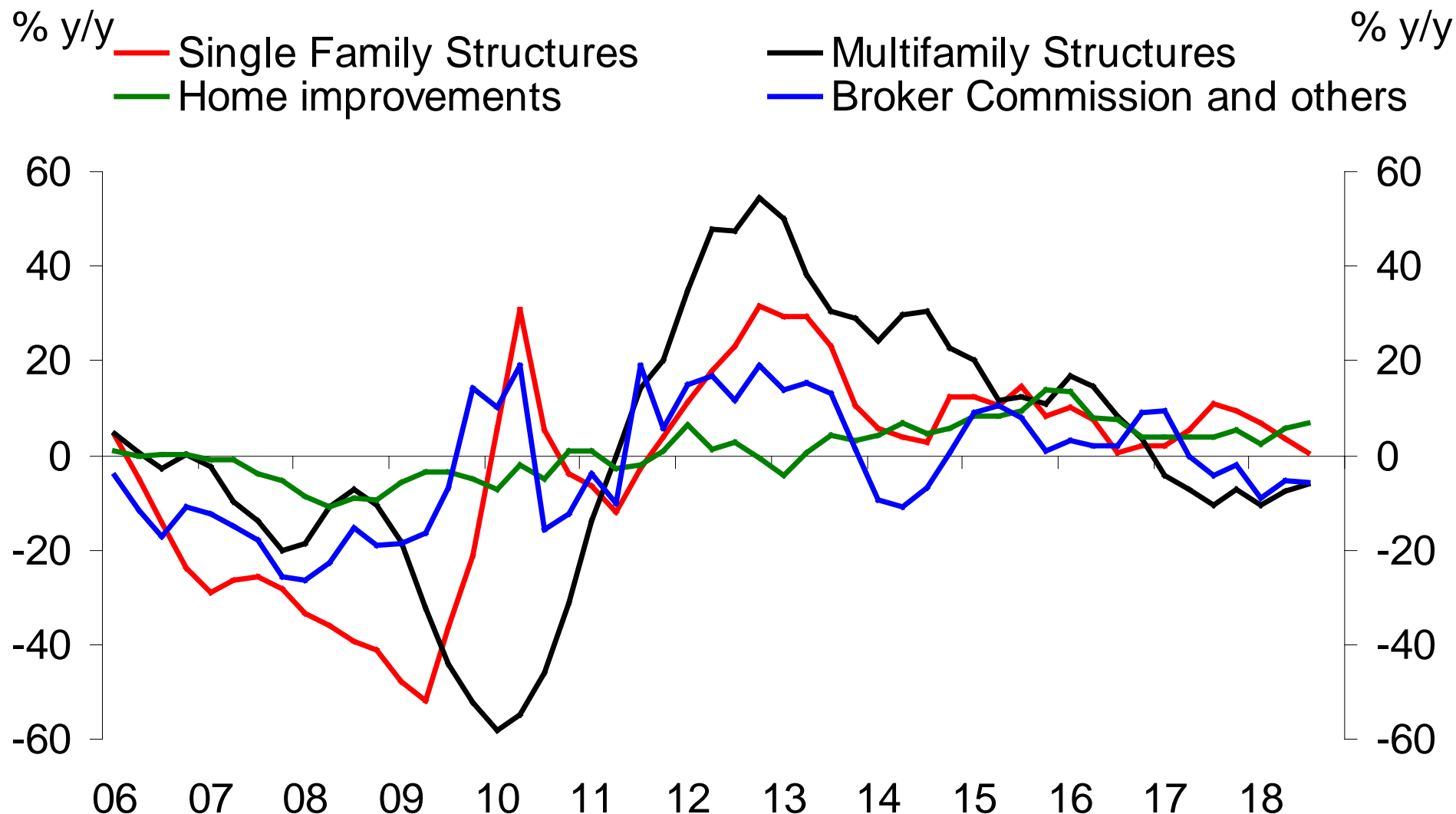


# Residential investment contribution to GDP growth



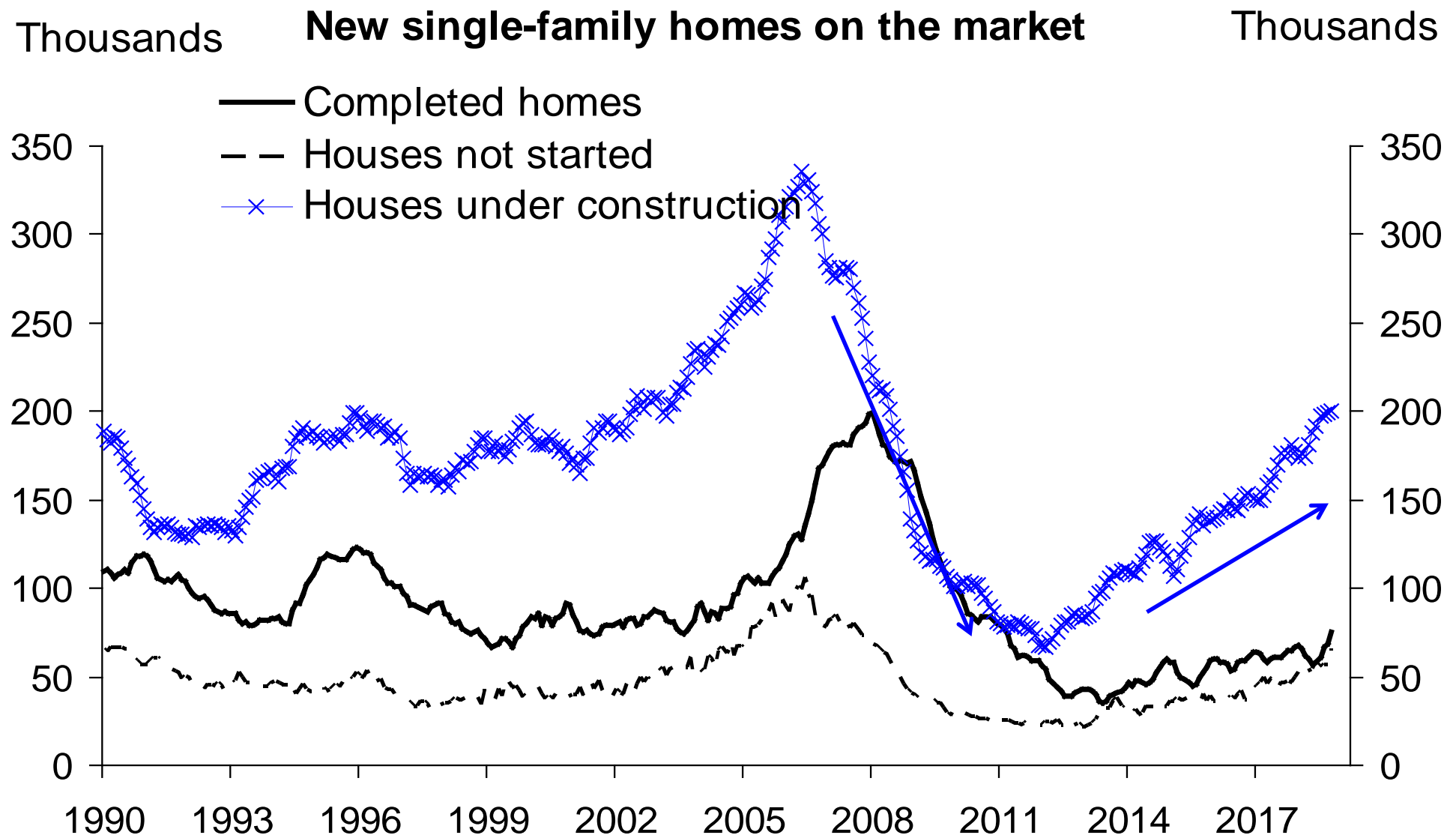
Source: BEA, Haver Analytics, DB Global Research

# Year-over-year growth in housing components contributing to GDP



Source: BEA, Haver Analytics, DB Global Research

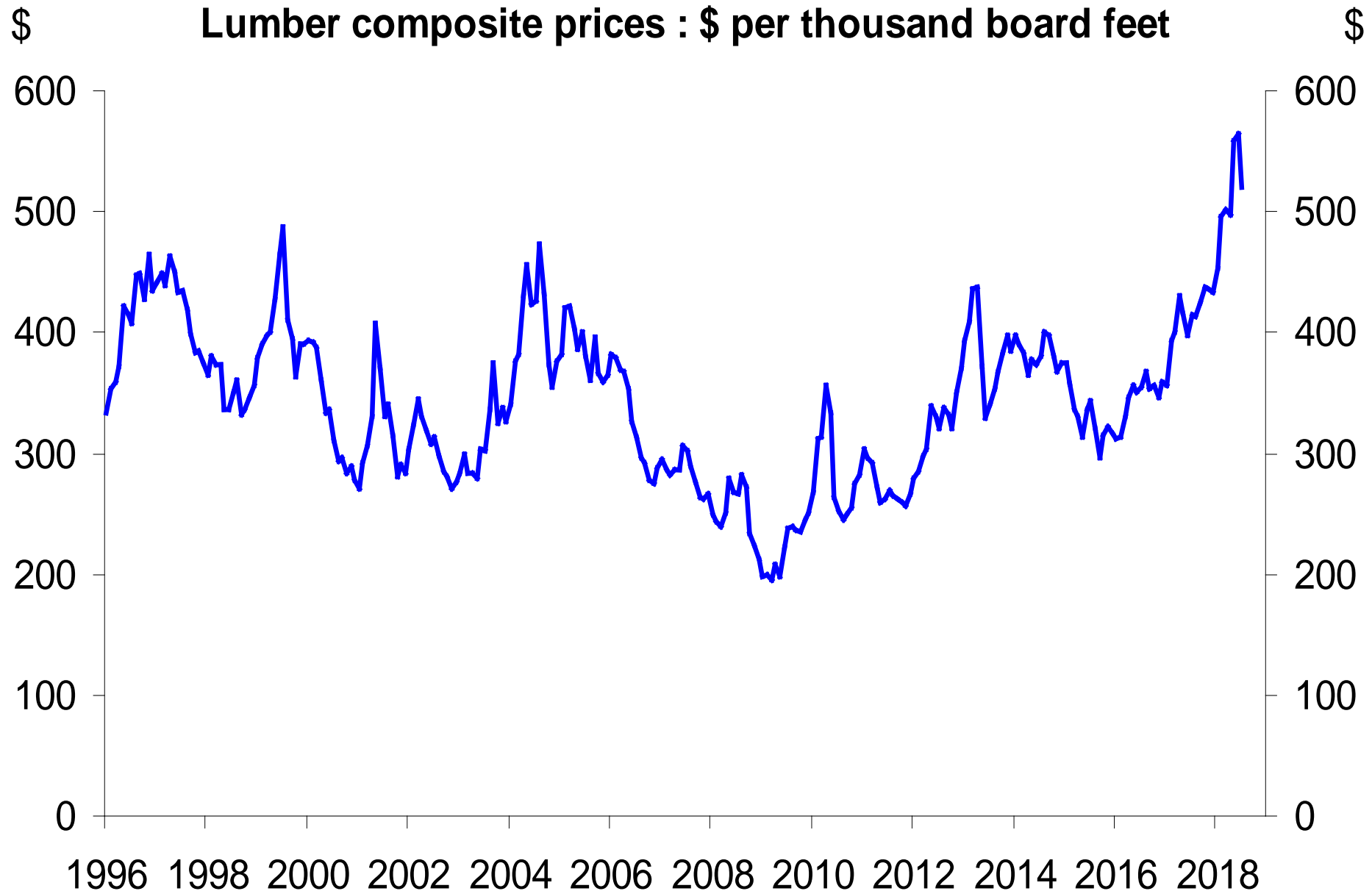
# Single-family homes under construction looking better



Source: Census, Haver Analytics, DB Global Research

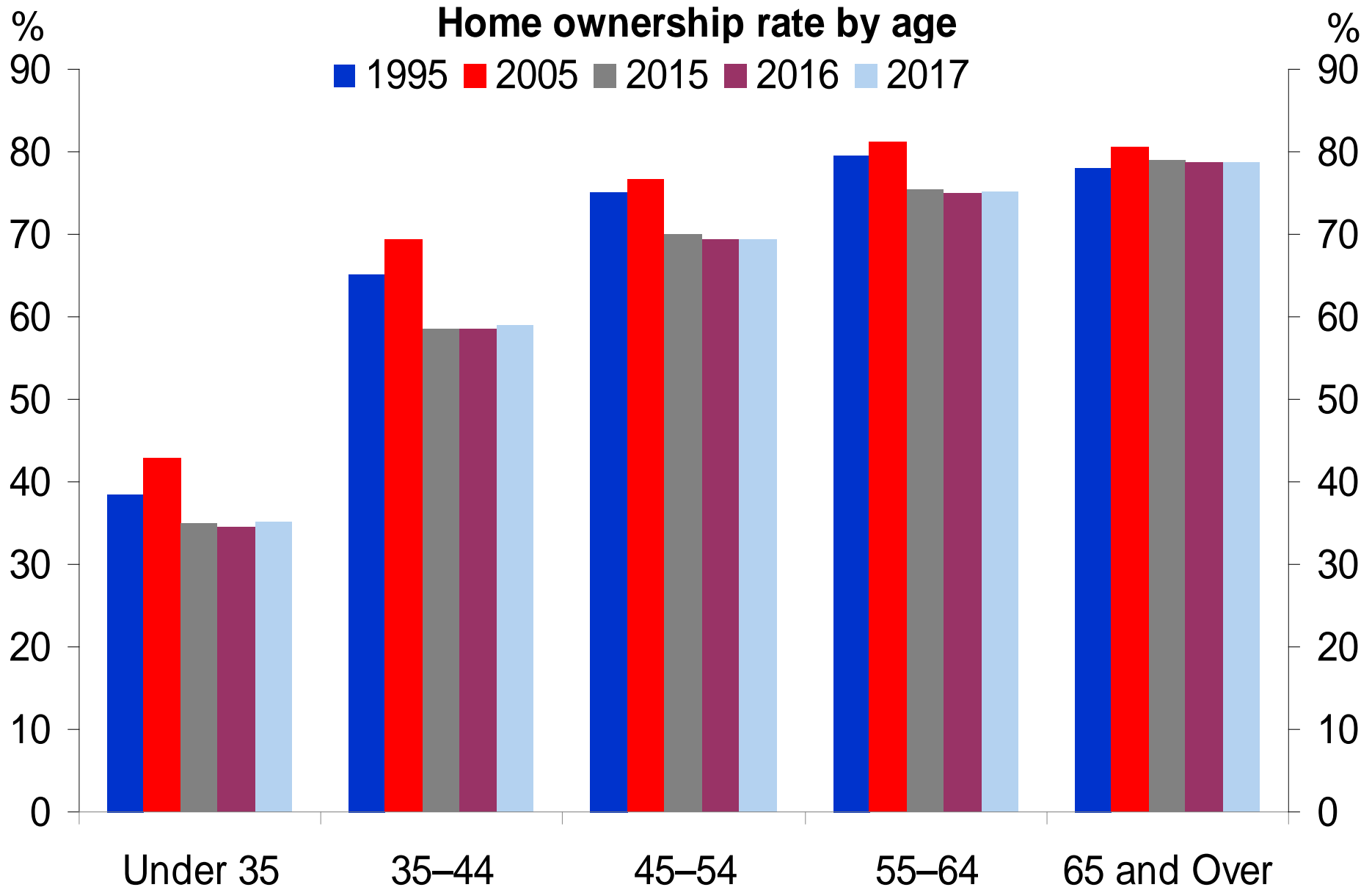


# Lumber prices up recently



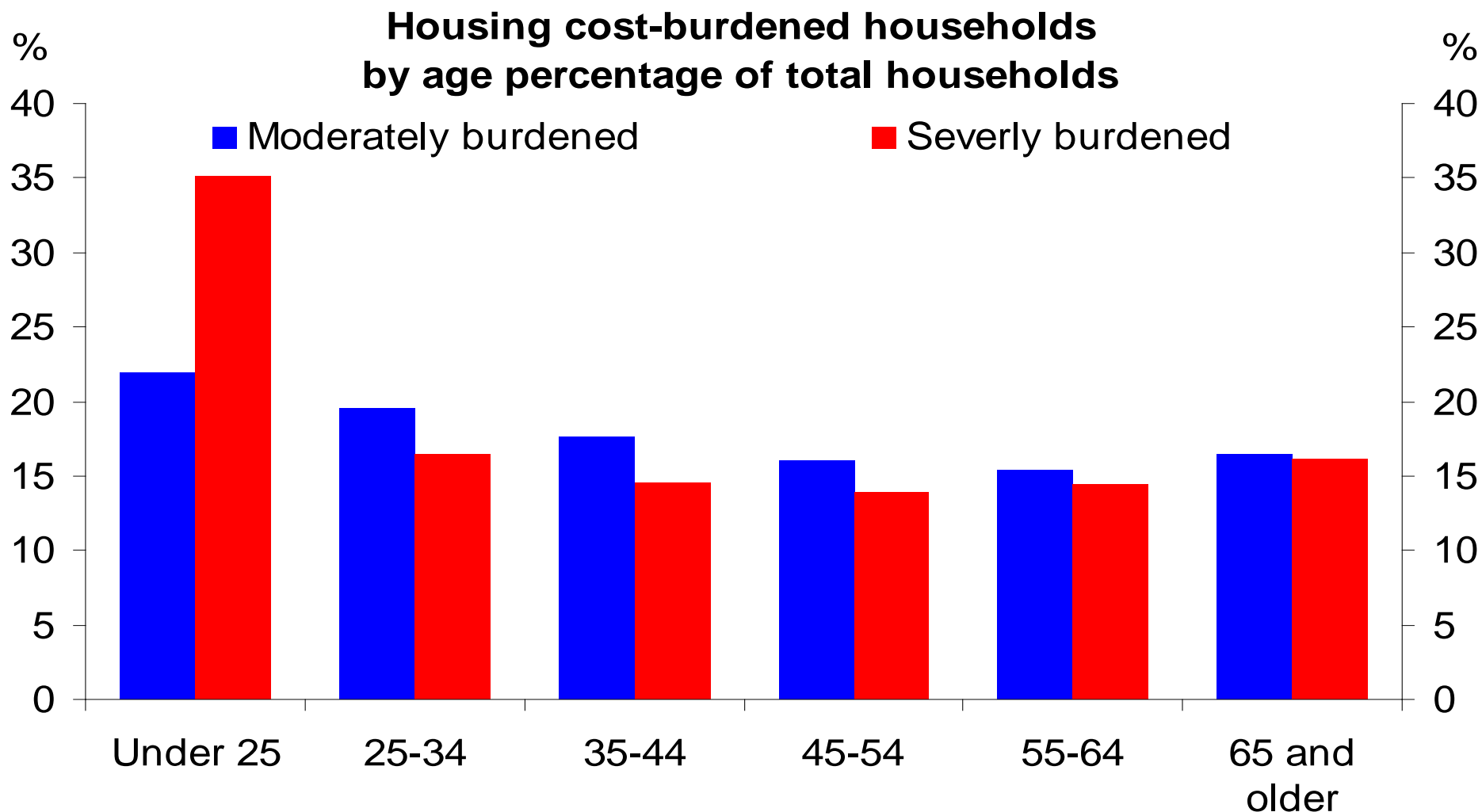
Source: Random Lengths, DB Global Research

# Home ownership rates still below pre-crisis level across age groups



Source: Census Bureau, Haver Analytics, DB Global Research

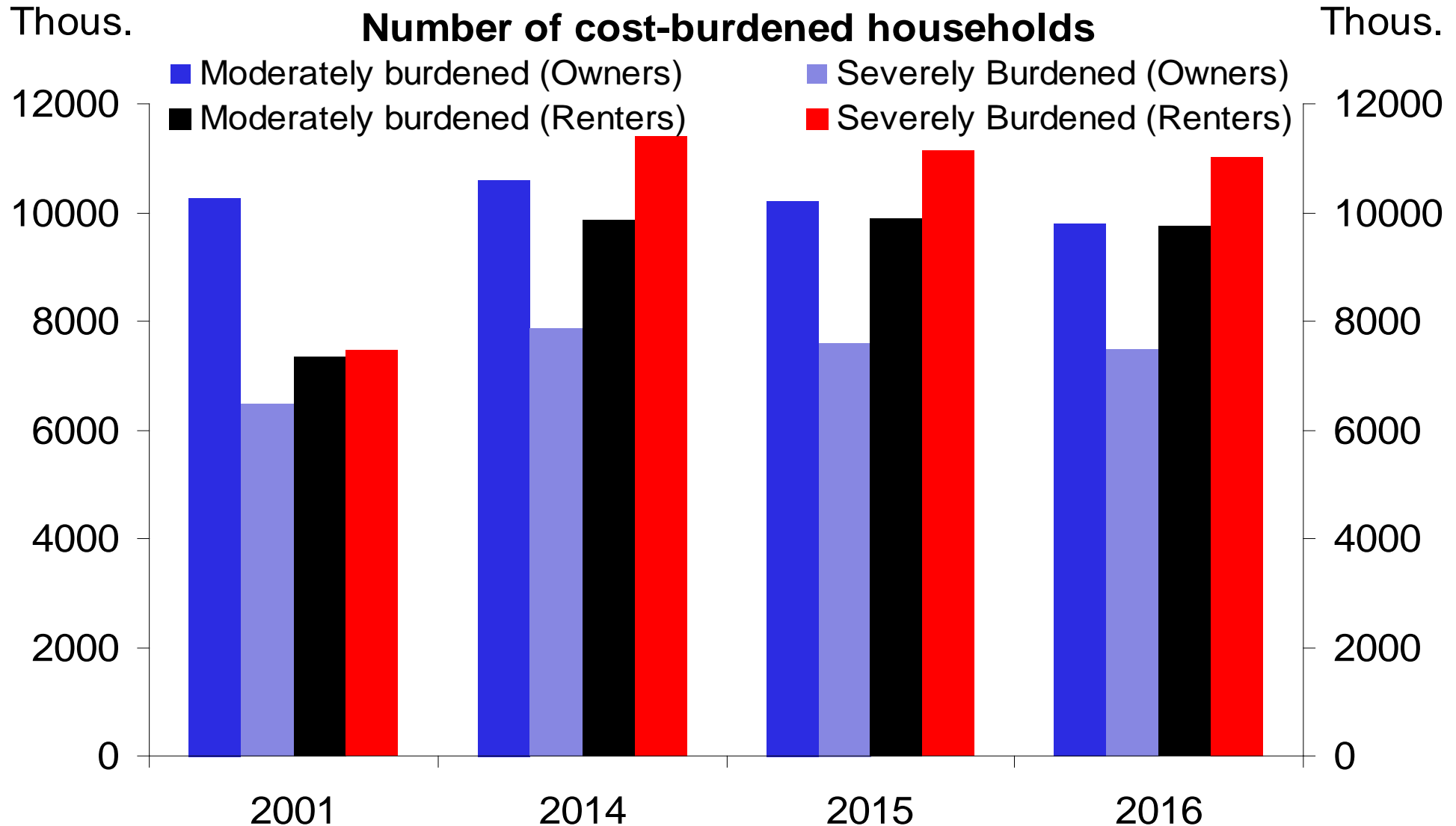
# Many cost-burdened households among Millennials



Notes: Moderately (severely) cost-burdened households pay more than 30% up to 50% (more than 50%) of household income for housing. Households with zero or negative income are assumed to be severely burdened, while households paying no cash rent are assumed to be unburdened. Income cutoffs are in 2014 dollars adjusted for inflation using the CPI-U for All Items. White, black, and Asian/other householders are non-Hispanic. Hispanic householders may be of any race. Children are the householder's own, adopted, or step children under the age of 18. High school degree includes householders who completed a GED. Fully employed householders worked for at least 48 weeks during the previous 12 months, short-term unemployed for 27–47 weeks, and long-term unemployed for 1–26 weeks. Fully unemployed householders did not work in the previous 12 months but were in the labor force. Householders not in the labor force include those under the age of 16.

Source: JCHS tabulations of US Census Bureau, American Community Surveys, DB Global Research

# Number of cost-burdened renters has increased

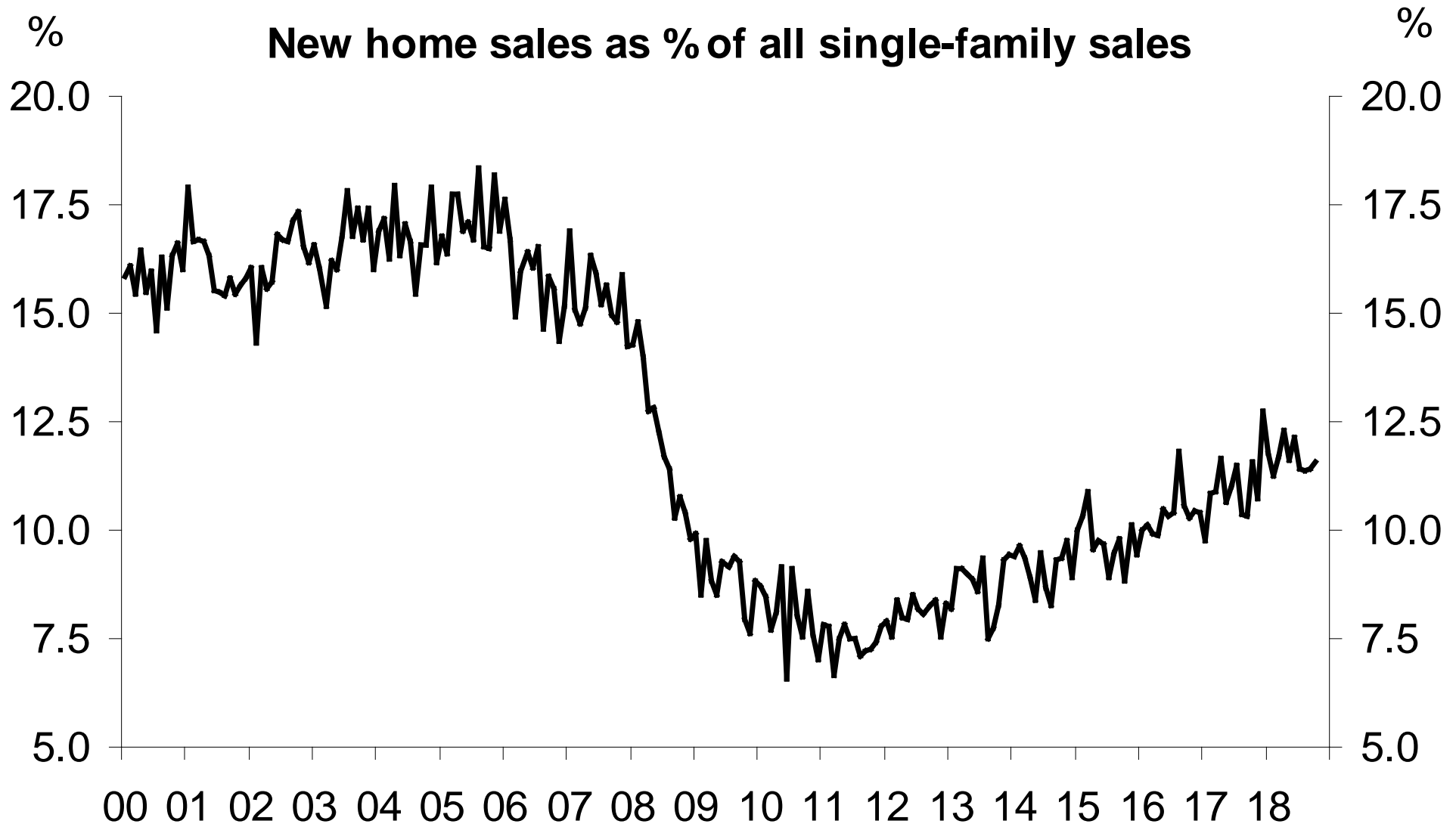


Notes: Moderate (severe) burdens are defined as housing costs of more than 30% and up to 50% (more than 50%) of household income. Households with zero or negative income are assumed to be severely burdened, while renters paying no cash rent are assumed to be unburdened. Income cutoffs are adjusted to 2014 dollars by the CPI-U for All Items.

Source: JCHS tabulations of US Census Bureau, American Community Surveys, DB Global Research



# New home sales as a share of total sales



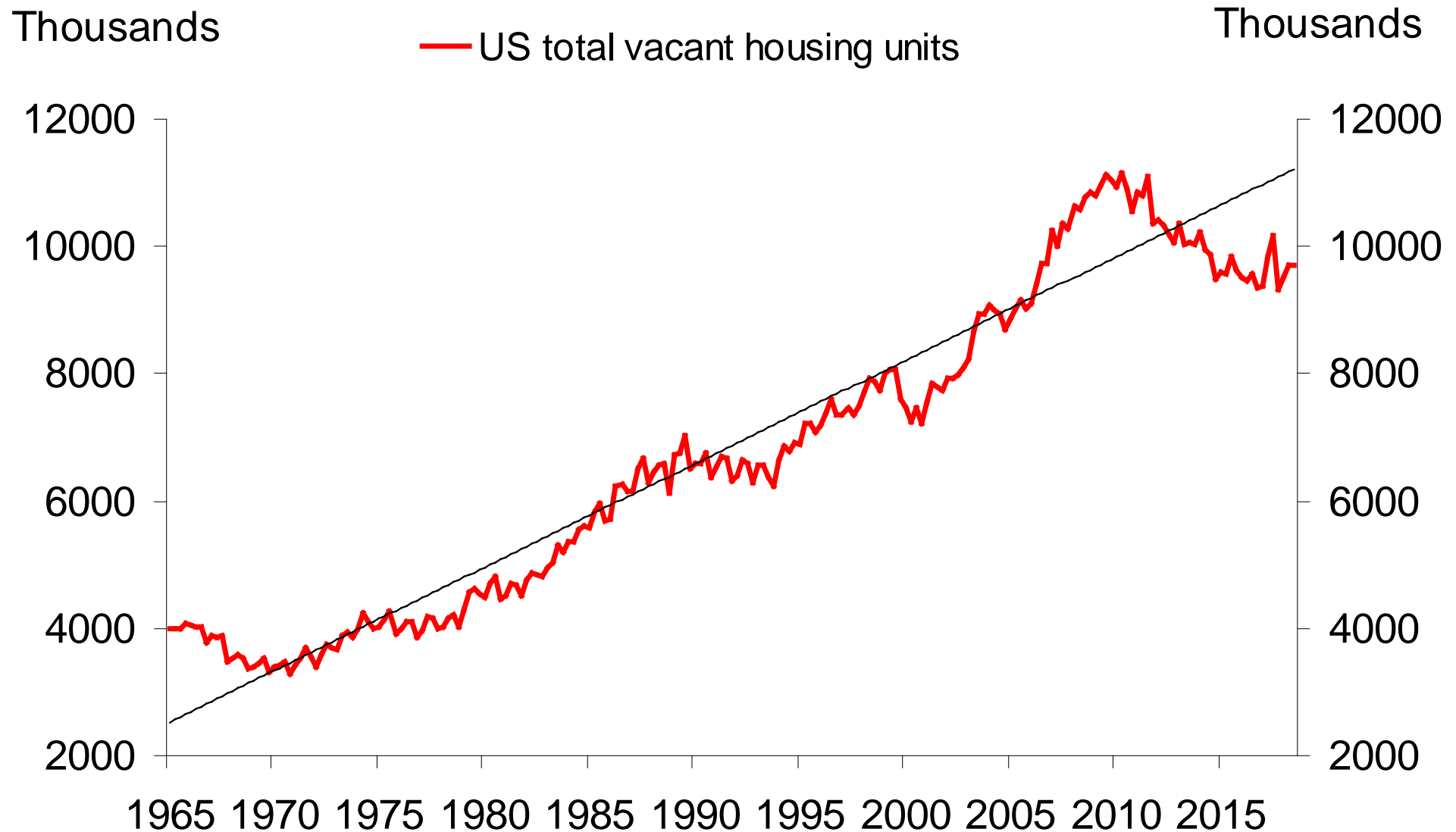
Source: Census, NAR, DB Global Research



# Housing Supply

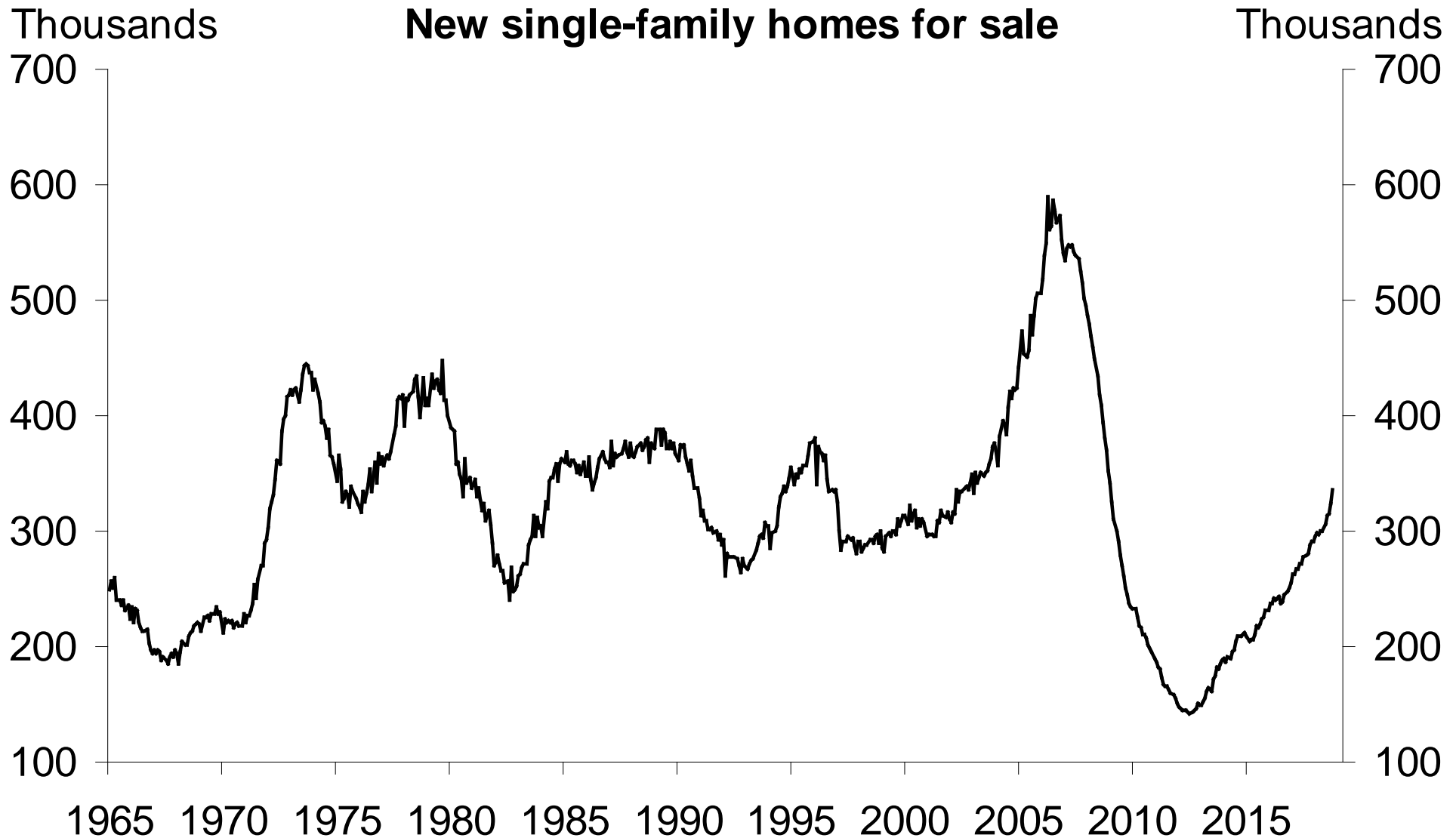


# Excess inventory below long-term trend



Source: Census, Haver Analytics, DB Global Research

# Inventory of new single-family homes for sale moving higher but half of where it was in 2006



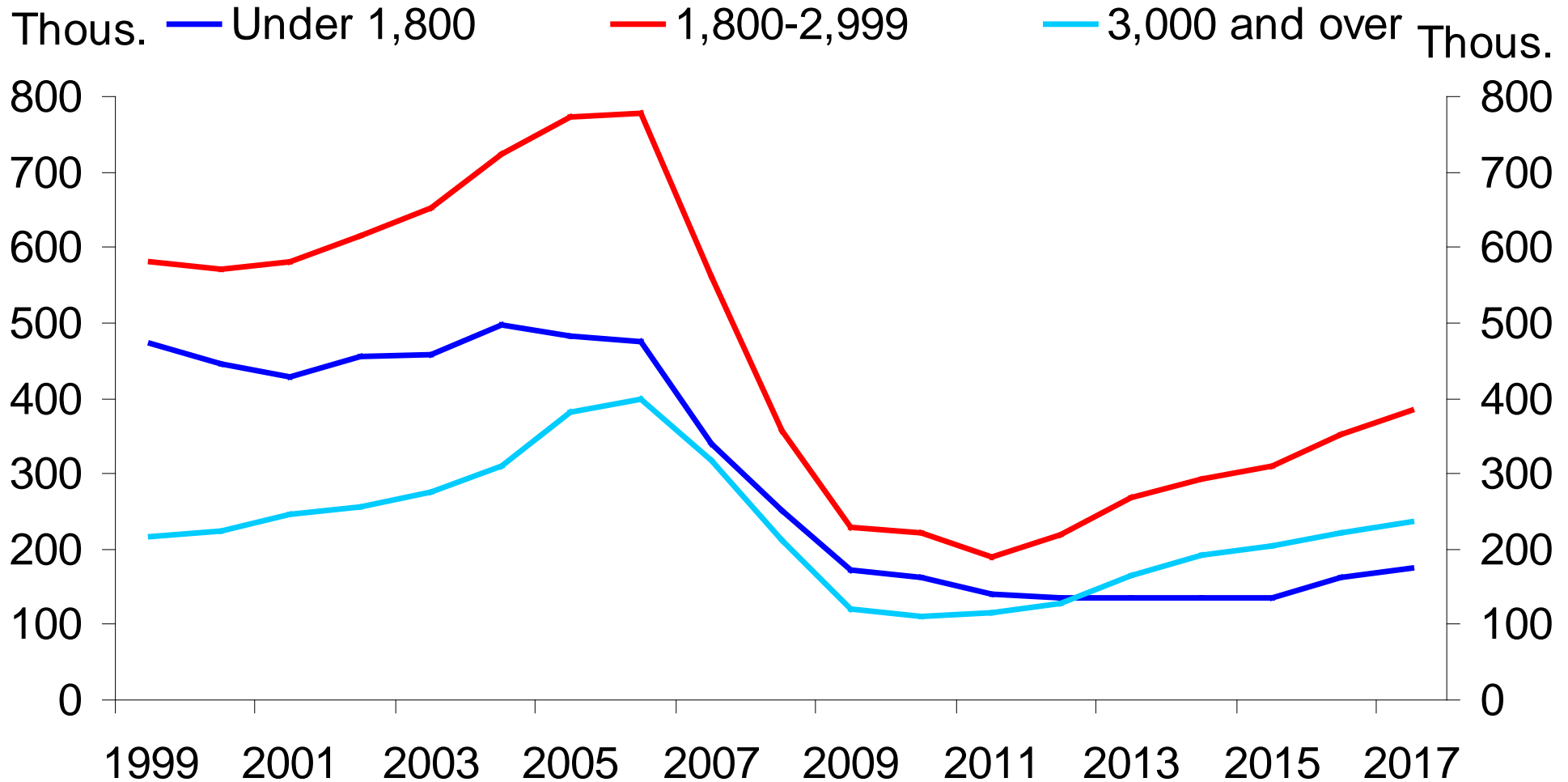
Source: Census, Haver Analytics, DB Global Research





# New homes are smaller

## New single-family houses completed by sq feet of floor area

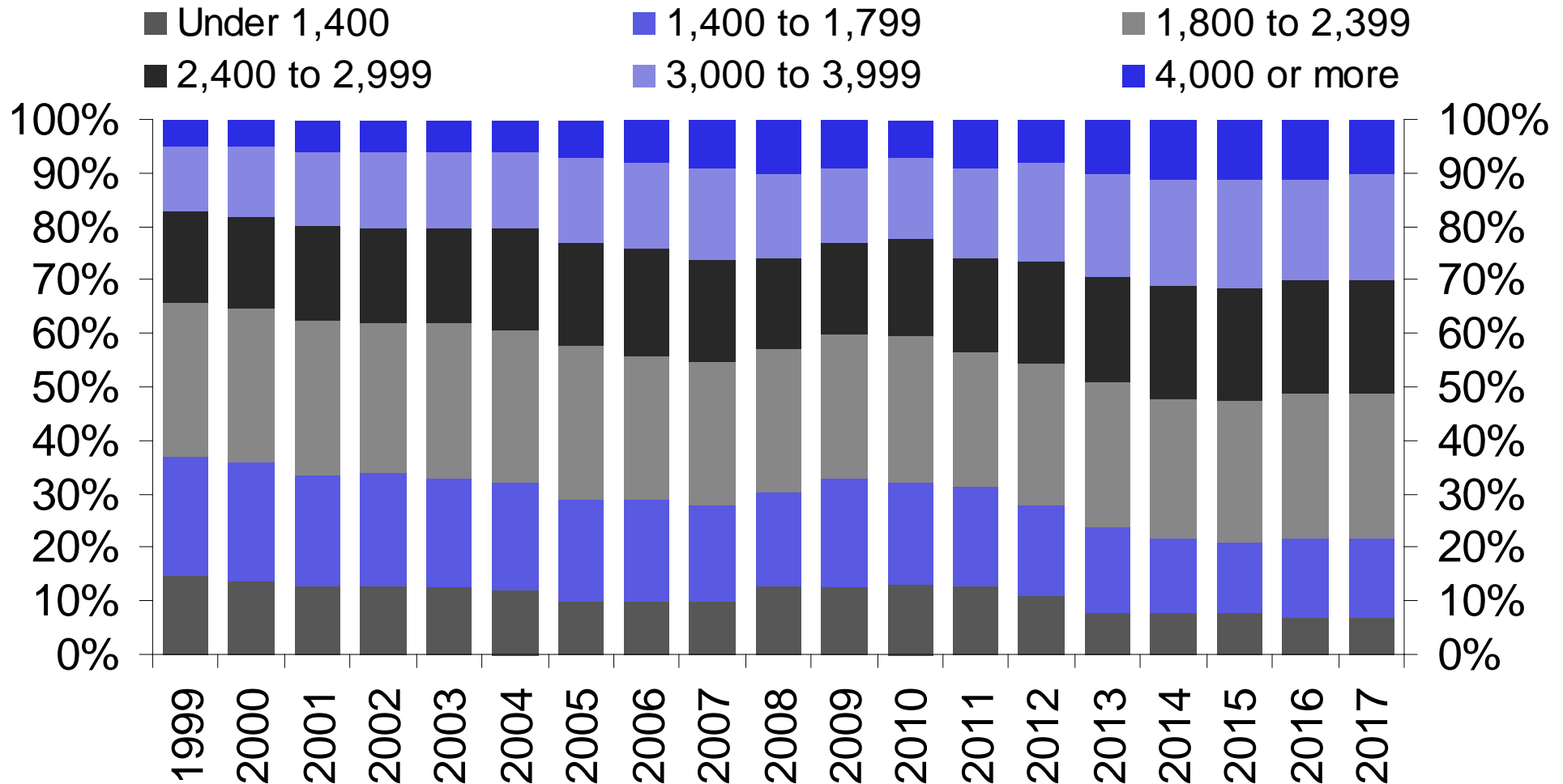


Source: Census, DB Global Research

# 30% of new homes were 3,000 square feet or bigger in 2017



## New single-family houses completed by sq. feet of floor area



Source: Census, DB Global Research



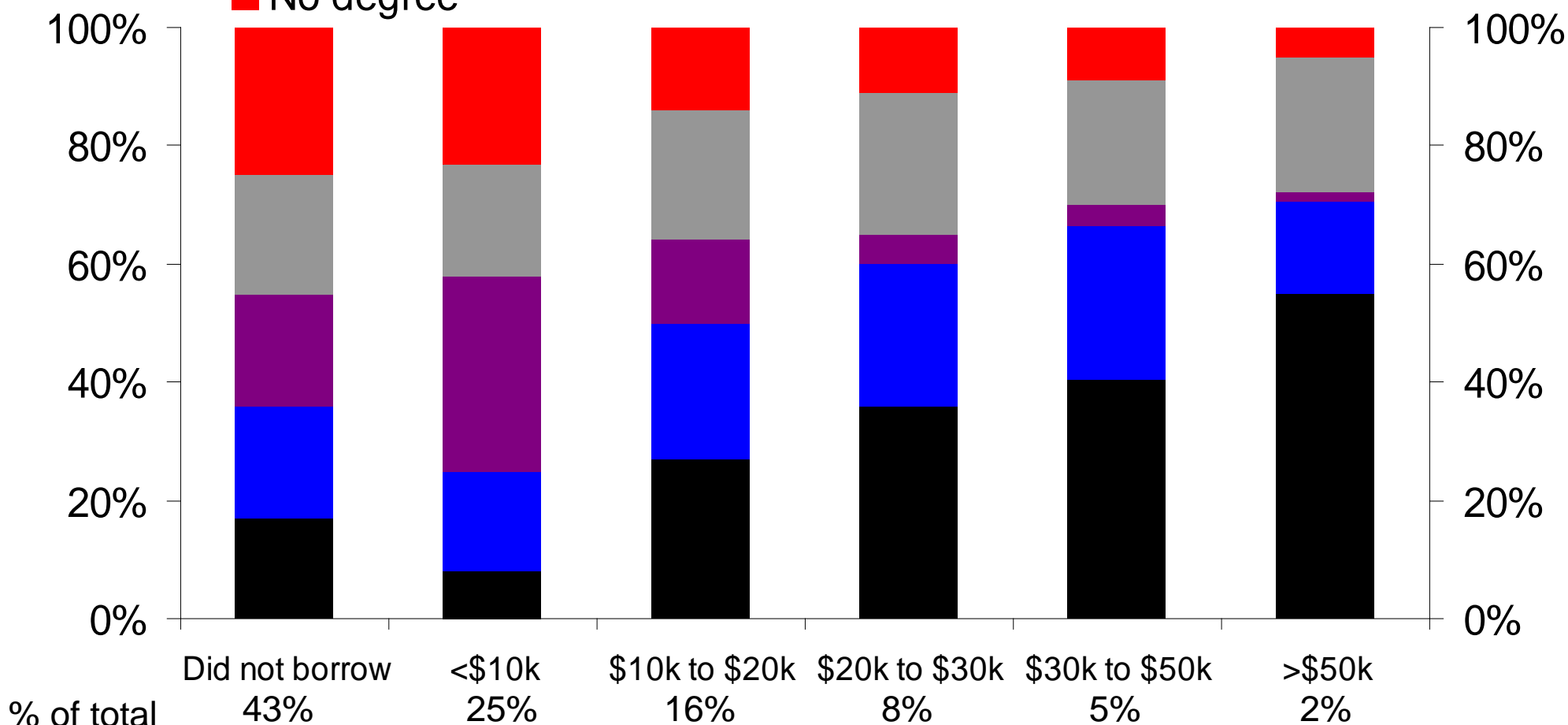
# Housing Demand

For students beginning post-secondary education in 2003-04:  
43% did not borrow and of those who did borrow 93%  
have student loan balances that are less than \$30k



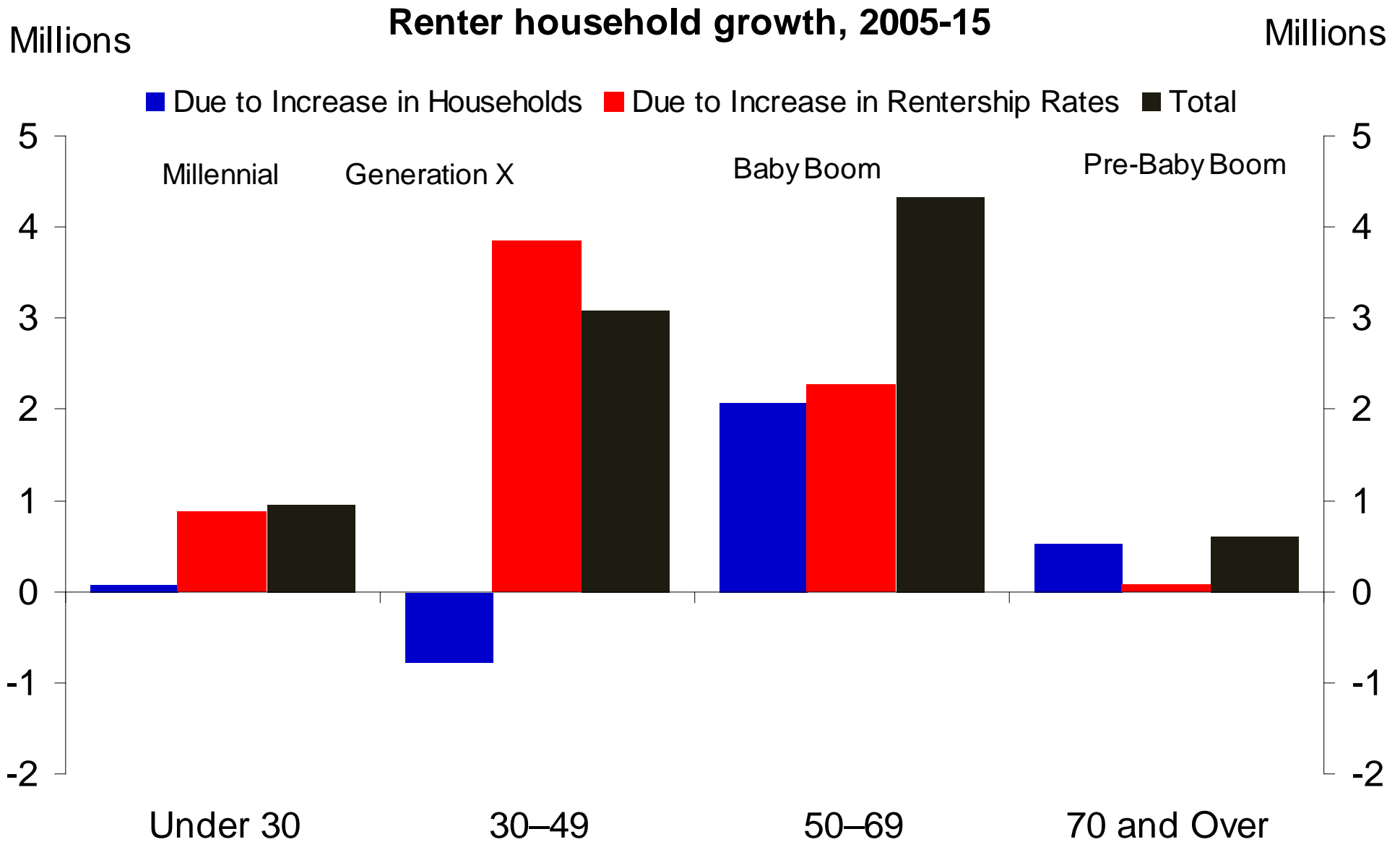
## Education attainment by student debt levels

■ Bachelor's degree  
 ■ Associate degree  
 ■ Certificate  
 ■ No degree, still enrolled  
 ■ No degree



Source: St. Louis Fed: [http://research.stlouisfed.org/publications/es/14/ES\\_14\\_2014-06-09.pdf](http://research.stlouisfed.org/publications/es/14/ES_14_2014-06-09.pdf)

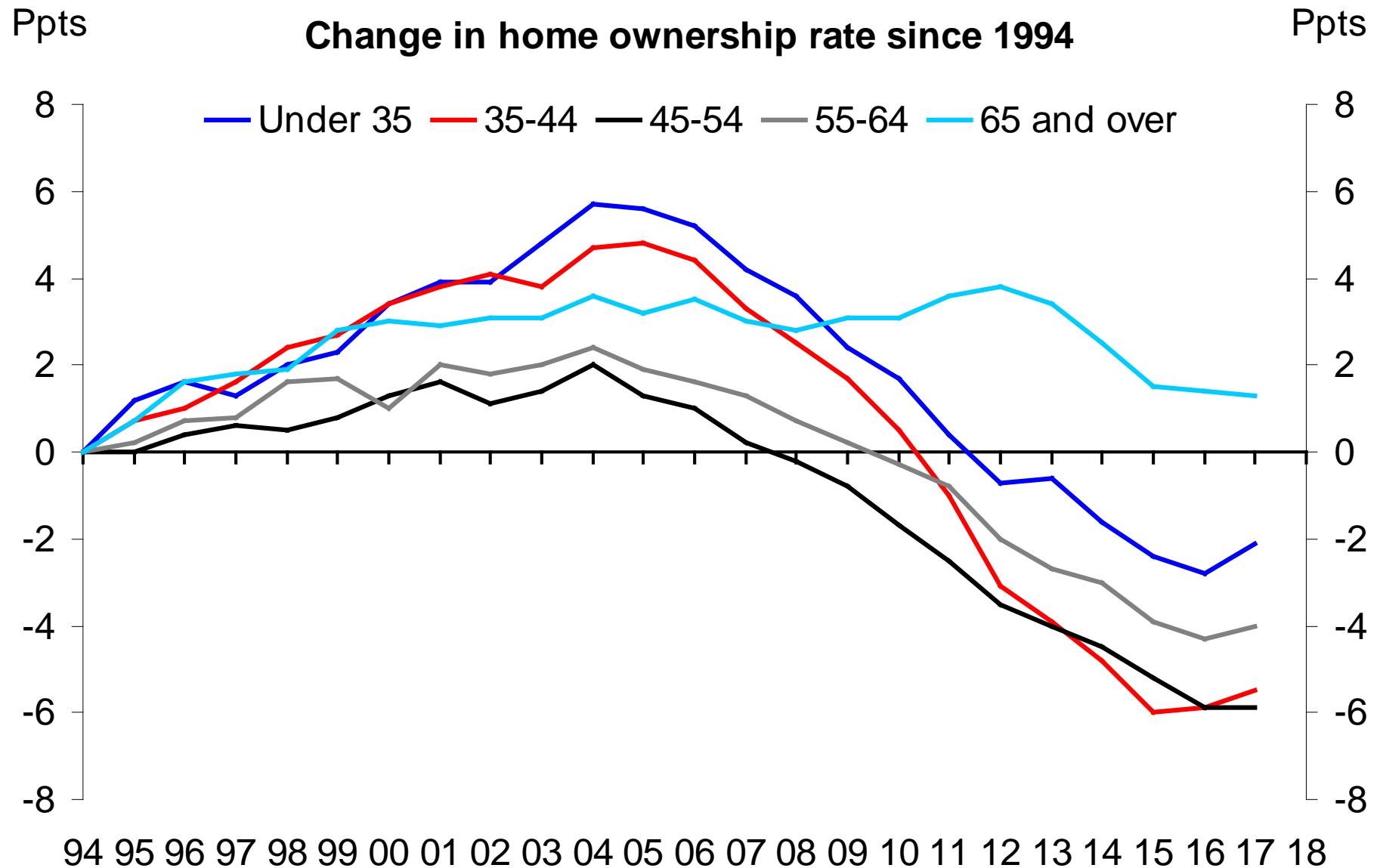
# Gen-X-ers and Baby Boomers have driven most of the recent growth in renter households



Source: JCHS tabulations of US Census Bureau, Current Population Surveys, DB Global Research



# Homeownership rate down for everyone except people who are 65 years and older



Source: JCHS tabulations of US Census Bureau, Housing Vacancy Surveys, DB Global Research

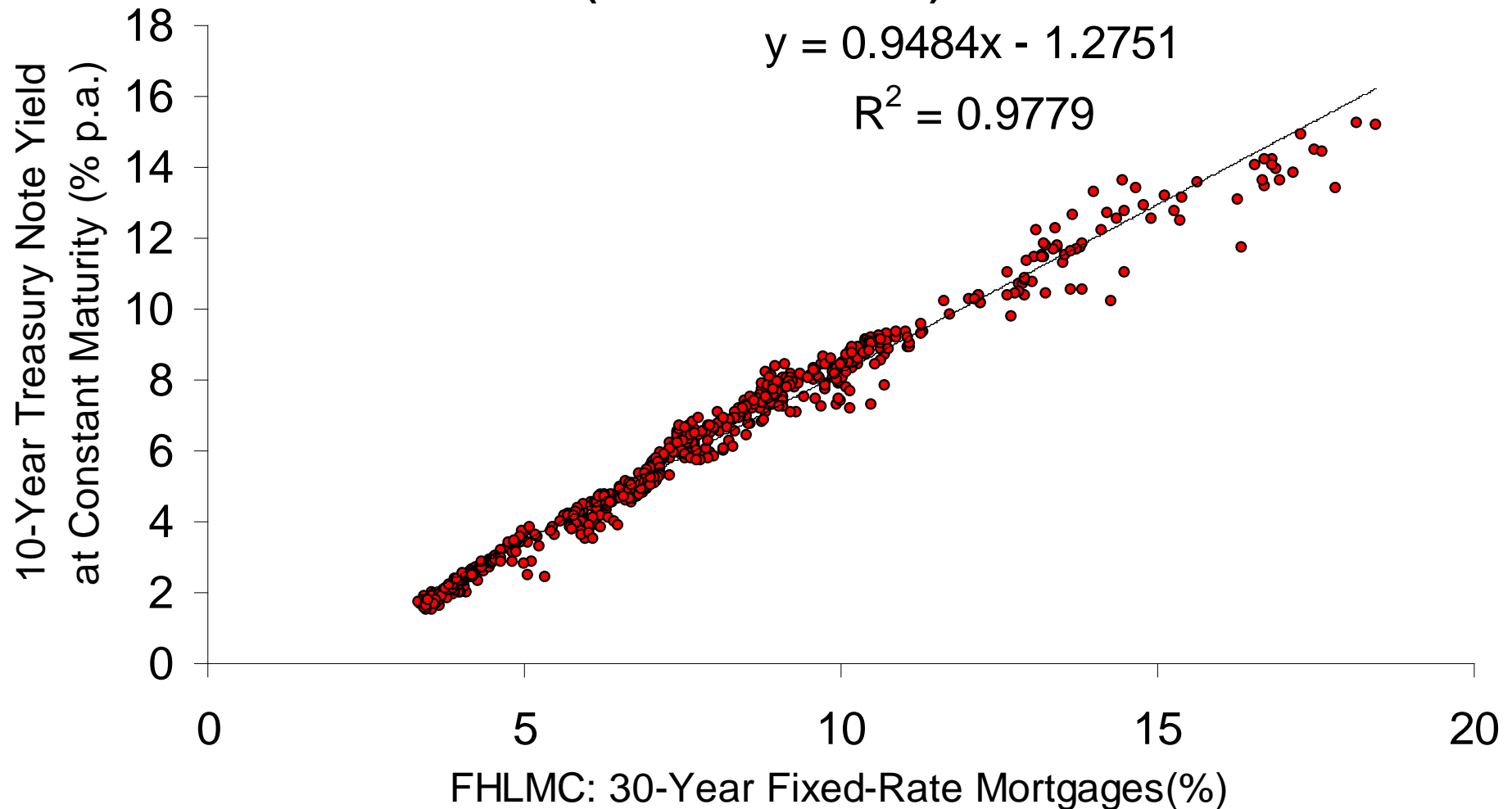


# Financing Conditions and Sales

# Mortgage rates and 10-year Treasury yields are highly correlated



10 yr treasury yield Vs 30 yr mortgage rate  
(1970 to Dec 2018)

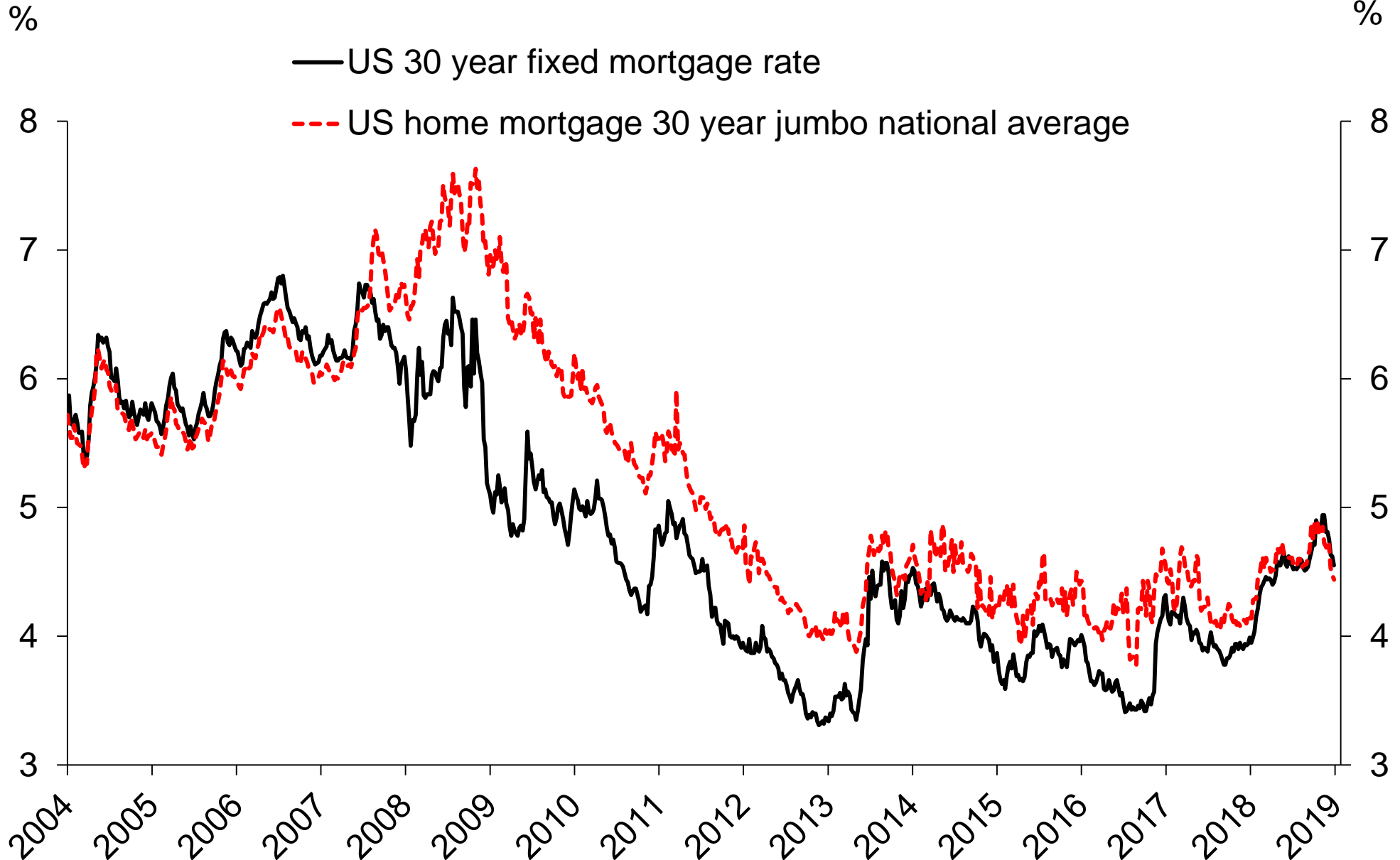


Source: FRB, FHLMC, DB Global Research





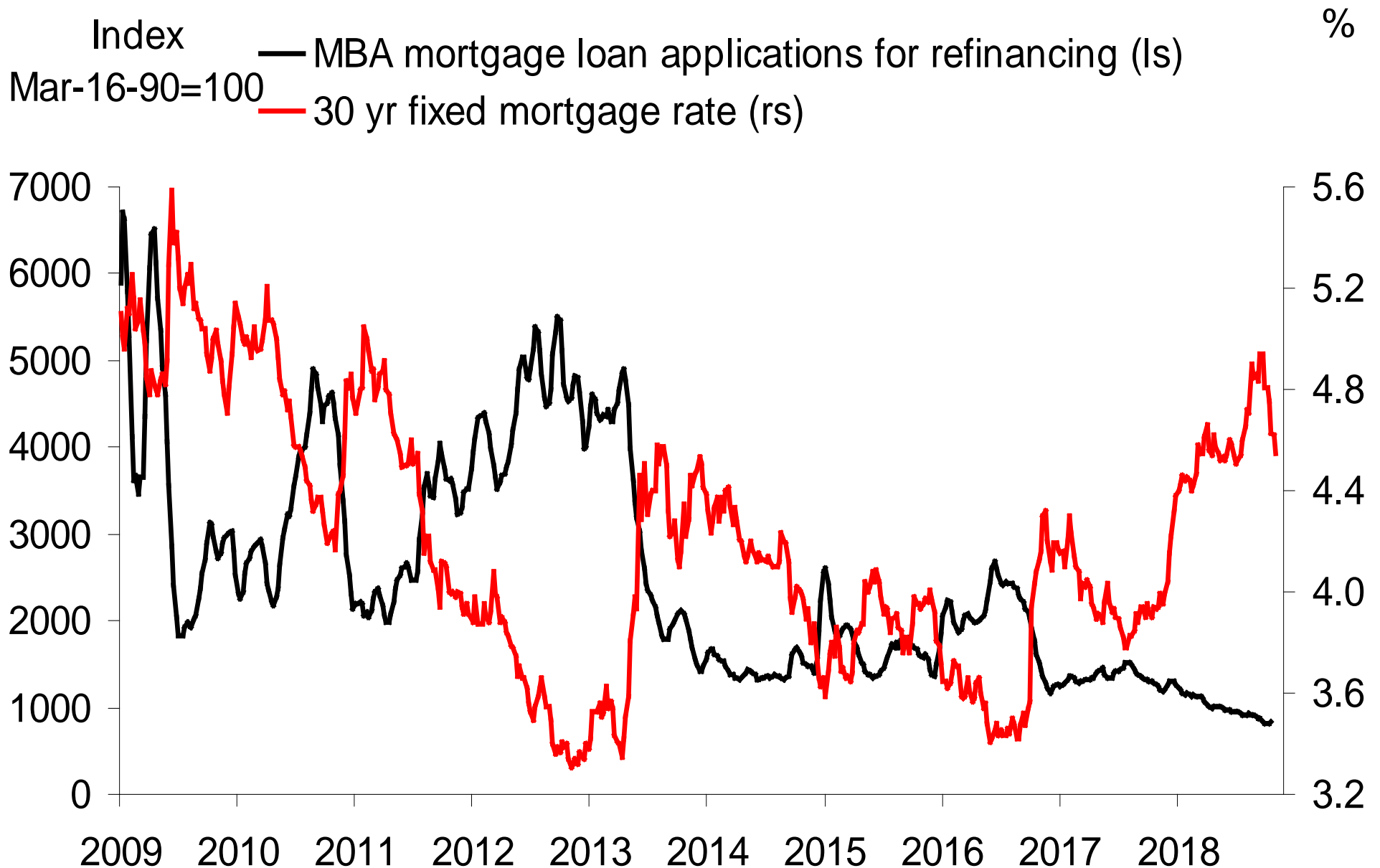
# Mortgage rates down recently



Source: FRB, Haver Analytics, Bloomberg Finance LP, DB Global Research

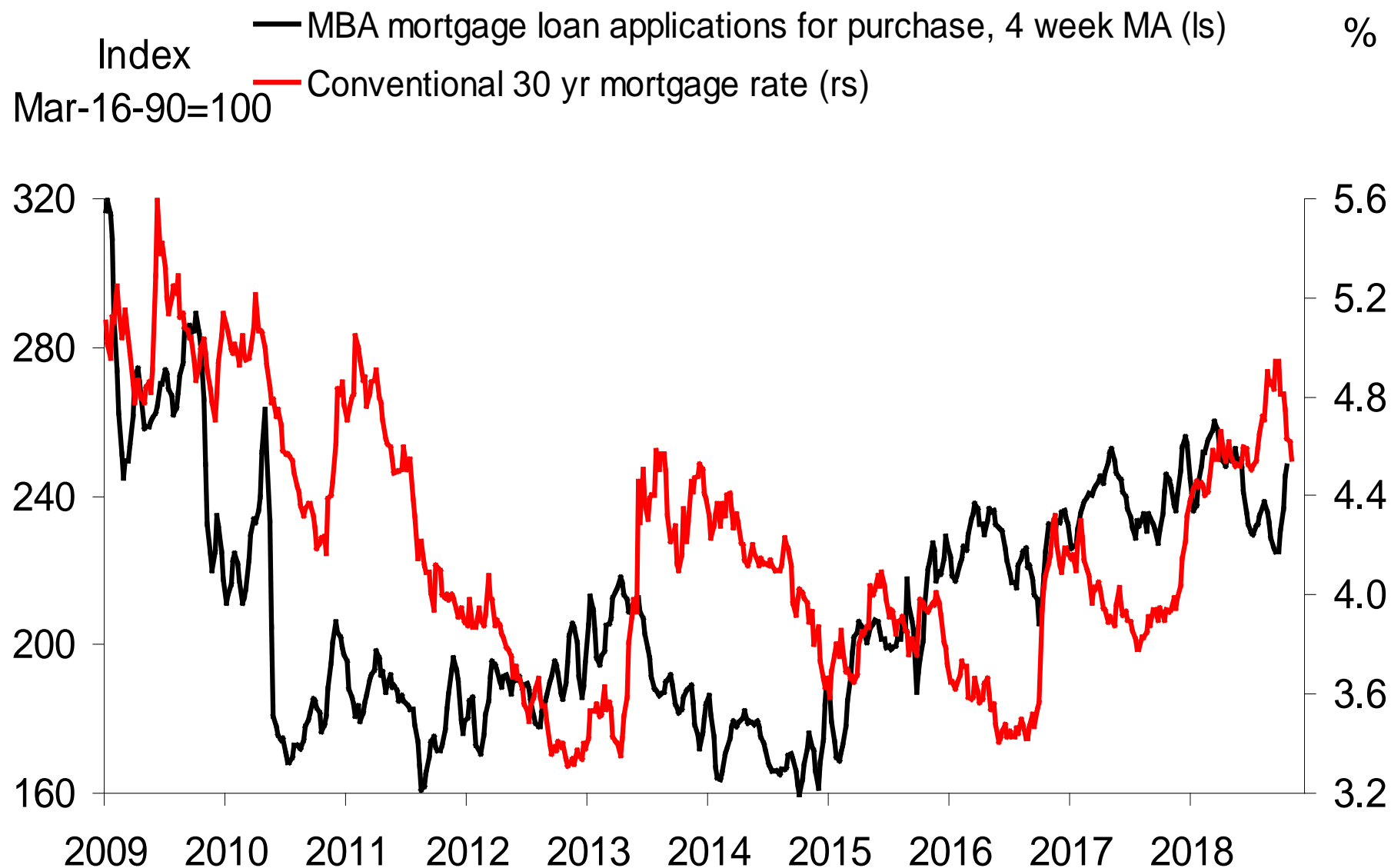


# Mortgage refi application activity at low levels



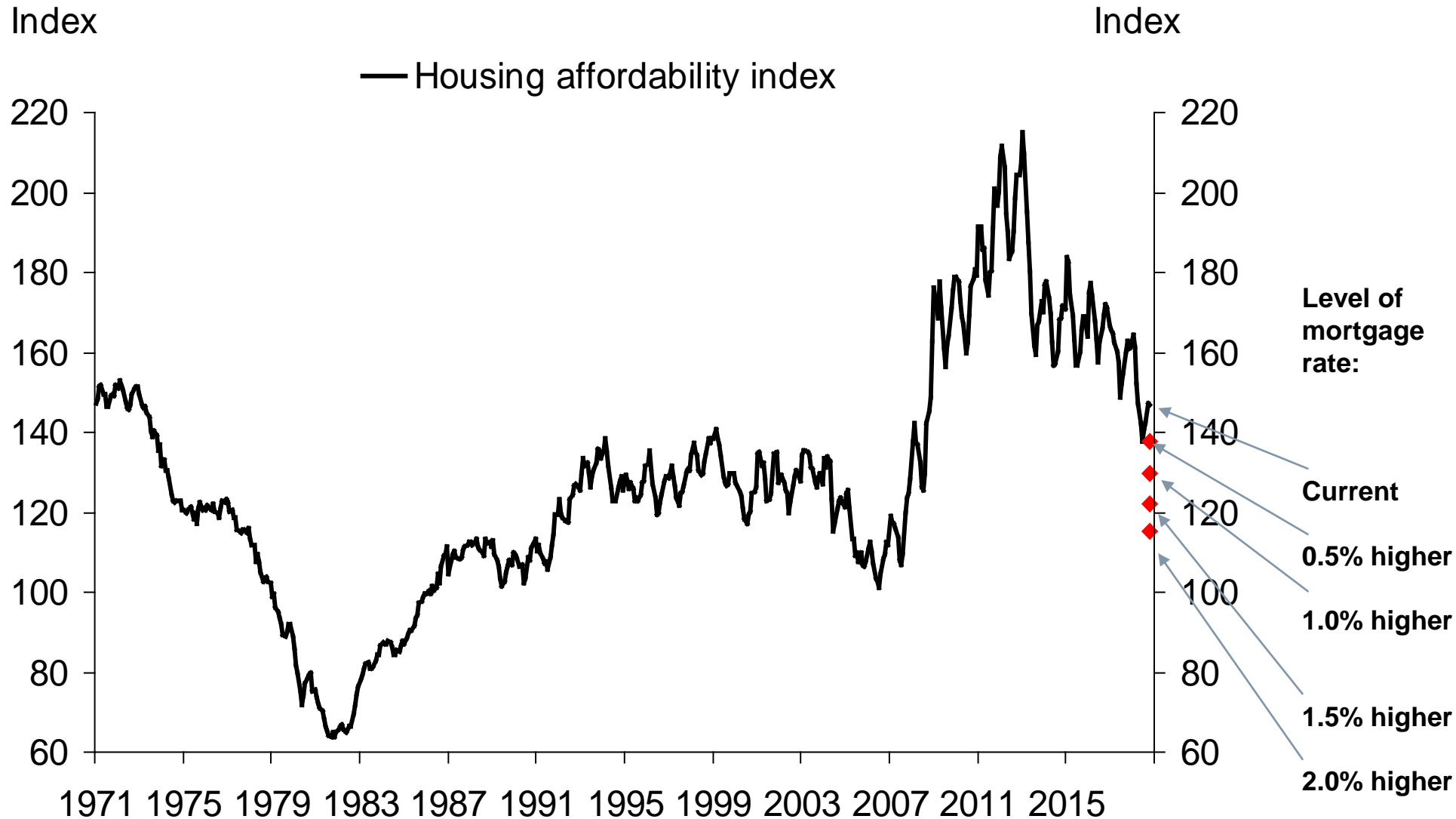
Source: FHLMC, MBA, , Haver Analytics, DB Global Research

# Purchase applications inversely related to mortgage rates



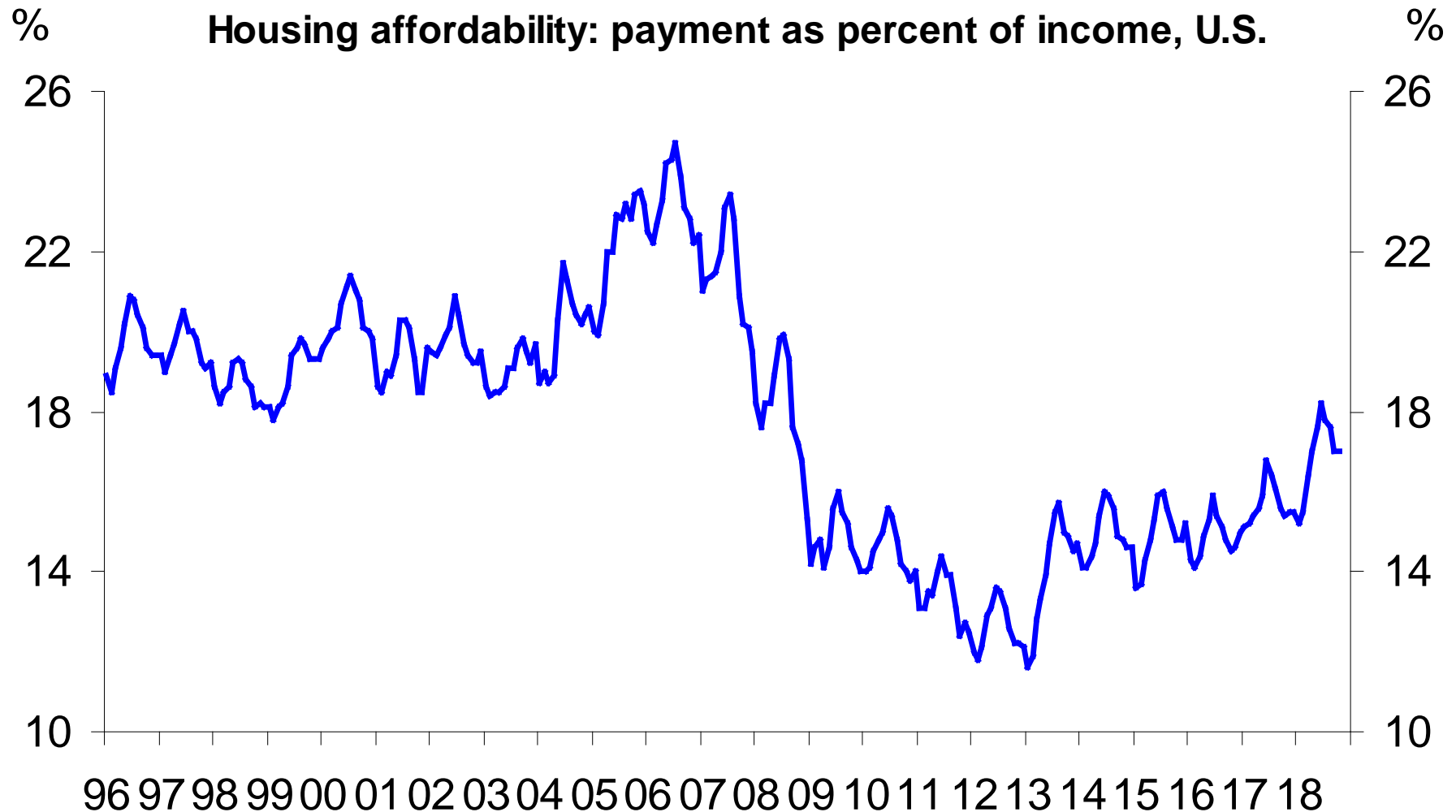
Source: FRB, MBA, Haver Analytics, DB Global Research

# Housing affordability approaching 2006 levels



Source: NAR, Haver Analytics, DB Global Research

# Mortgage payments as a percent of income trending higher



Source: NAR, Haver Analytics, DB Global Research

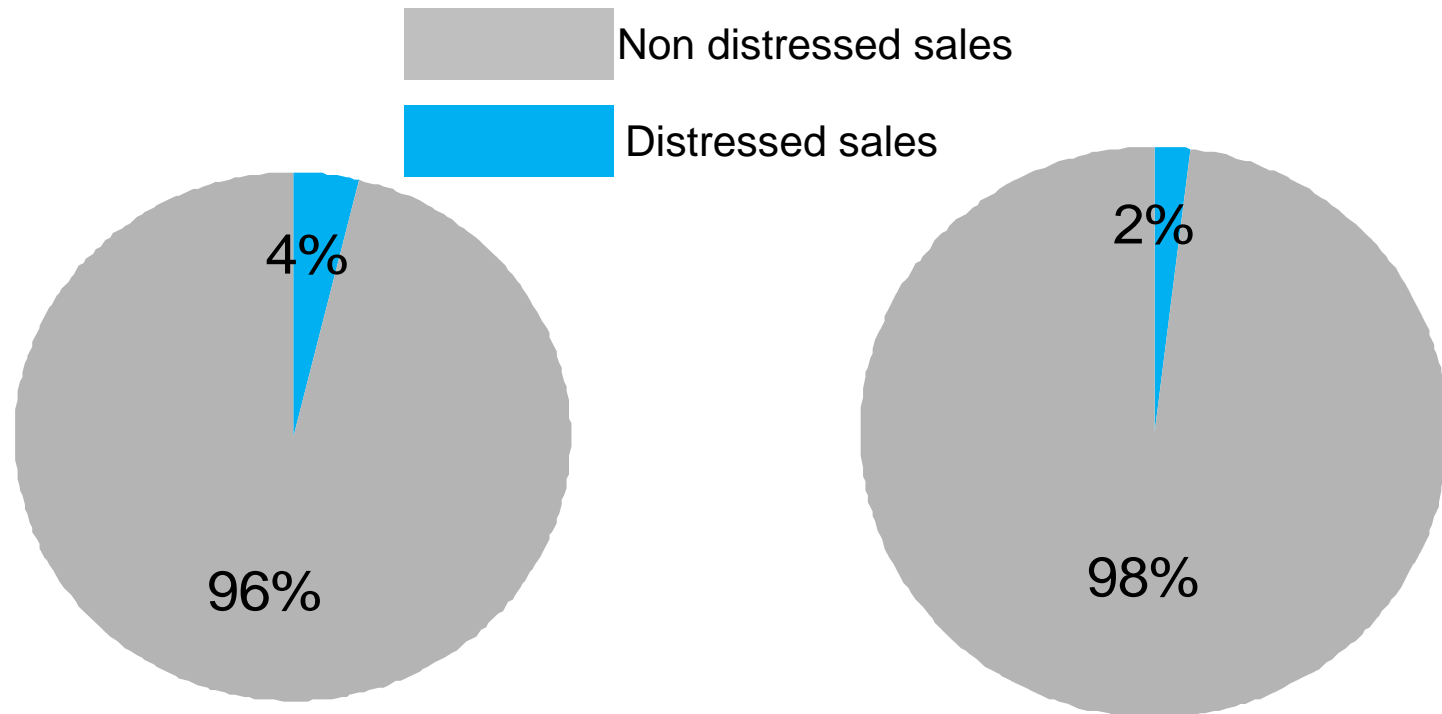
# Only 2% of existing home sales are distressed



## Distressed homes sales as % of total existing -home sales

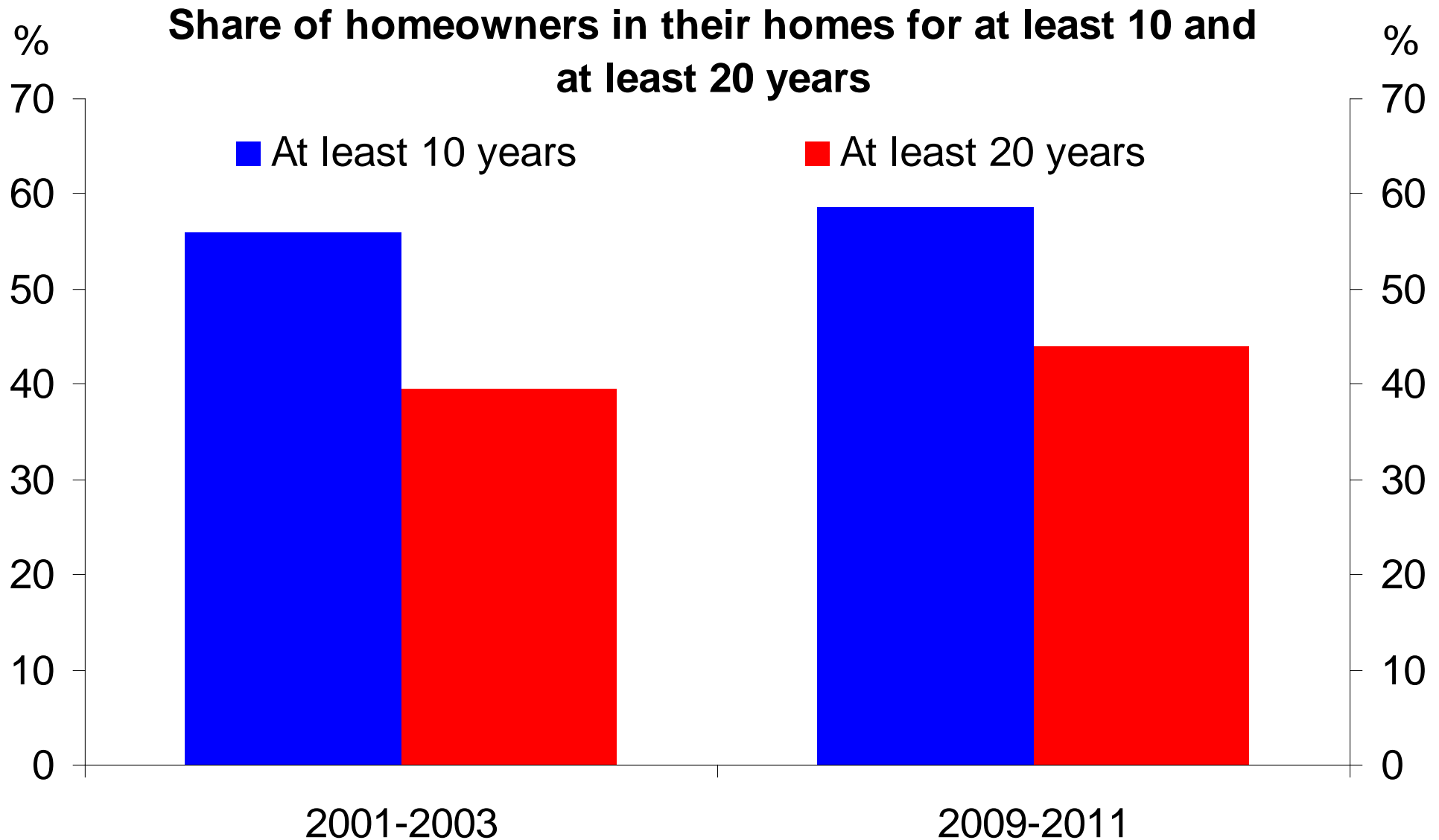
Nov 2017

Nov 2018



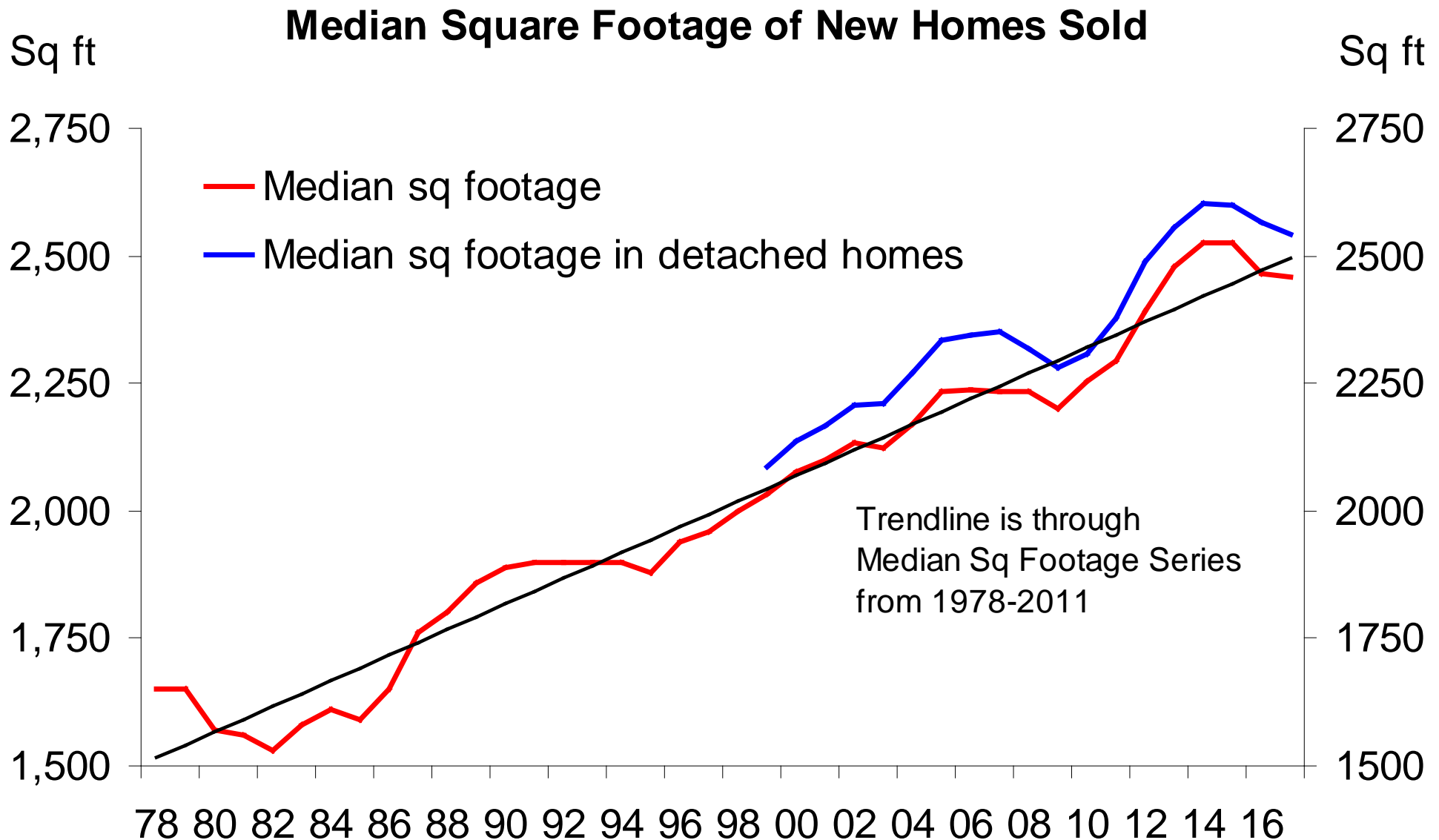
Source: NAR, Deutsche Bank Global Market Research

# About 60% of all homeowners have lived in their homes for more than 10 years



Source: US Bureau of the Census, Decennial Census (2000), American Community Survey, NAHB, DB Global Research

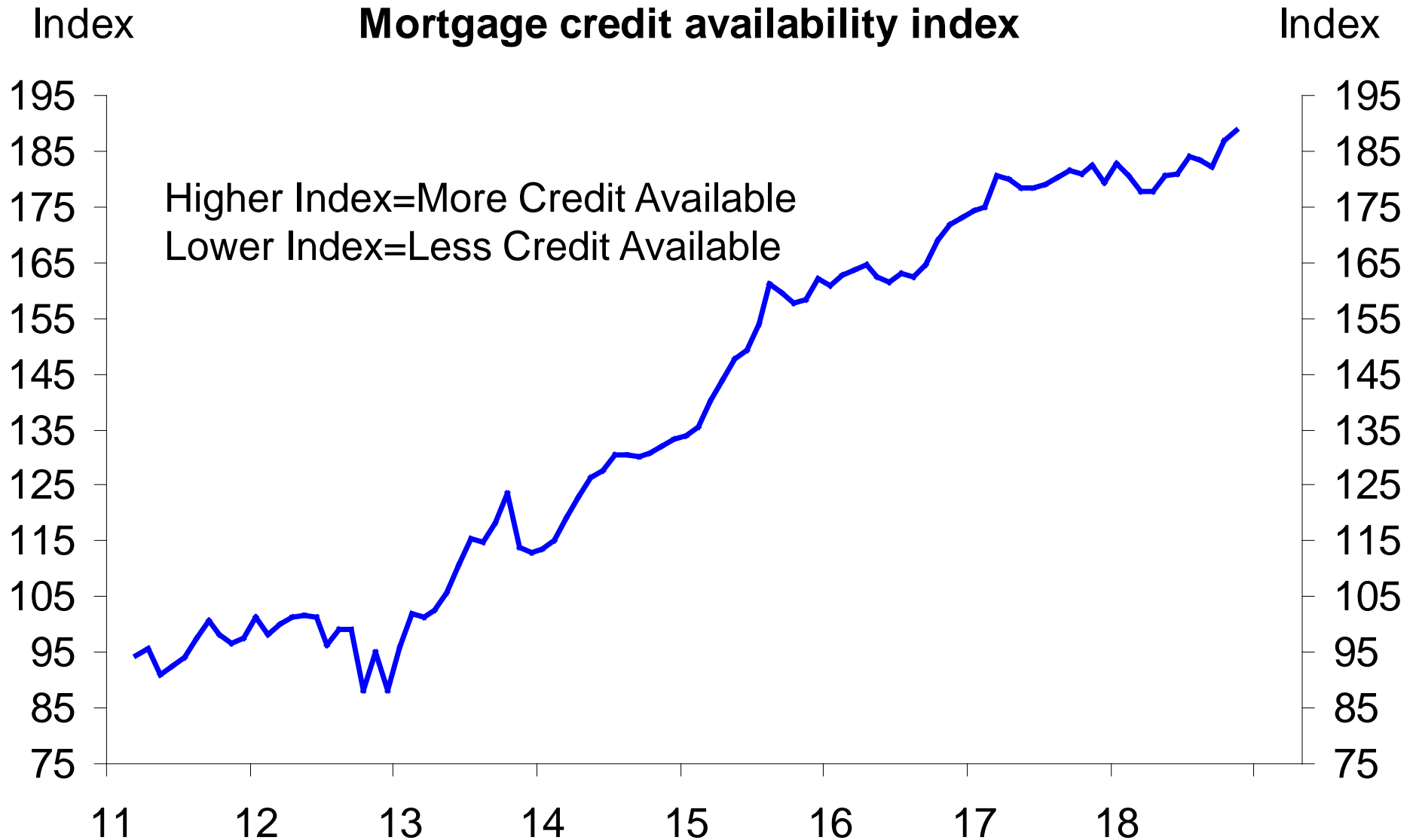
# Median square footage sold is at trend



Source: US Bureau of the Census, DB Global Research



# Credit availability steadily improving



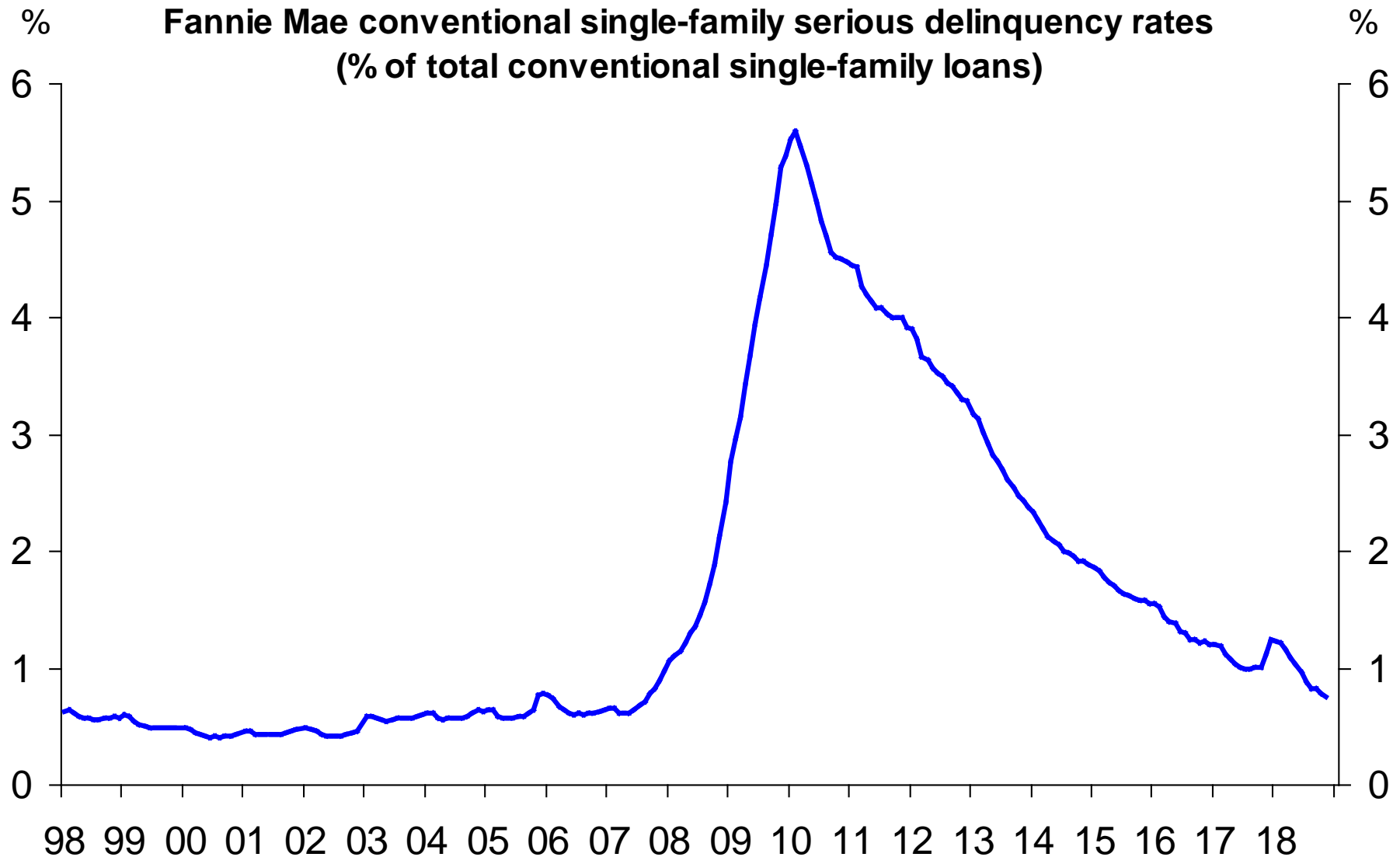
Source: MBA, Haver Analytics, DB Global Research



# Foreclosures and Delinquencies

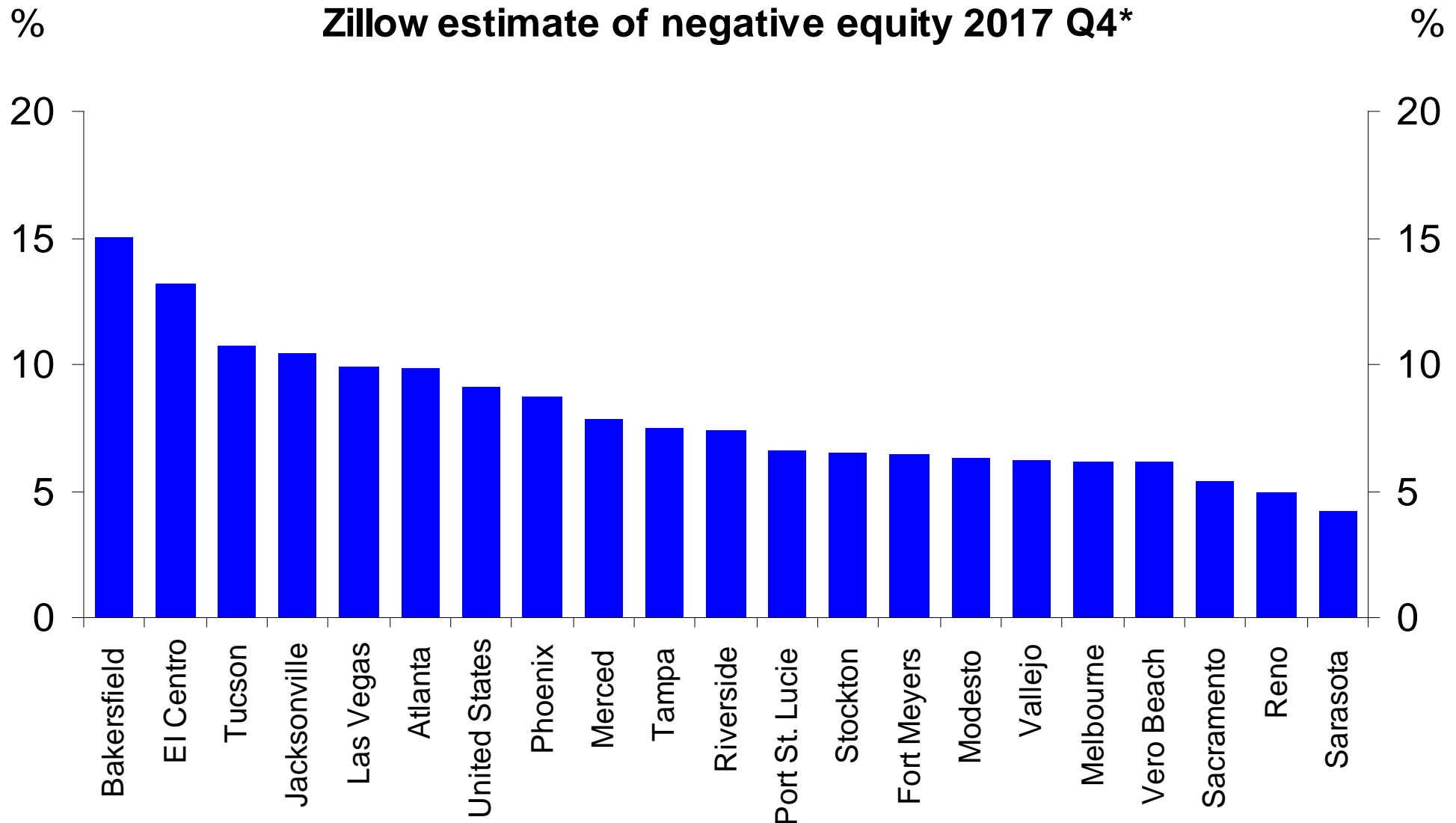


# Single-family delinquency rates at 2006 levels



Source: Fannie Mae, Haver Analytics, DB Global Research

# Negative equity declining across the country



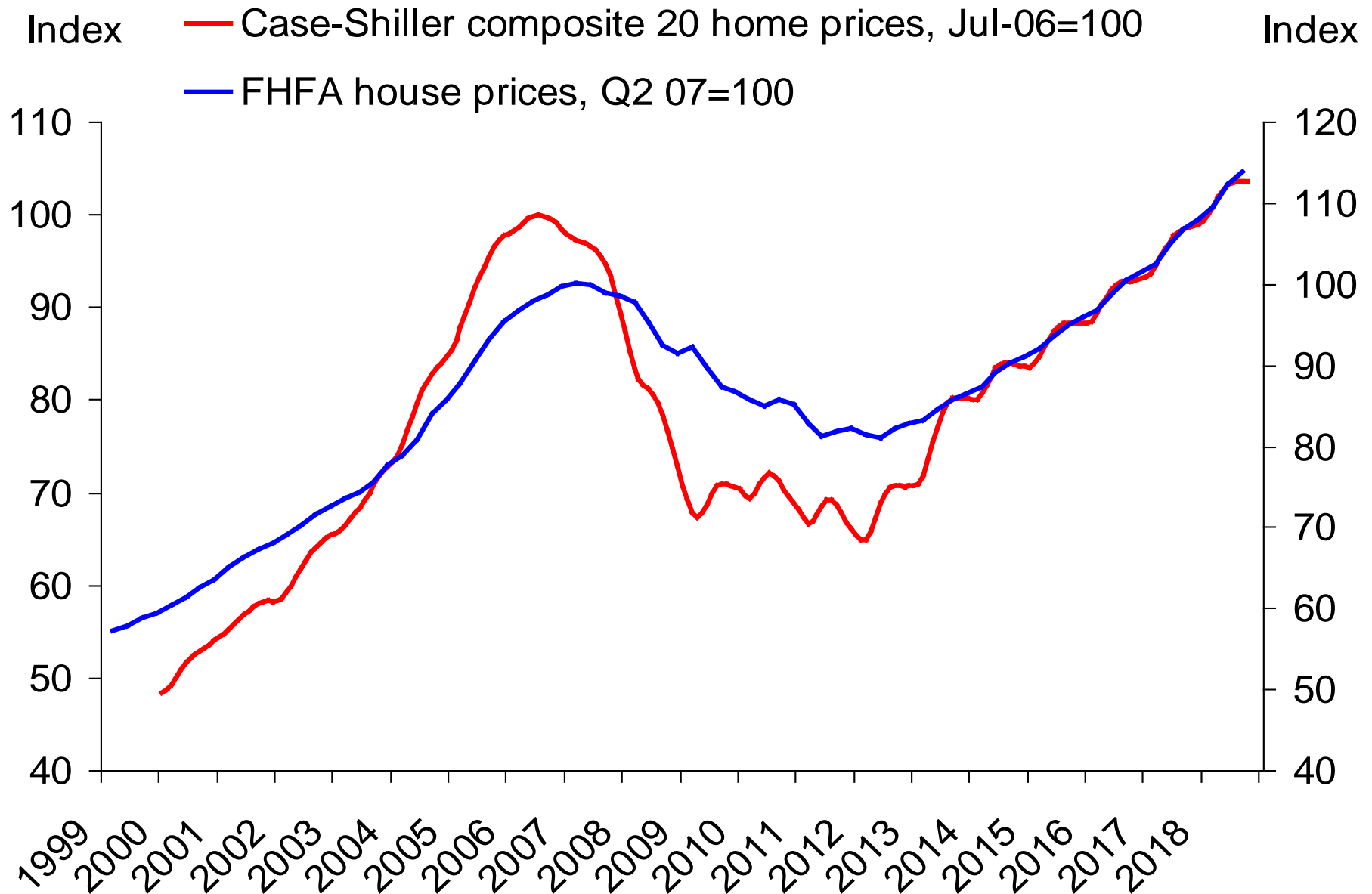
\*single- family homeowners with a mortgage

Source: Zillow, Haver Analytics, DB Global Research



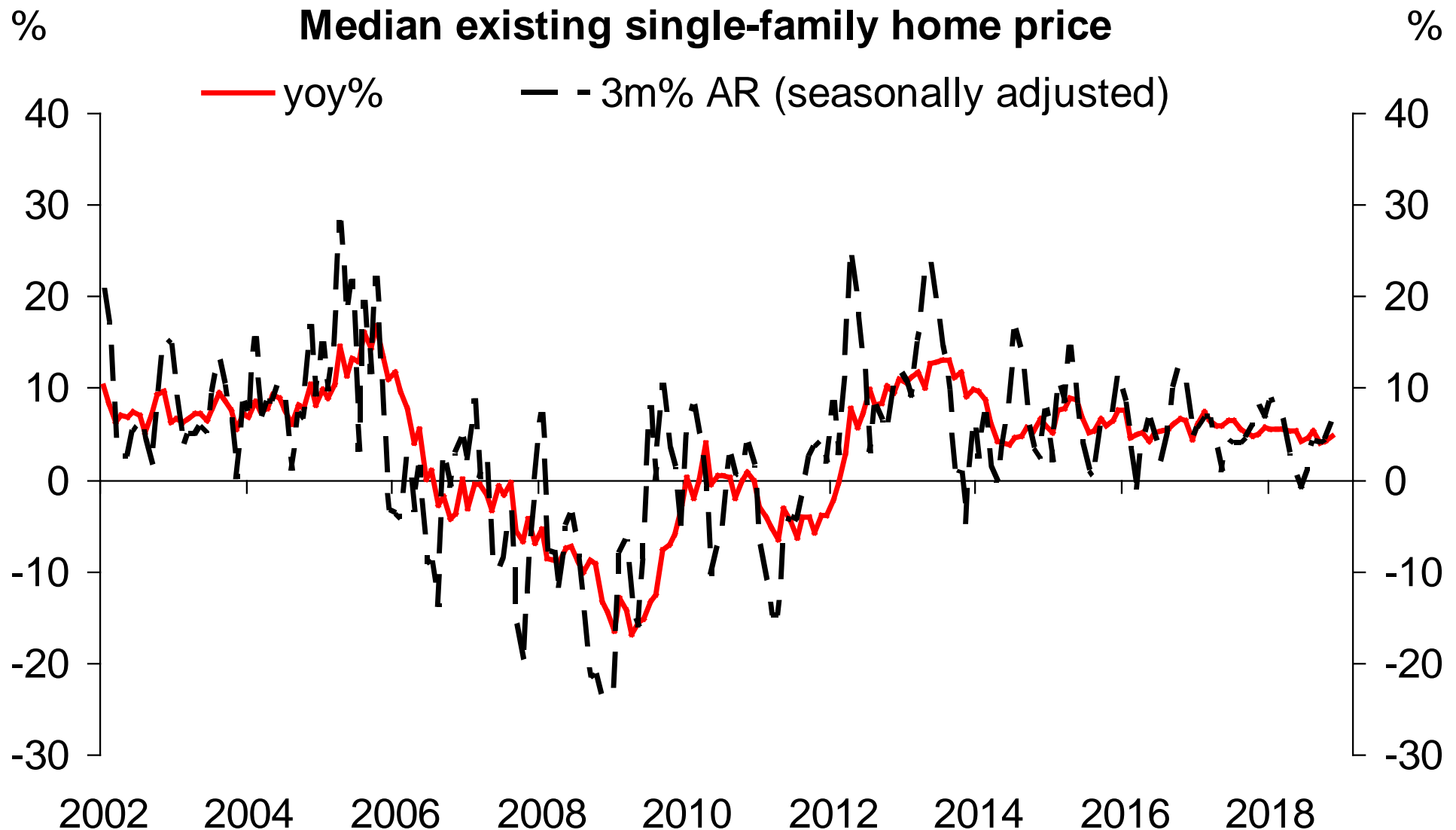
# House Prices

# The level of home prices now above the 2006/2007 peak



Source: FHFA, S&P, Haver Analytics, DB Global Research

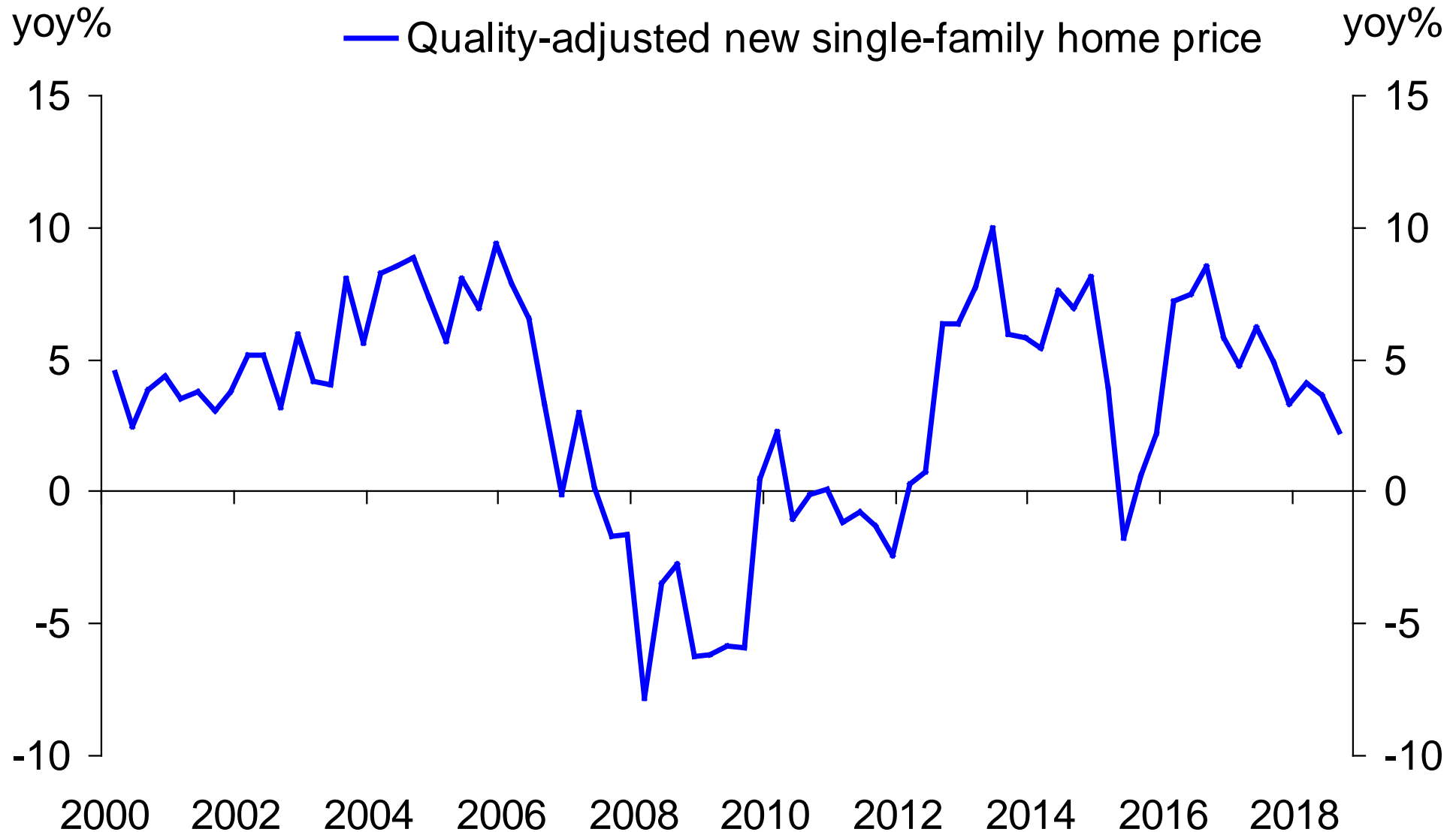
# Median existing home price inflation positive



Source: NAR, Haver Analytics, DB Global Research



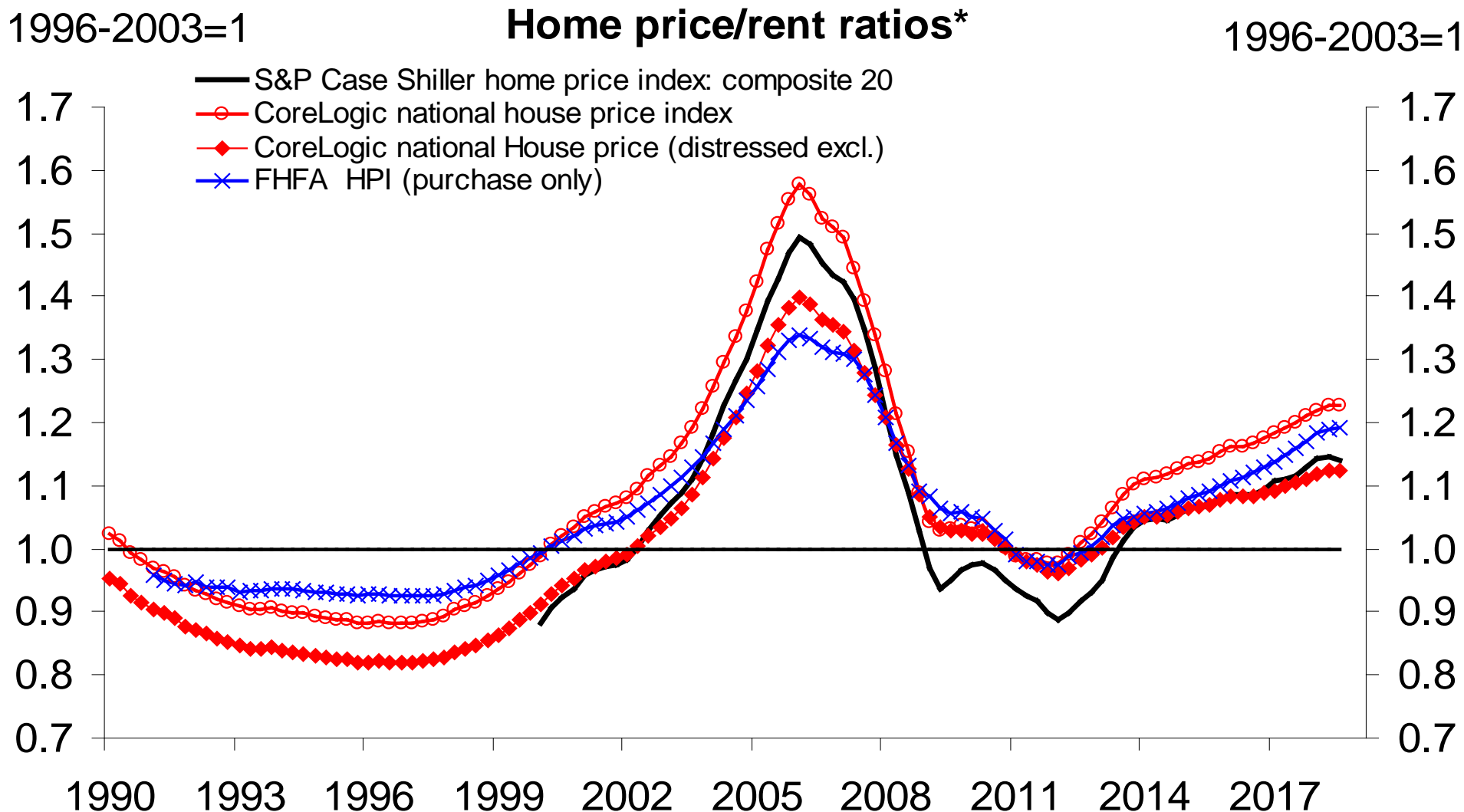
# Quality-adjusted new home price inflation coming down



Source: Census, Haver Analytics, DB Global Research



# Price to rent ratios moving higher

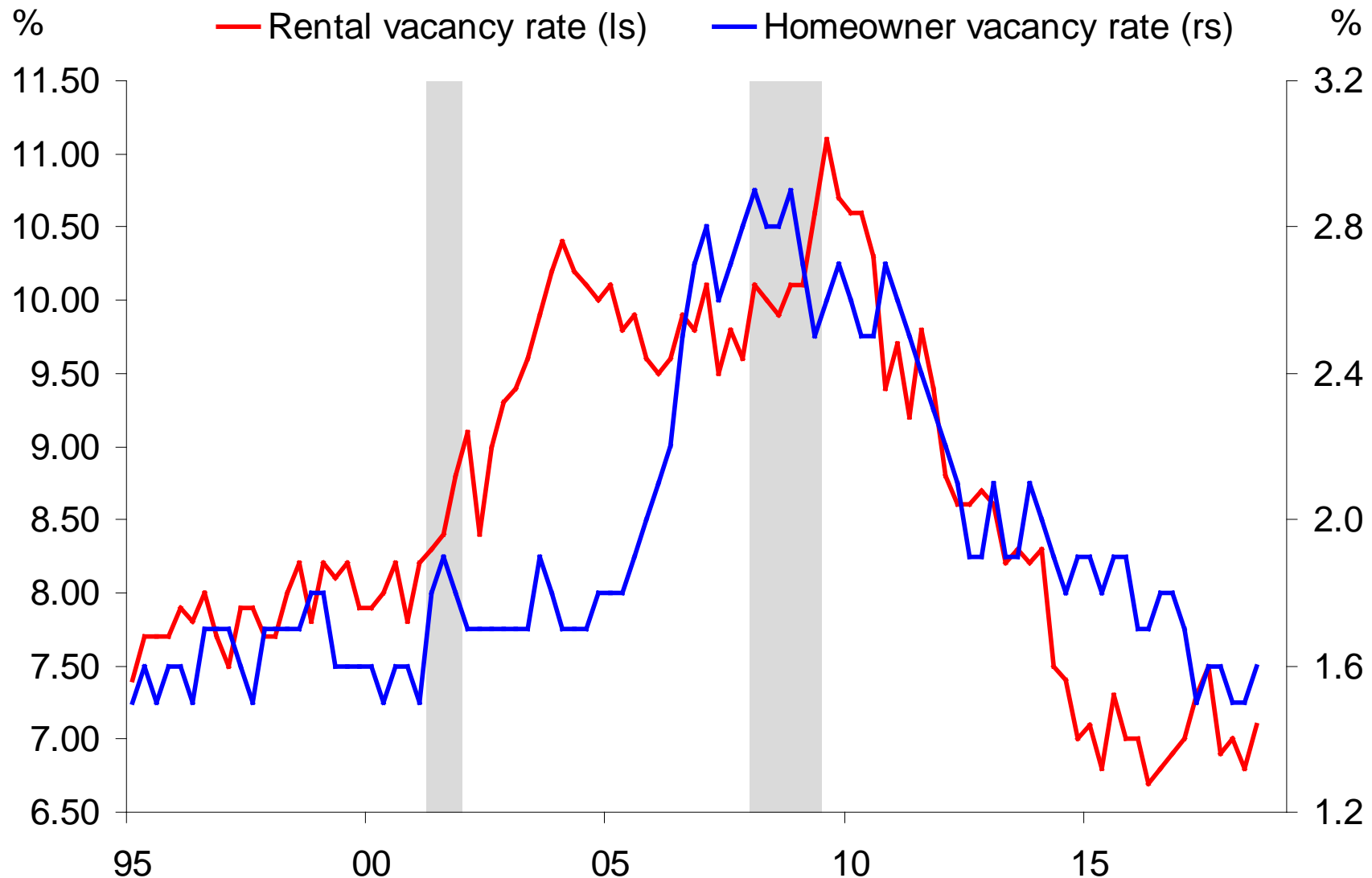


\*Uses owners' equivalent rent of residence from CPI

Source: S&P, CoreLogic, FHFA, Haver Analytics, Deutsche Bank Global Market Research



## Vacancy rates low for both renters and homeowners



*Note: A housing unit is vacant if no one is living in it at the time of the interview, unless its occupants are only temporarily absent. In addition, a vacant unit may be one which is entirely occupied by persons who have a usual residence elsewhere.*

Source: Census, Haver Analytics, DB Global Research



# Regional Developments

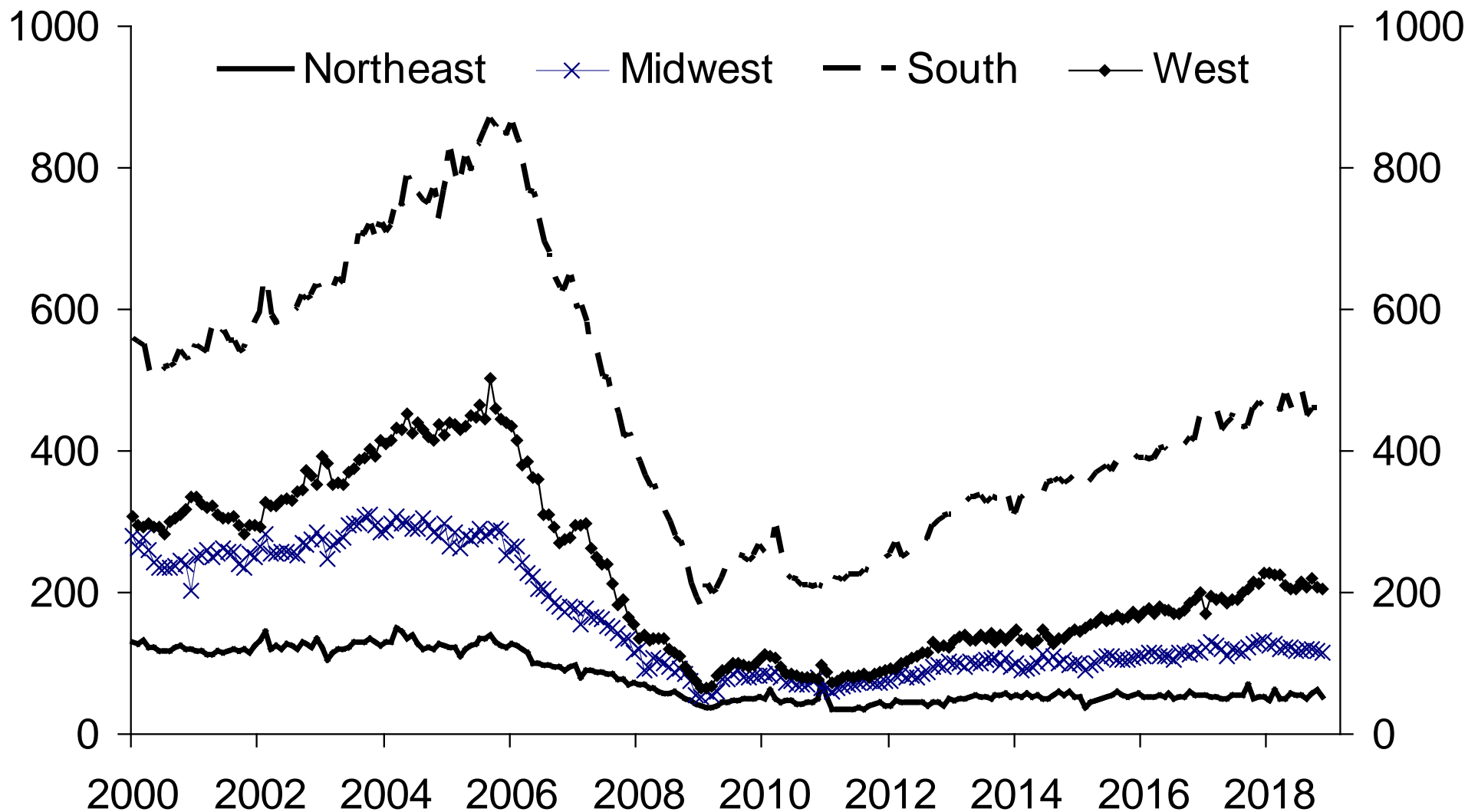
# Permits moving sideways



Thousands

## Single-family building permits

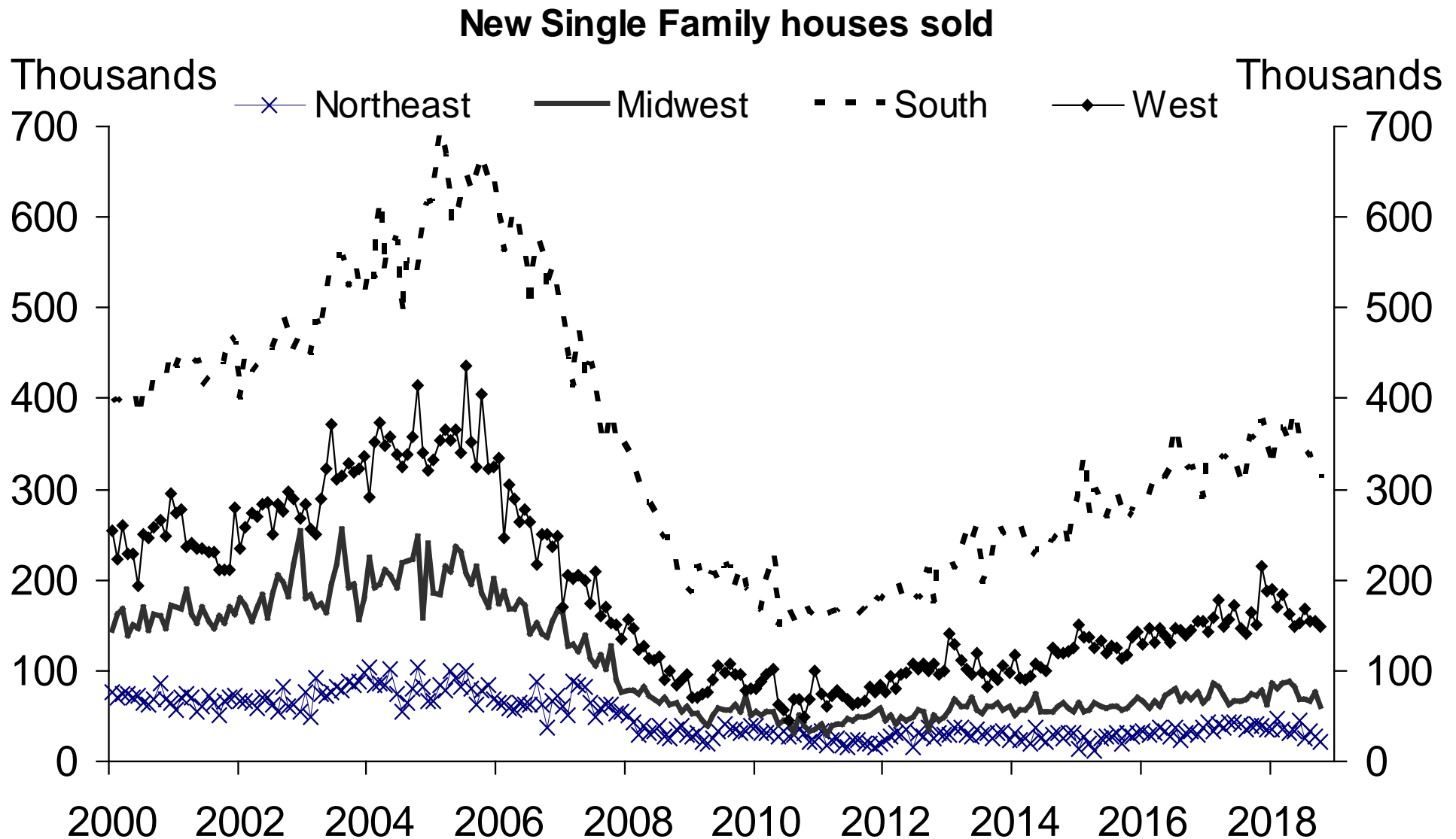
Thousands



Source: Census, Haver Analytics, DB Global Research



# New single-family home sales down across regions



Source: Census, Haver Analytics, DB Global Research

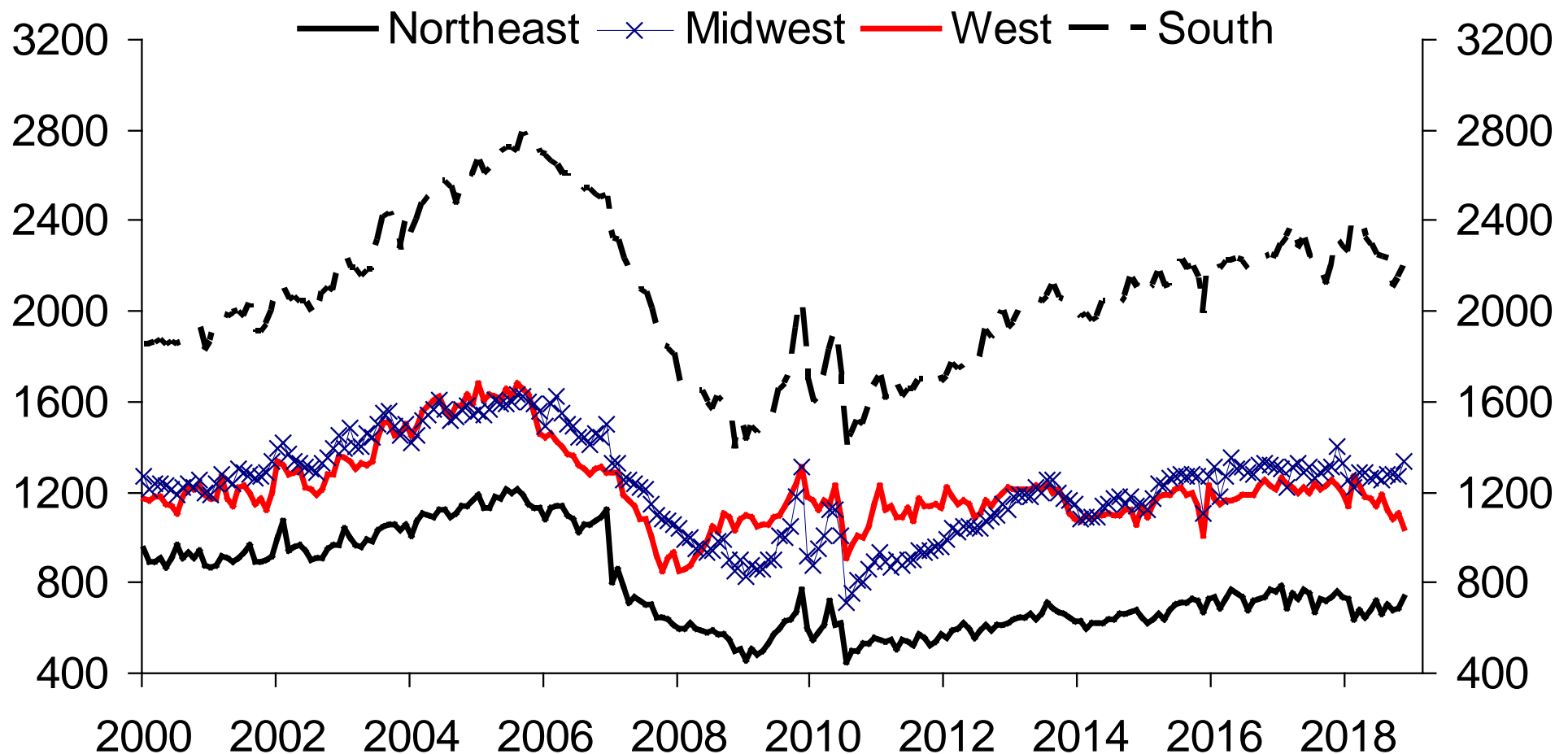


# Existing home sales sideways

Thousands

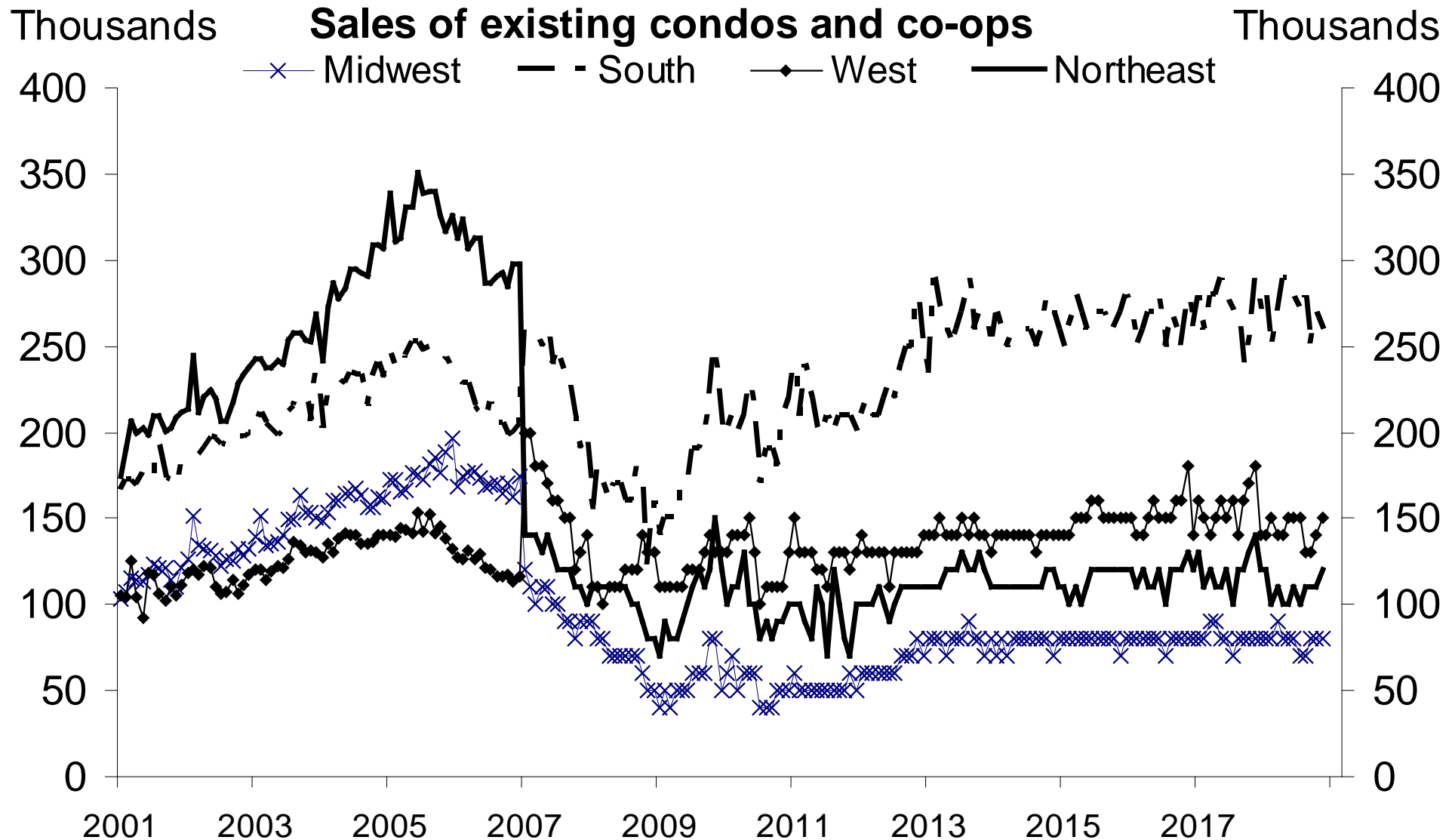
## Existing single-family home sales

Thousands



Source: NAR, Haver Analytics , DB Global Research

## ...and condo and co-op sales moving sideways



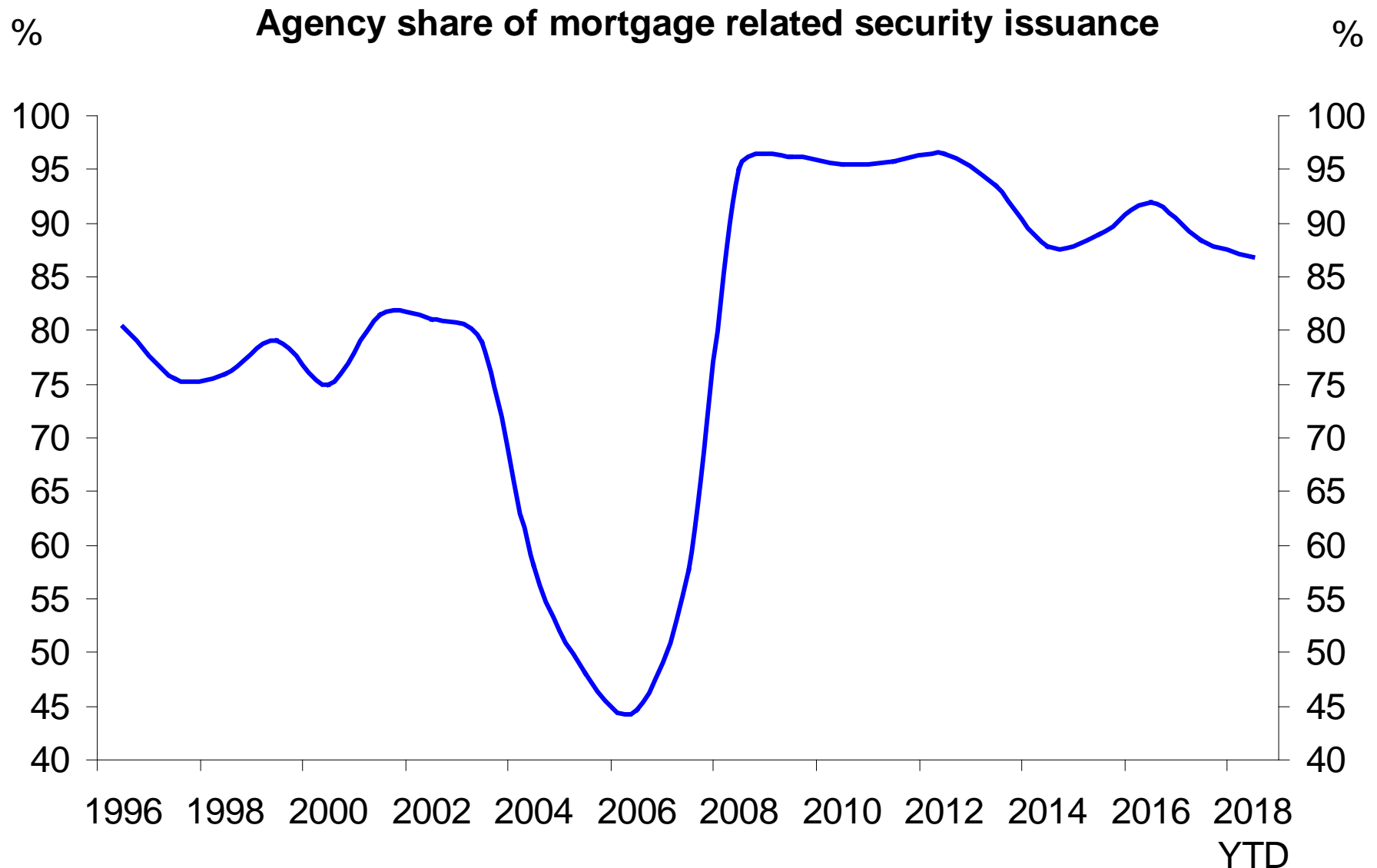
Source: NAR, Thomson Reuters Datastream, DB Global Research



# Mortgage Market

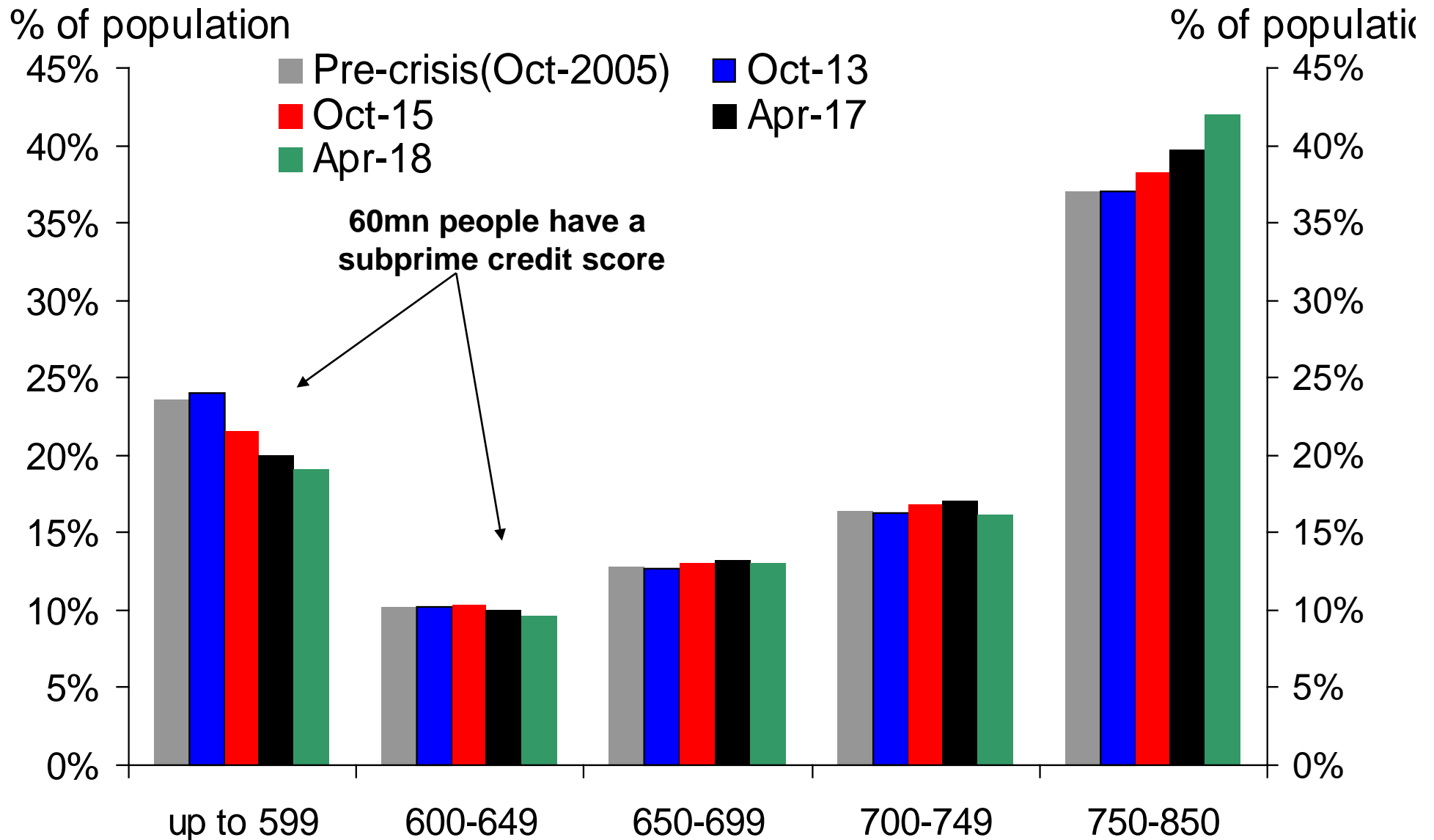


# GSEs currently provide almost all liquidity in the mortgage market



Source: SIFMA, DB Global Research

# A credit score of less than 650 is considered subprime

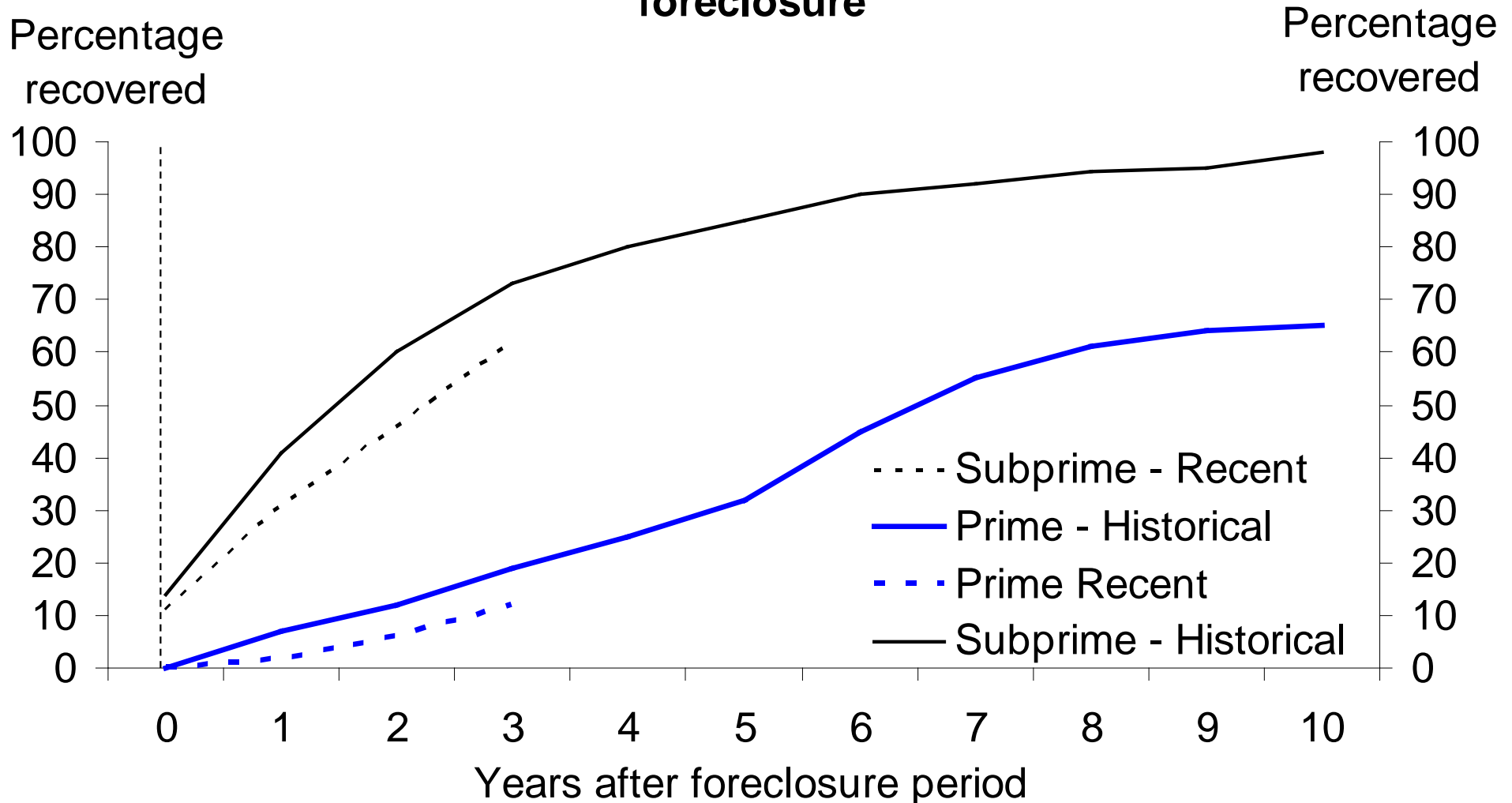


Source: FICO, DB Global Research



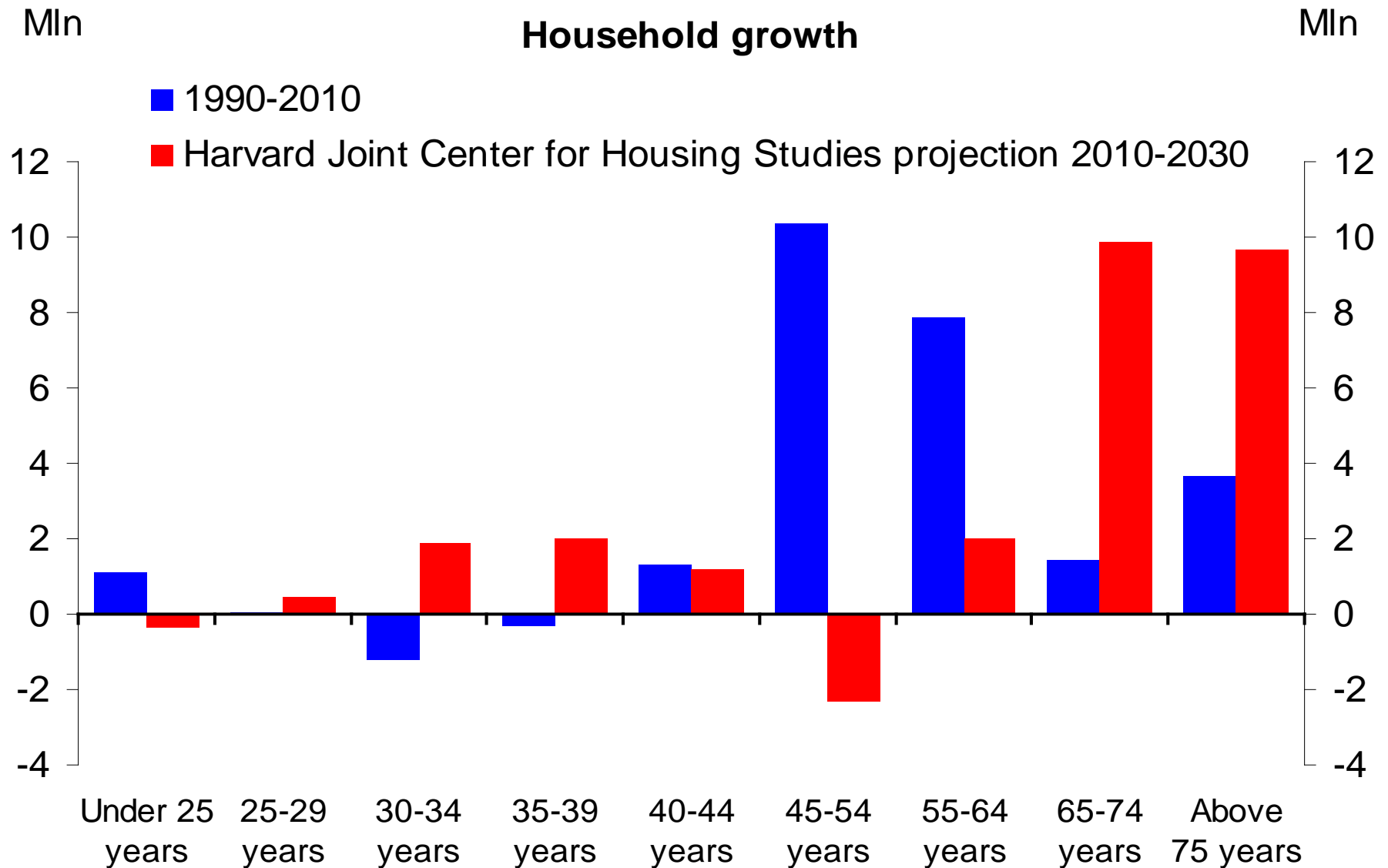
# Prime borrowers slow to recover after a hit to their credit scores

## Share of borrowers whose credit score recovered after foreclosure



Source: Federal reserve, DB Global Research

# Significant housing demand from babyboomers



Source: JCHS tabulationsof HUD, 2013 American Housing Survey, DB Global Research

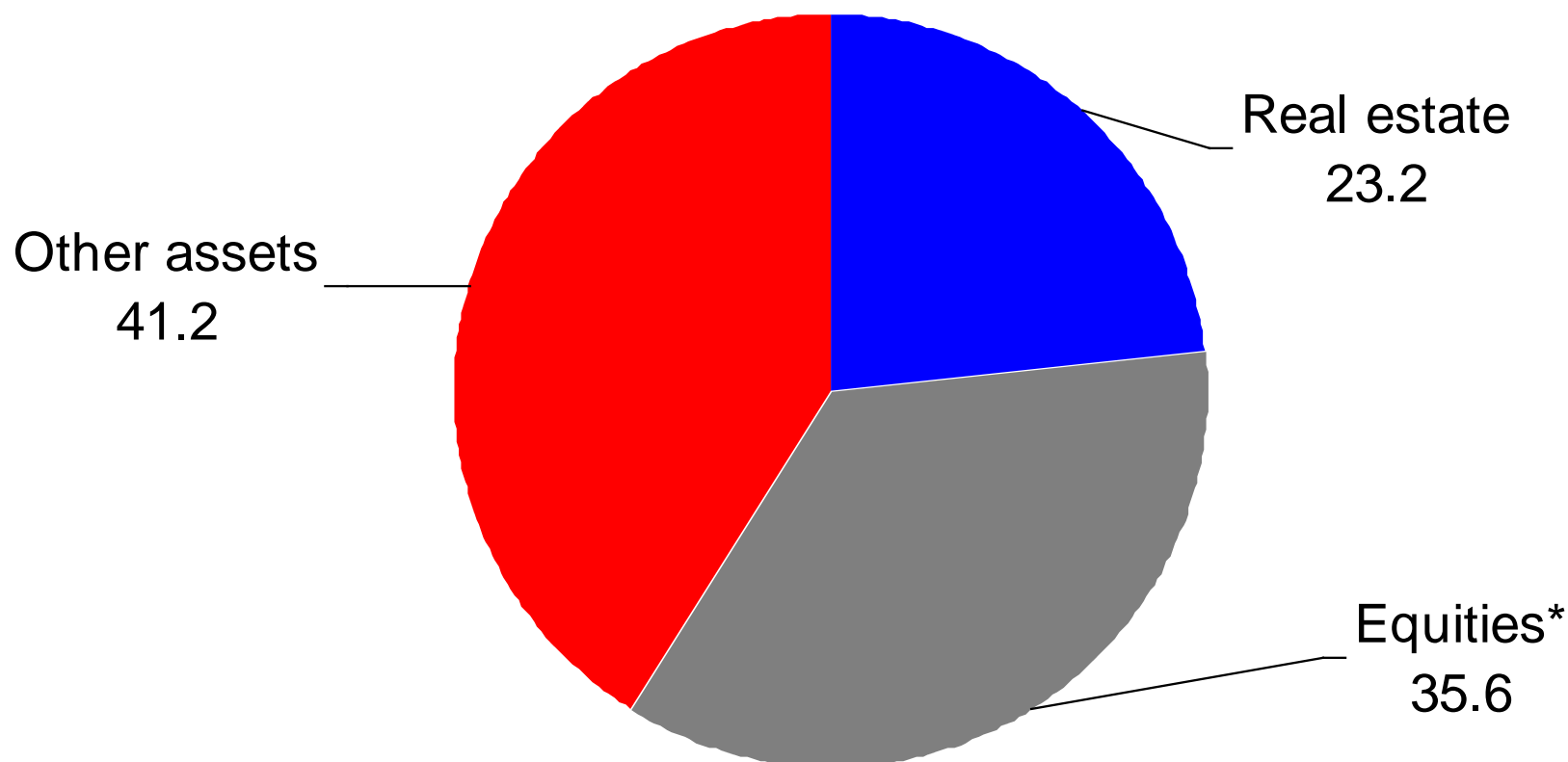


# The Outlook

# House prices are key for consumer balance sheets



## Assets of household sector: Q3 2018 (in percentage)

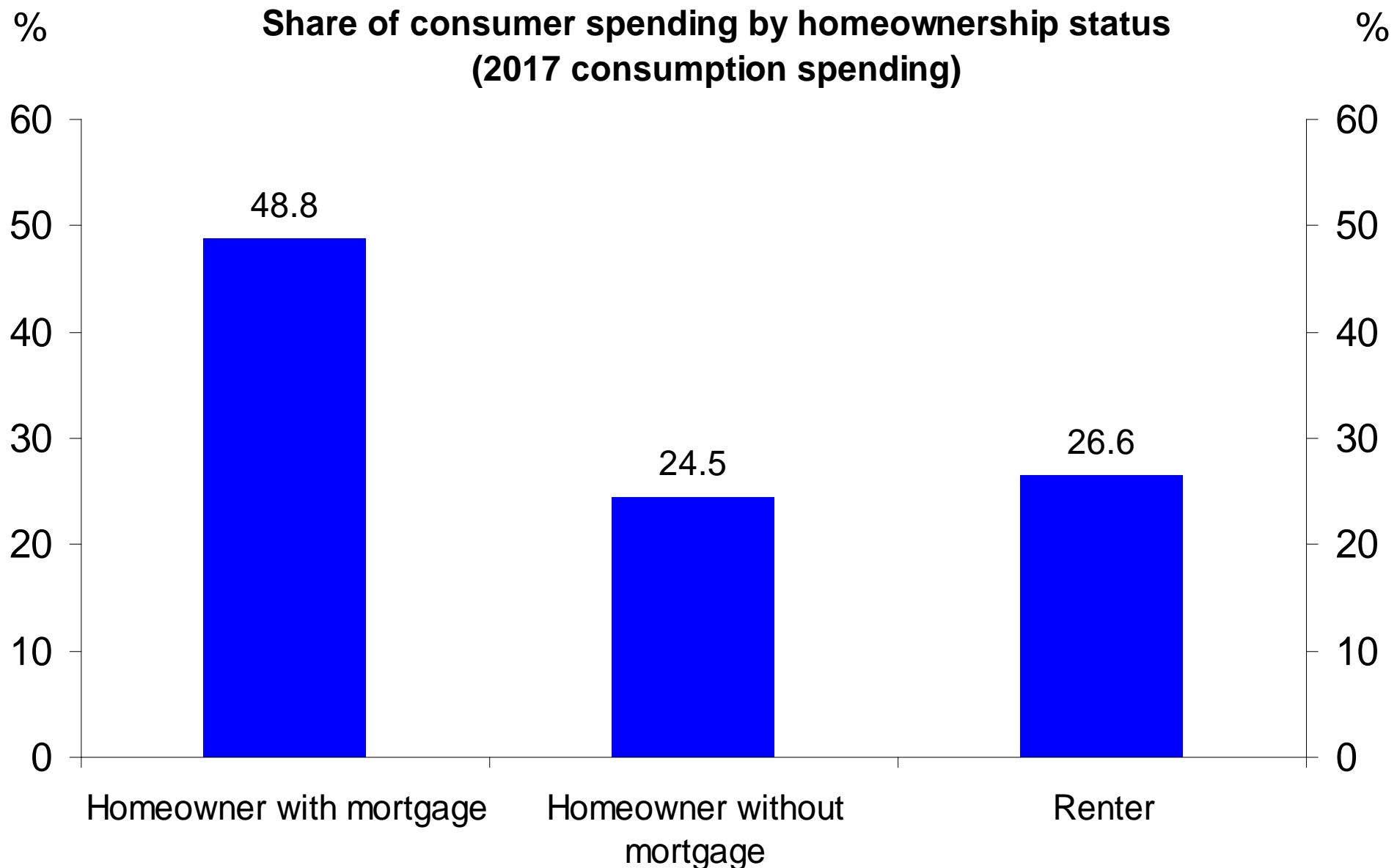


\*For equities both Directly and indirectly held along with Noncorporate Business are included in calculations

Source: FRB, Haver Analytics, DB Global Research

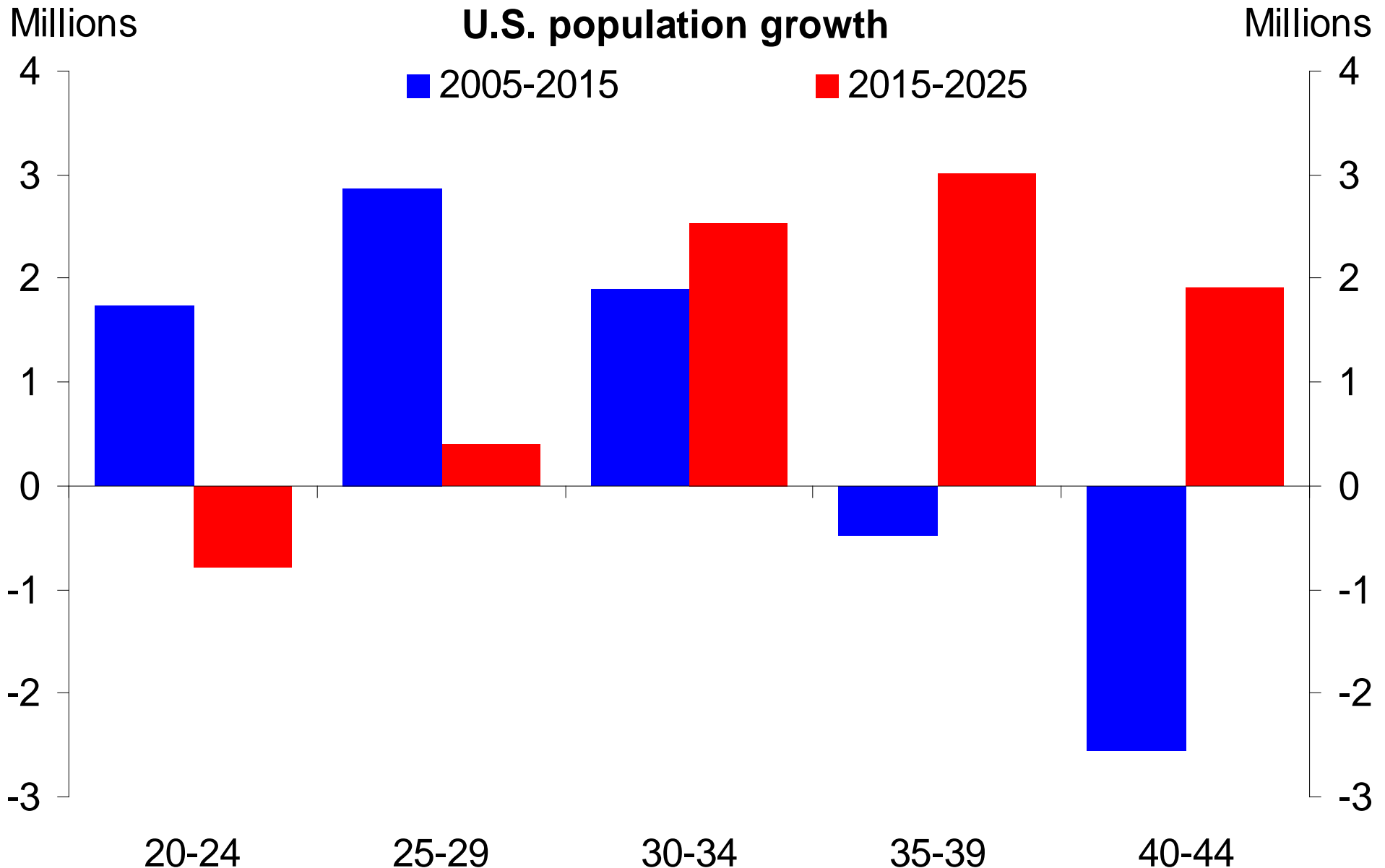


# And consumer spending mainly driven by homeowners



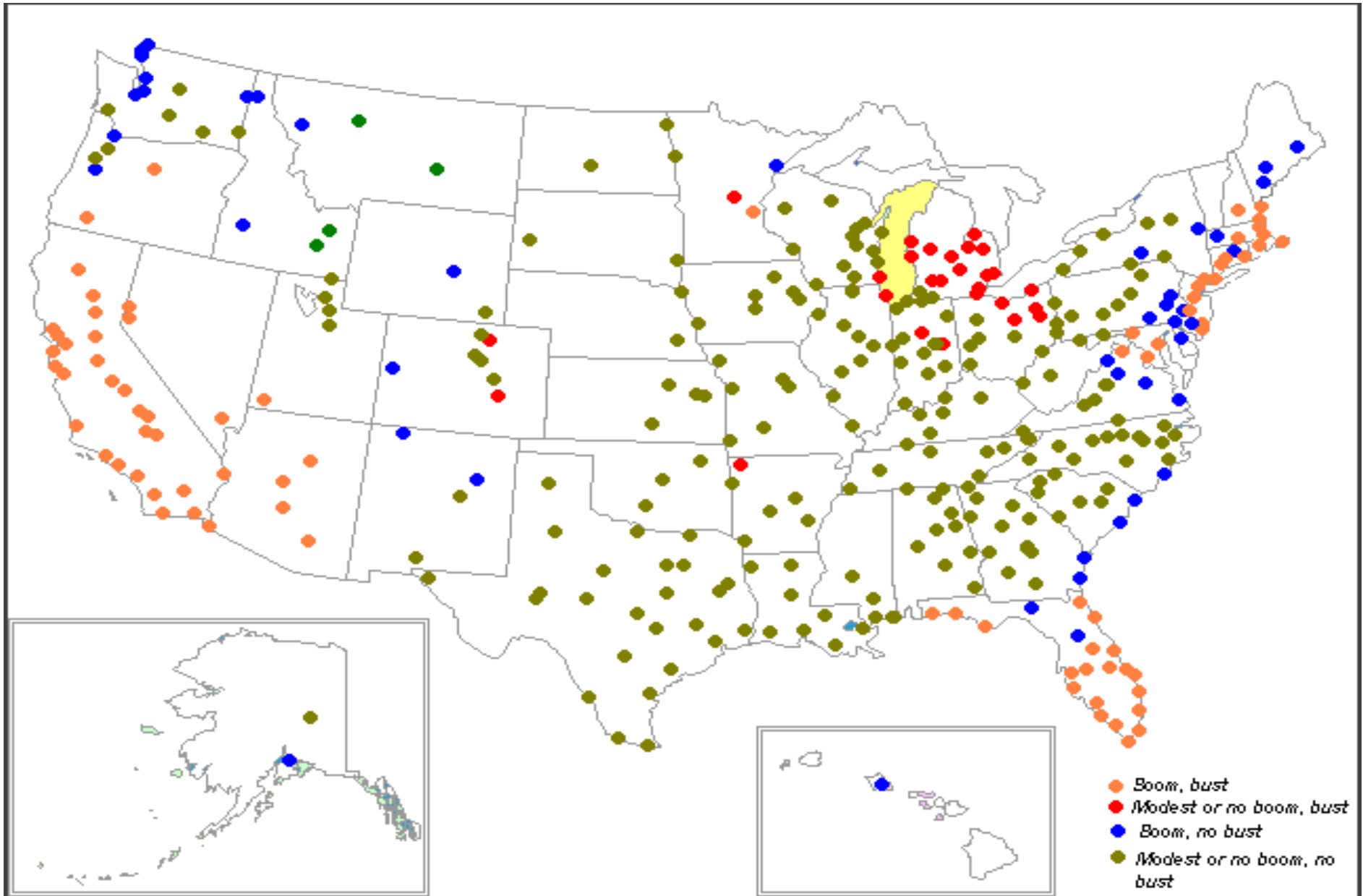
Source: CES, BLS , Haver Analytics, DB Global Research

# Over next ten Years, aging of the Millennial generation will boost the population in their 30s





# Geographical distribution of housing boom/bust



Source: NY Fed, DB Global Research



About 75% of US households live in homes valued at less than 300K

Distribution of U.S. homeowners by house values					
House value	<150K	150-300K	300k-650K	650K-1M	>=1M
Units	27.8mn	28.0mn	16.1mn	2.5mn	1.0mn
Units w mortgages	19.2mn	19.3mn	11.1mn	1.7mn	0.7mn
Of all homes w mortgage % shares by house value	36.9%	37.1%	21.3%	3.3%	1.4%

Source: Loan performance/core logic, S&P/ Case- Shiller, DB Global Research

# Not all states are non-recourse

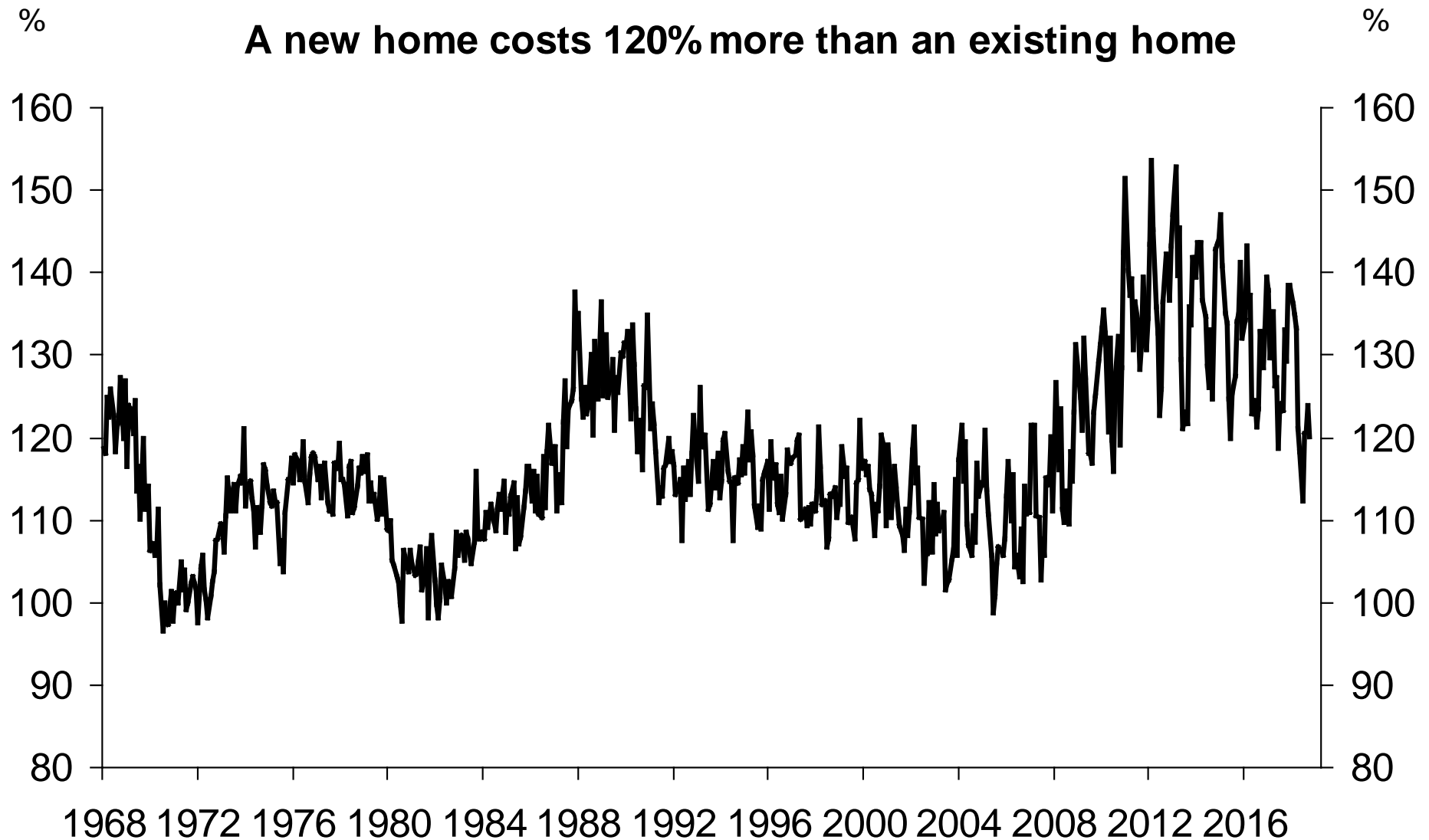


State	Recourse Classification	State	Recourse Classification	State	Recourse Classification
<b>Alabama</b>	Recourse	<b>Maine</b>	Recourse	<b>Oregon</b>	Non-Recourse
<b>Alaska</b>	Non-Recourse	<b>Maryland</b>	Recourse	<b>Pennsylvania</b>	Recourse
<b>Arizona</b>	Non-Recourse	<b>Massachusetts</b>	Recourse	<b>Rhode Island</b>	Recourse
<b>Arkansas</b>	Recourse	<b>Michigan</b>	Recourse	<b>S. Carolina</b>	Recourse
<b>California</b>	Non-Recourse	<b>Minnesota</b>	Non-Recourse	<b>S. Dakota</b>	Recourse
<b>Colorado</b>	Recourse	<b>Missouri</b>	Recourse	<b>Tennessee</b>	Recourse
<b>Connecticut</b>	Recourse	<b>Montana</b>	Non-Recourse	<b>Texas</b>	Recourse
<b>DC</b>	Recourse	<b>Mississippi</b>	Recourse	<b>Utah</b>	Recourse
<b>Delaware</b>	Recourse	<b>Nebraska</b>	Recourse	<b>Vermont</b>	Recourse
<b>Florida</b>	Recourse	<b>Nevada</b>	Non-Recourse	<b>Virginia</b>	Recourse
<b>Georgia</b>	Recourse	<b>New Hampshire</b>	Recourse	<b>Washington</b>	Non-Recourse
<b>Hawaii</b>	Recourse	<b>New Jersey</b>	Recourse	<b>W. Virginia</b>	Recourse
<b>Idaho</b>	Recourse	<b>New Mexico</b>	Recourse	<b>Wisconsin</b>	Non-Recourse
<b>Illinois</b>	Recourse	<b>New York</b>	Recourse	<b>Wyoming</b>	Recourse
<b>Indiana</b>	Recourse	<b>N. Carolina Purchase mortgages</b>	Non-Recourse		
<b>Iowa</b>	Non-Recourse	<b>N. Carolina Other mortgages</b>	Recourse		
<b>Kansas</b>	Recourse	<b>N. Dakota</b>	Non-Recourse		
<b>Kentucky</b>	Recourse	<b>Ohio</b>	Recourse		
<b>Louisiana</b>	Recourse	<b>Oklahoma</b>	Recourse		

Source: Richmond Fed, DB Global Research



# New home price divided by existing home price coming down

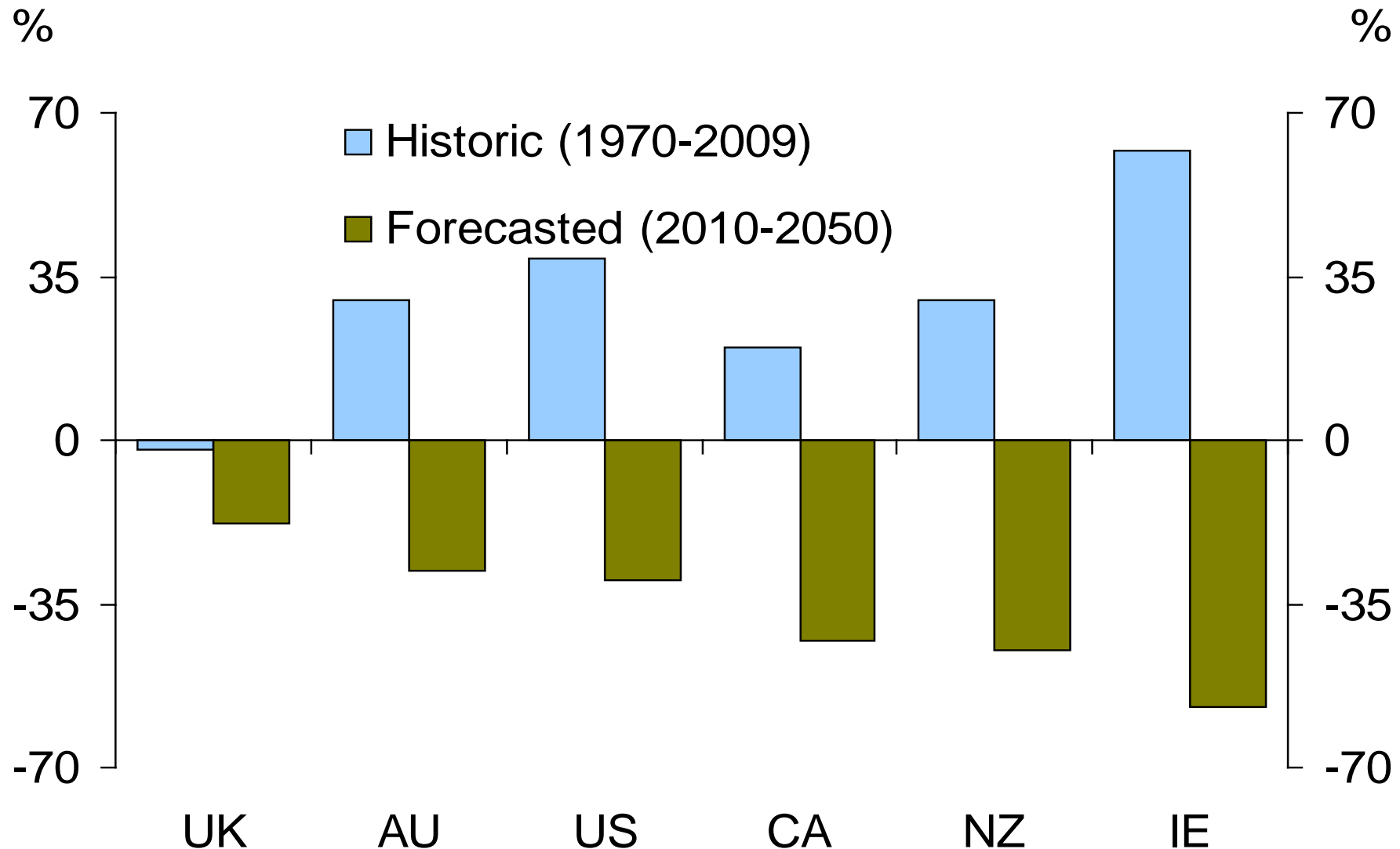


Source: Census, NAR, Haver Analytics, DB Global Research

# Demographics projected to put pressure on home prices going forward in English-speaking countries



## Demographic impact on home prices

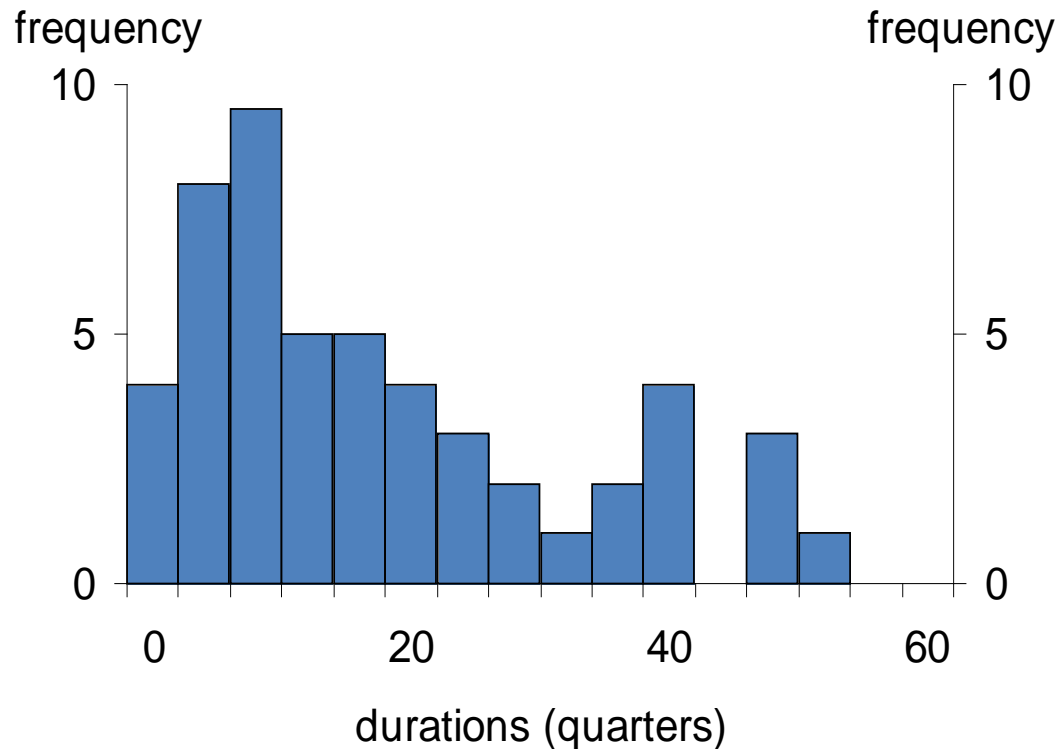


Source: BIS, DB Global Research

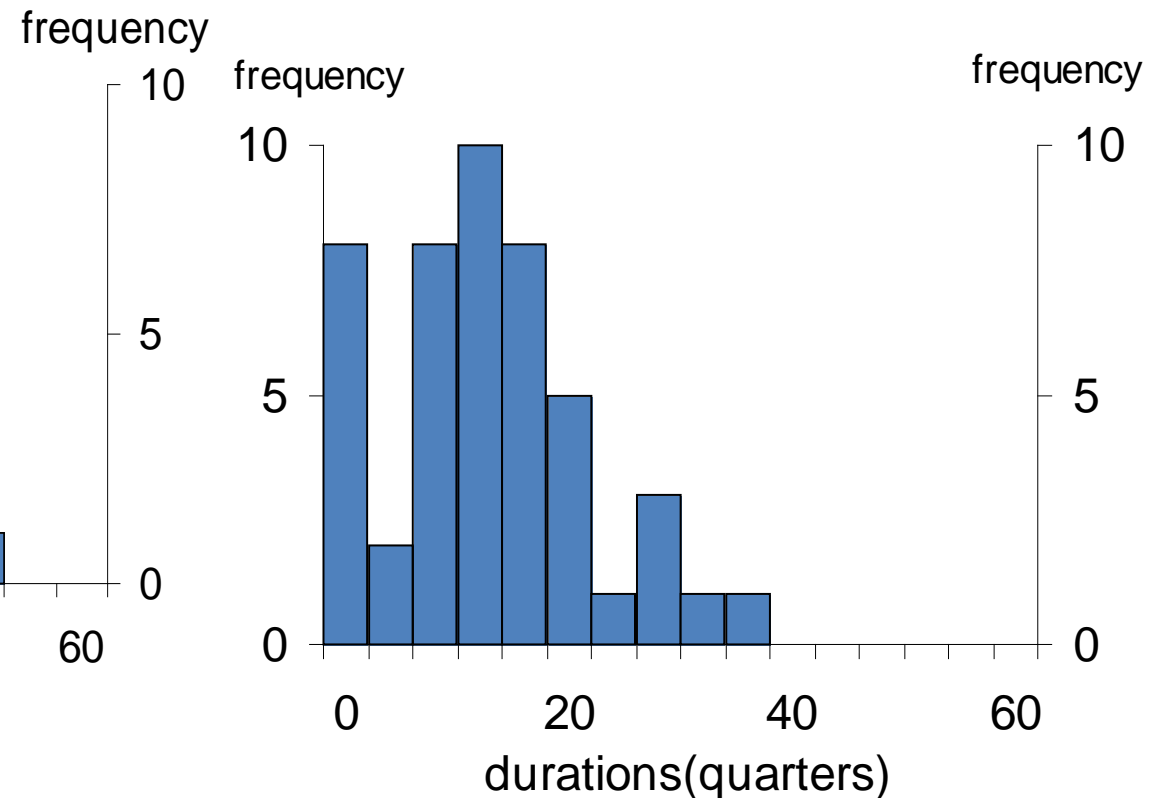


# Housing cycles: Slowdowns tend to last around 5 years

**Housing cycles: distribution of durations (upturns)**

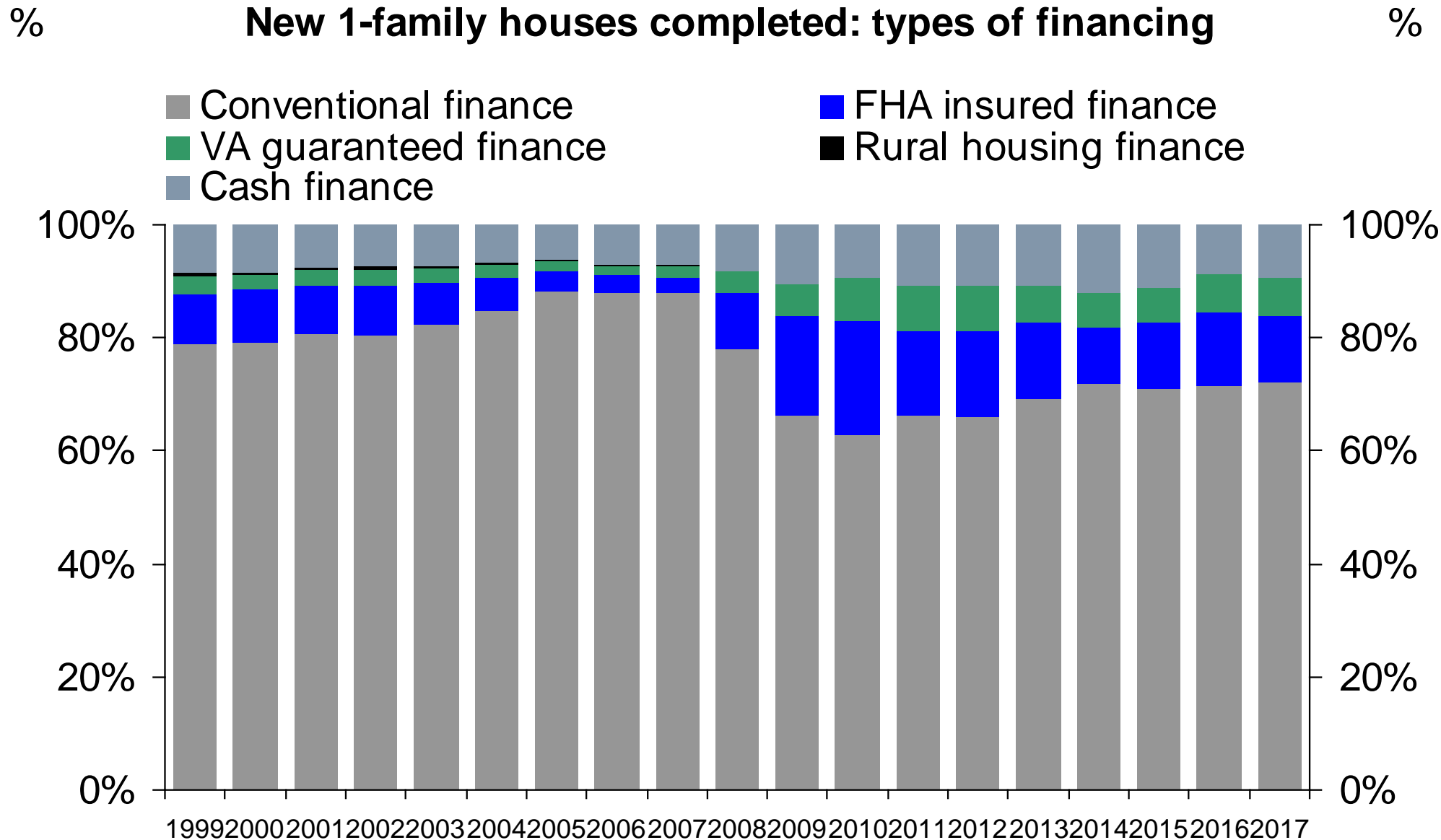


**Housing cycles: distribution of durations (downturns)**



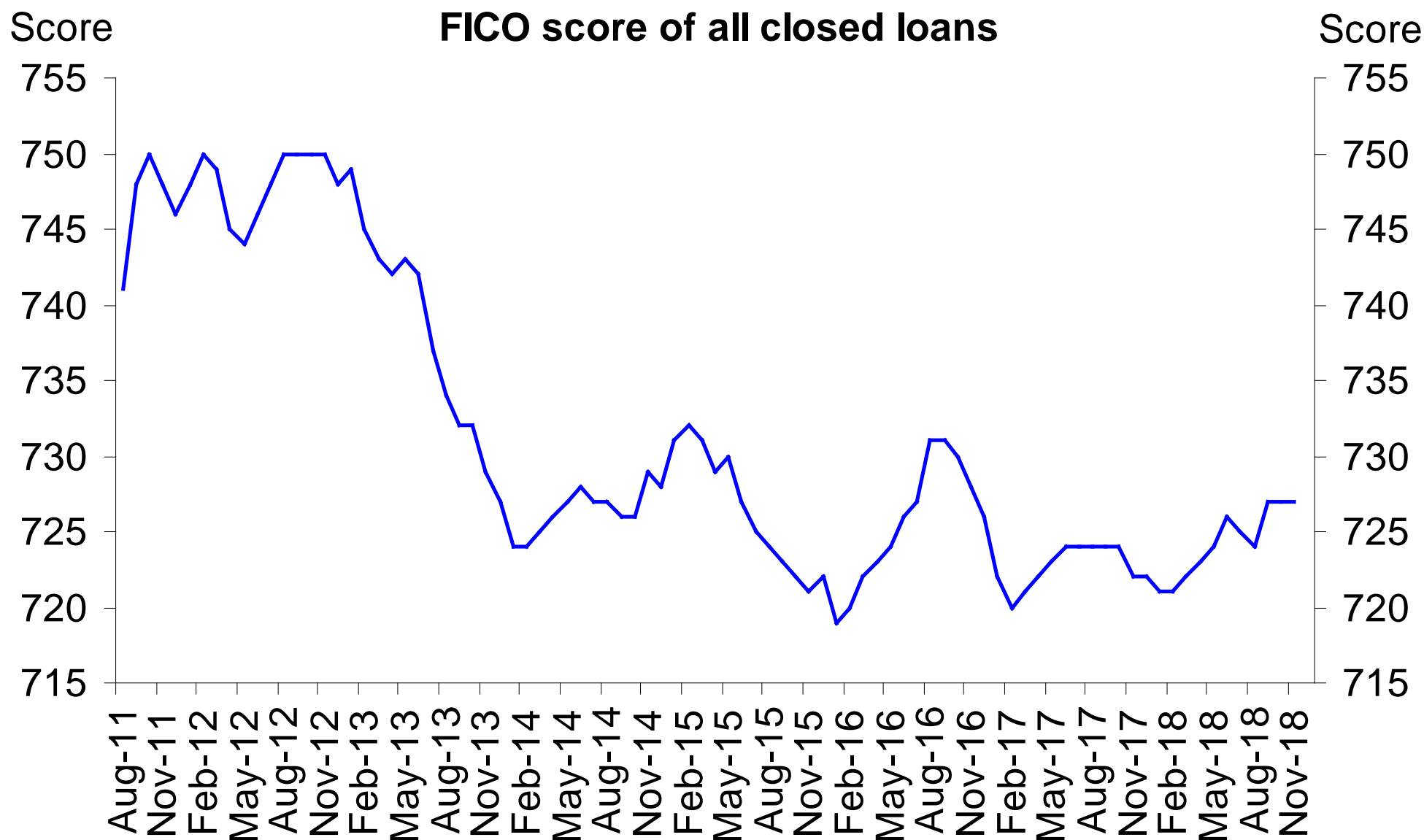
Source: IMF, DB Global Research

# FHA financing more homes



Source: Census, Haver Analytics, DB Global Research

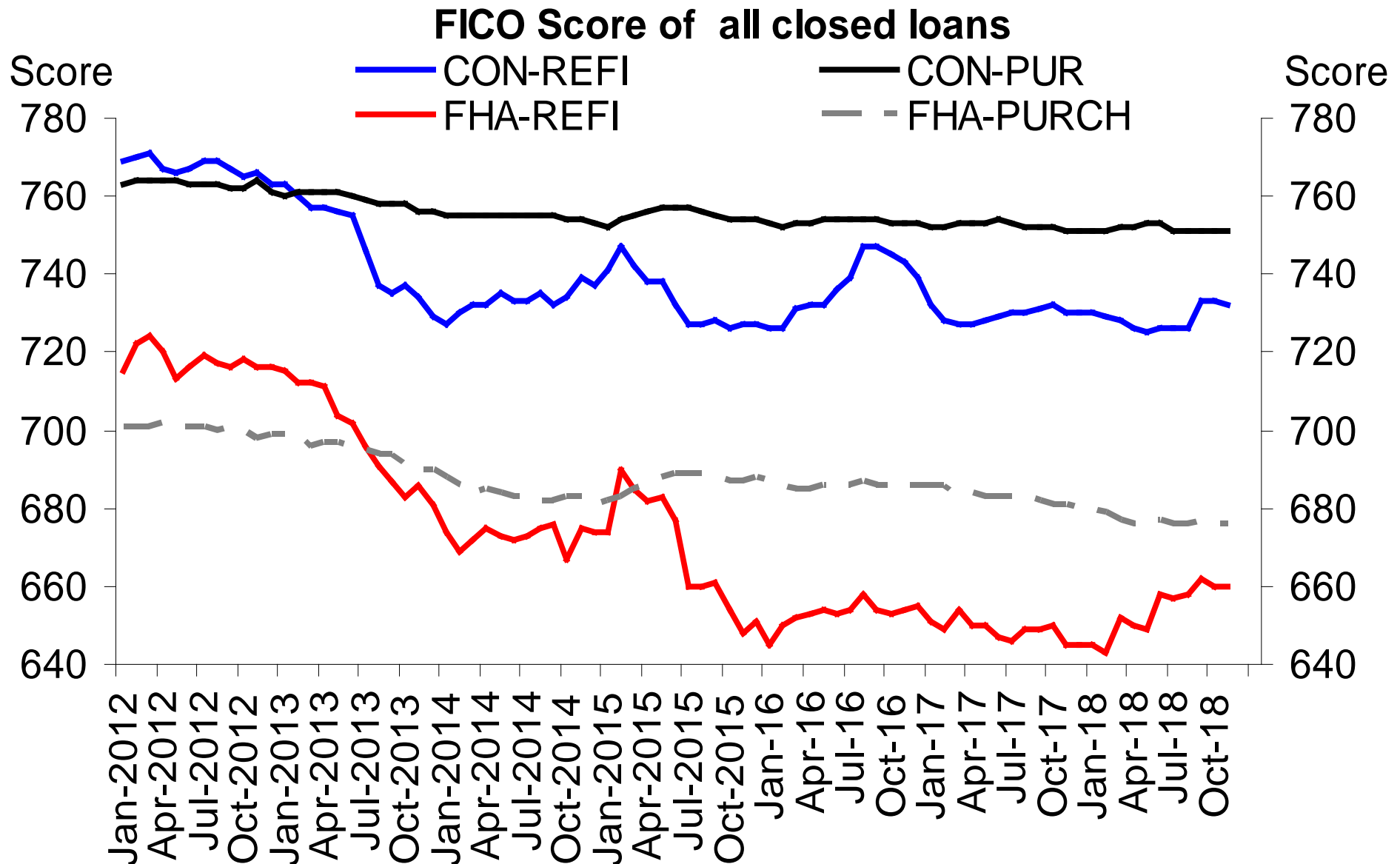
# Average FICO scores on new mortgages steady at 727



Source: Ellie Mae, DB Global Research

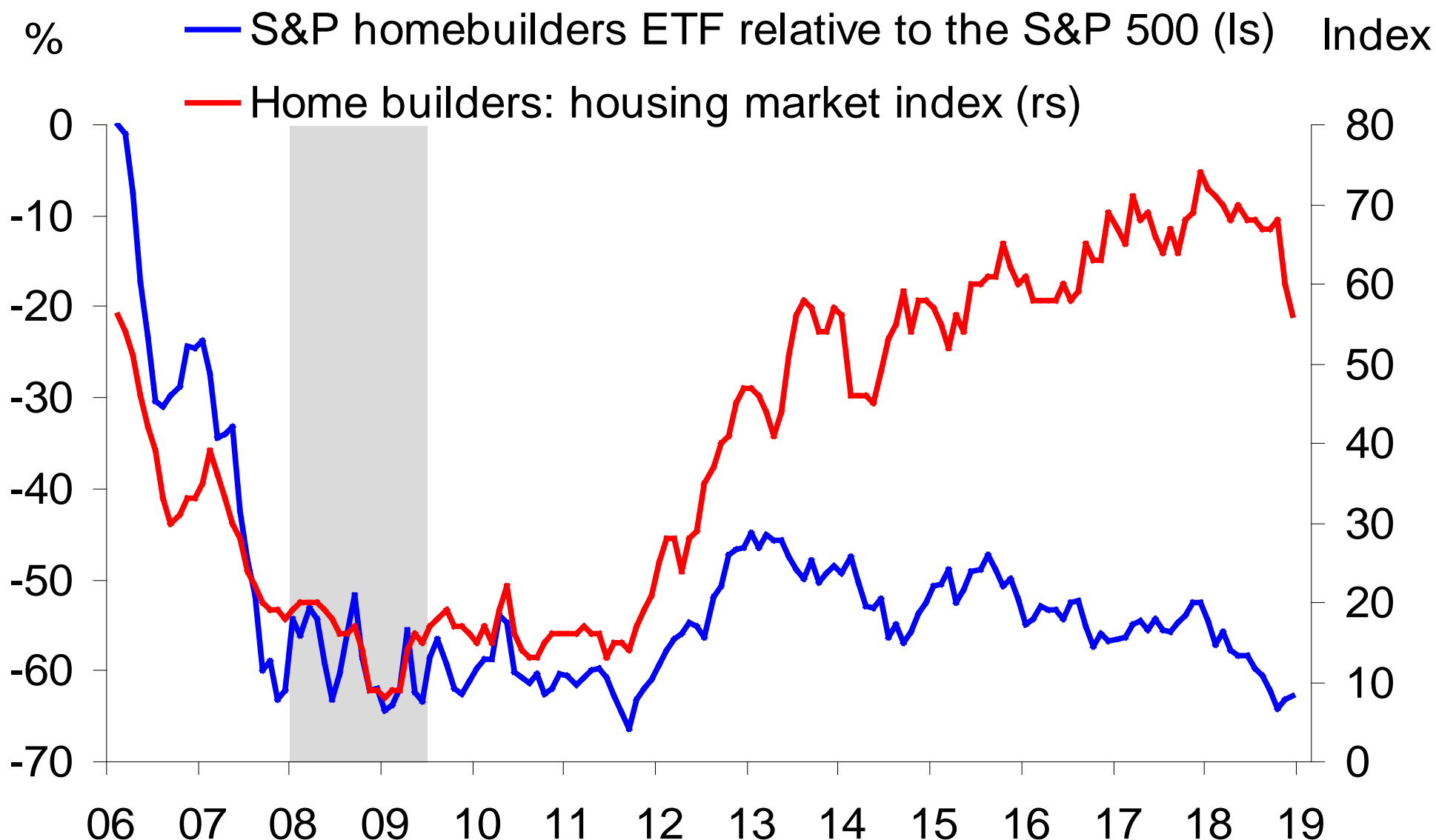


# Credit scores on purchase applications only coming down very slowly



Source: Ellie Mae, DB Global Research

# Homebuilder ETF vs housing market index



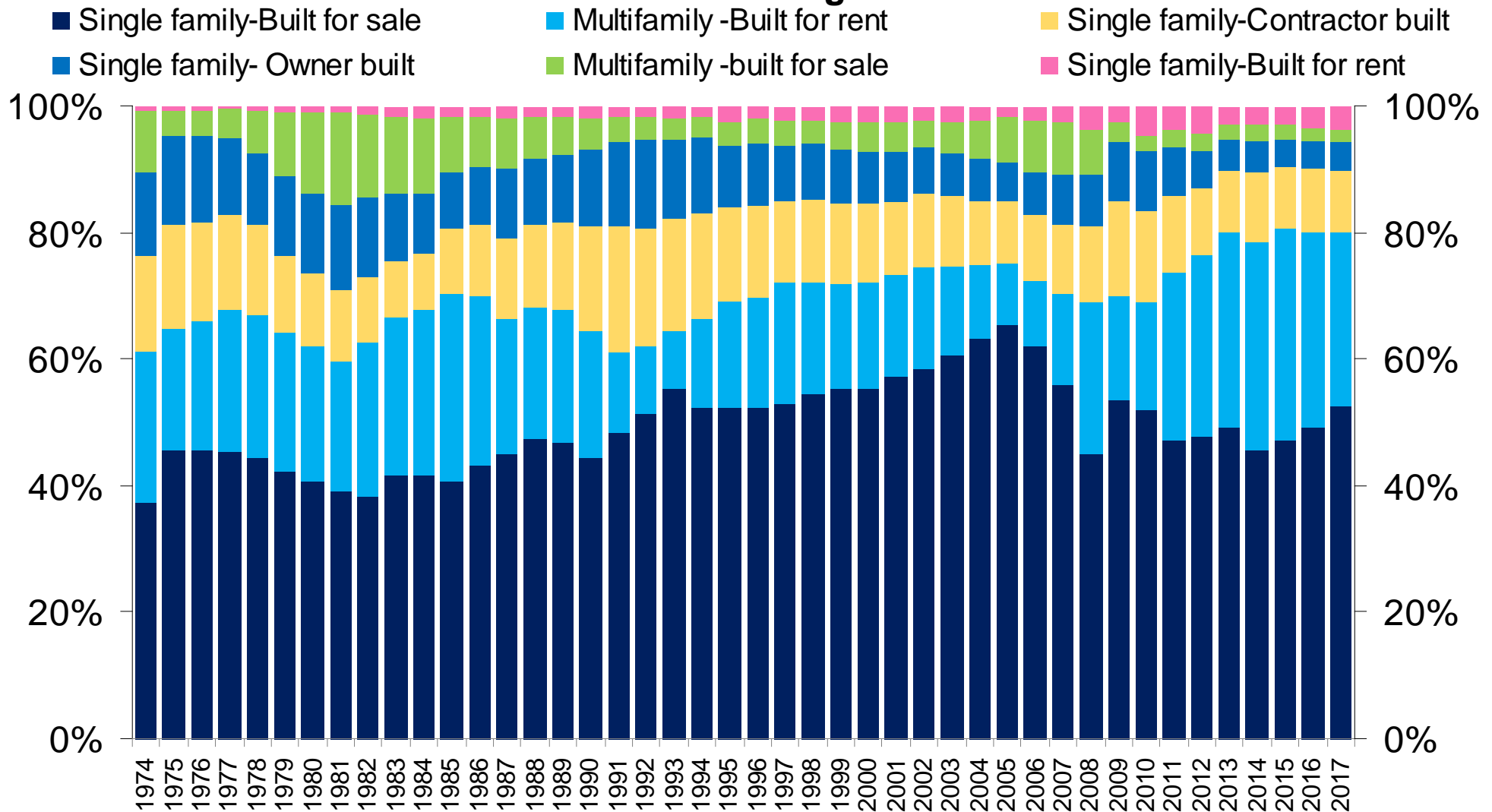
Source: NAHB, S&P, Bloomberg Finance LP, Haver Analytics, DB Global Research



# Units by intent of use

## New privately owned housing units started in US, by intent

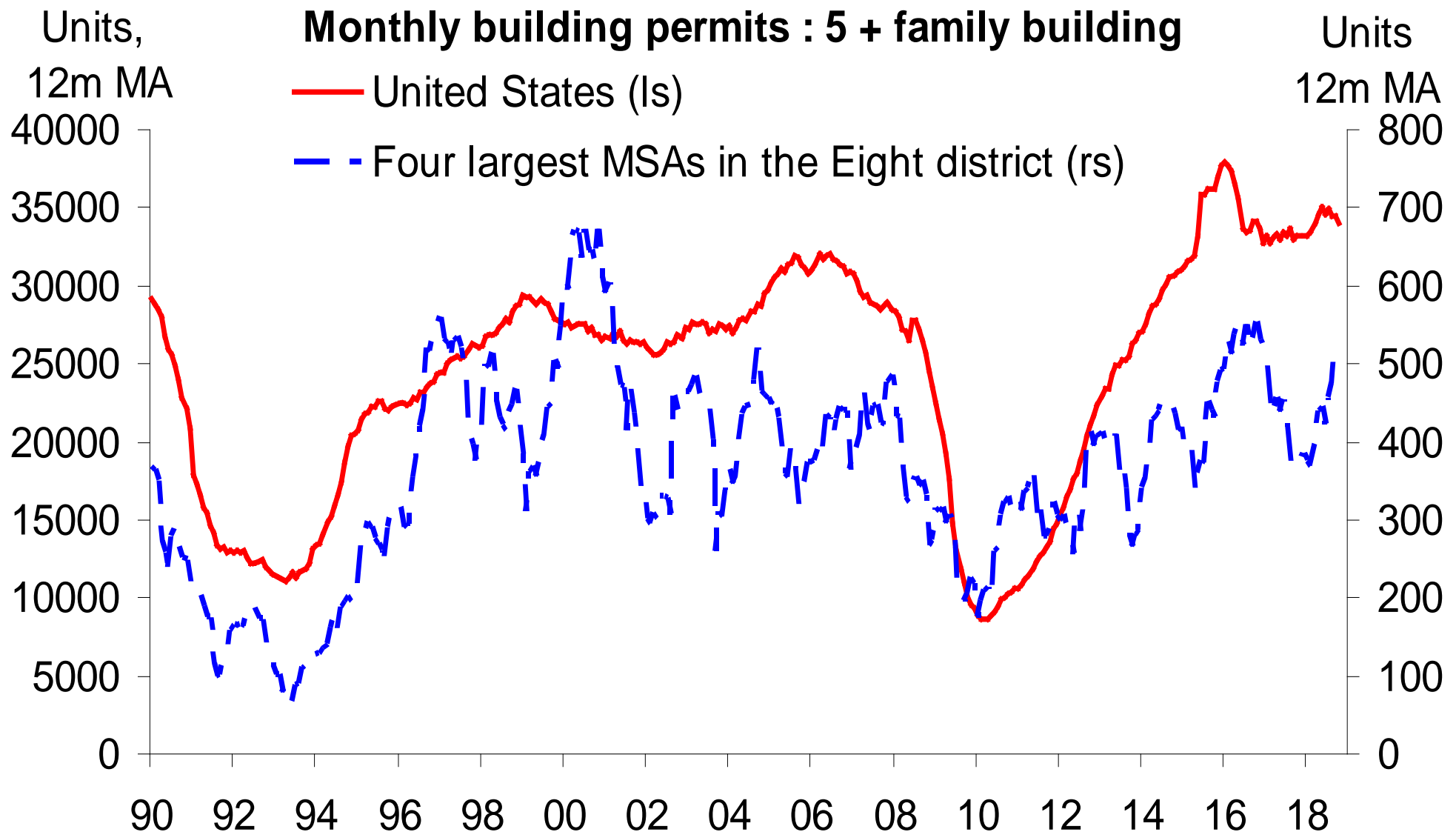
% of total housing starts



Source: Census, DB Global Research



## Multifamily starts are currently above their mid-2000s levels



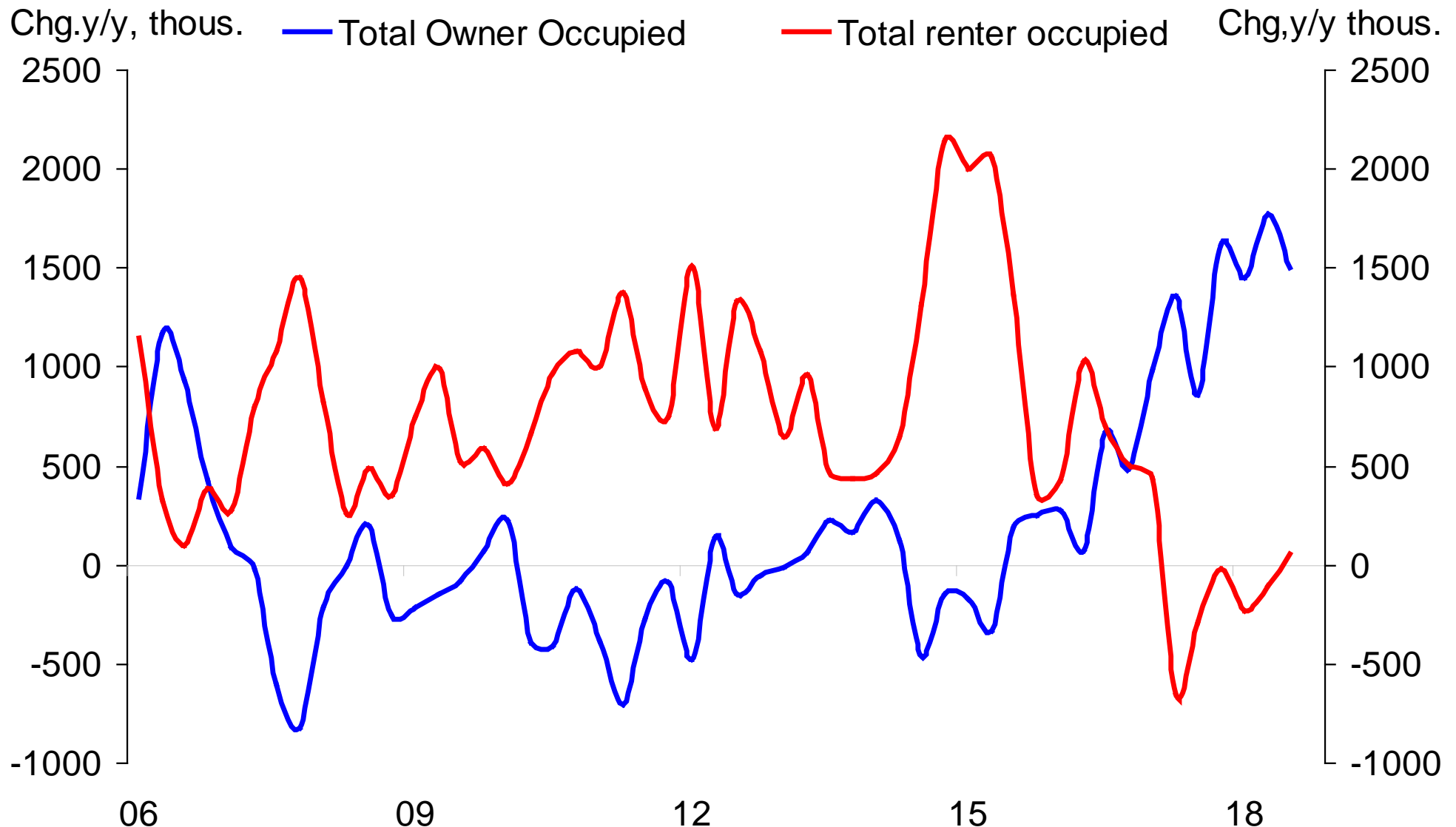
Note : Little Rock, Louisville, Memphis and St. Louis are the four largest MSAs in the Eight District.

Source: Census, Haver Analytics, DB Global Research



# Recently more owners and fewer renters

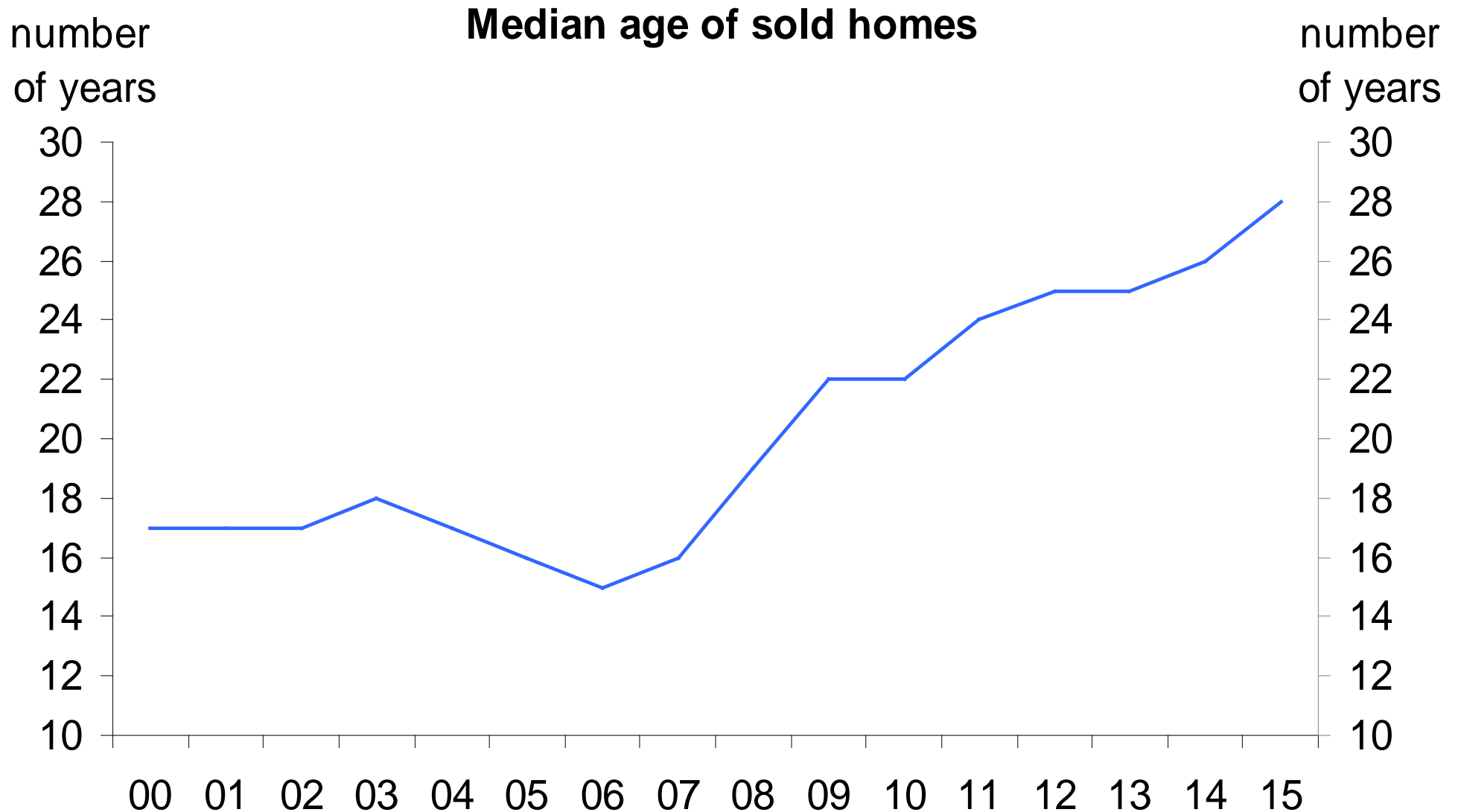
## U.S. household count by tenure



Source: Census, Haver Analytics, DB Global Research



# Median home sold is 28 years old

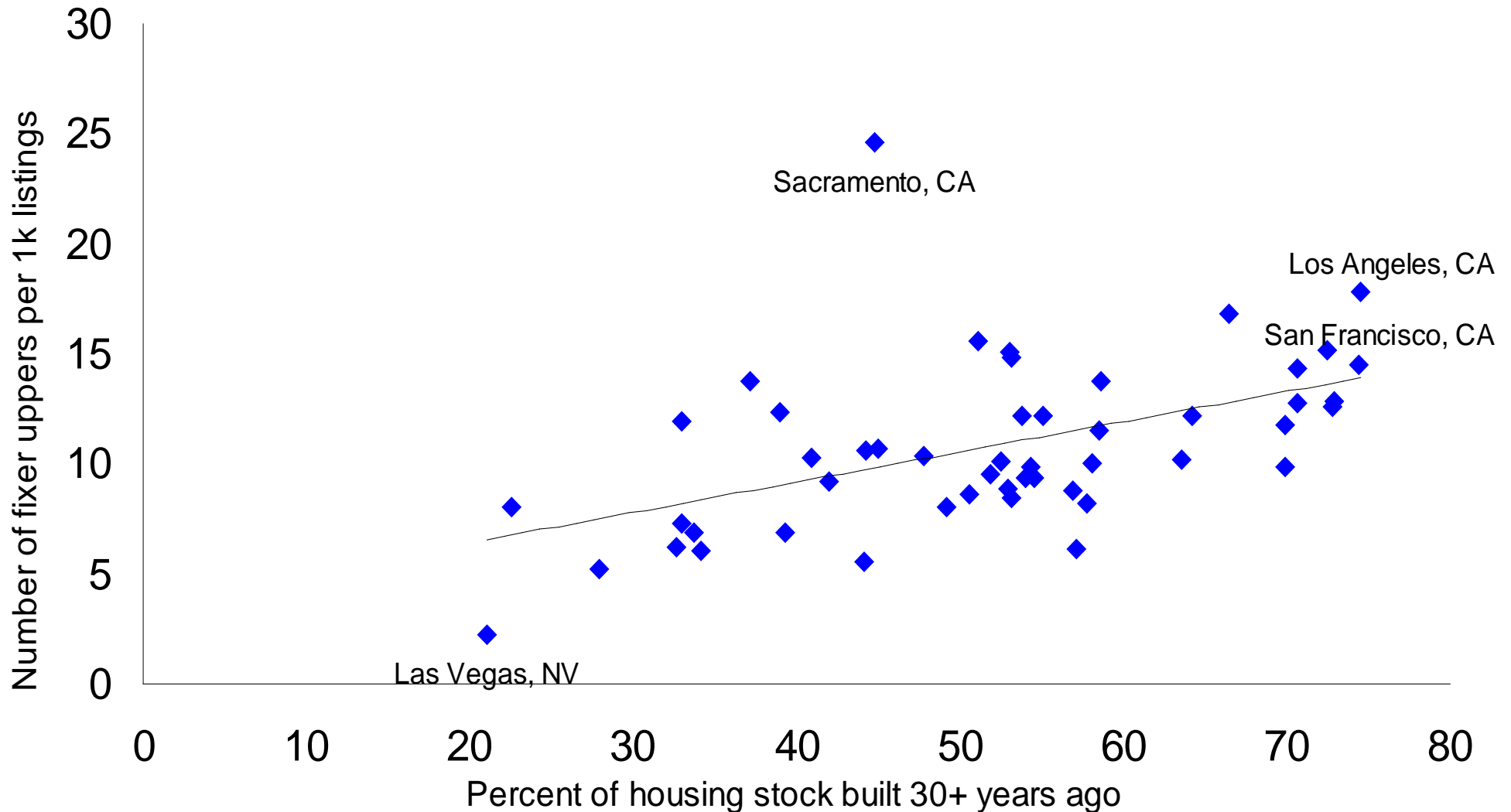


Source: Zillow, DB Global Research



# More fixer-uppers in areas with more old homes

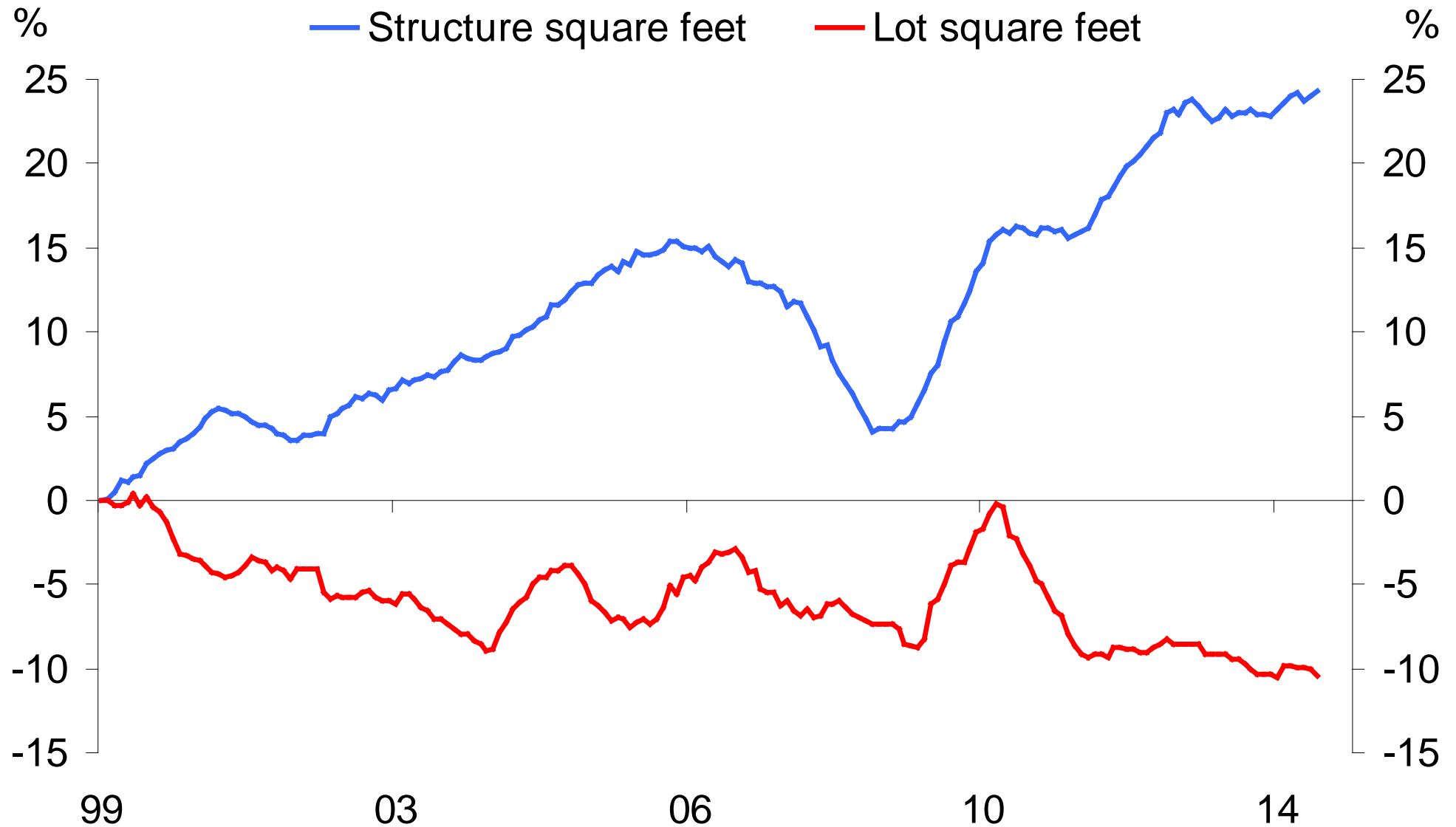
## Fixer upper share of listings



Source: Zillow, DB Global Research



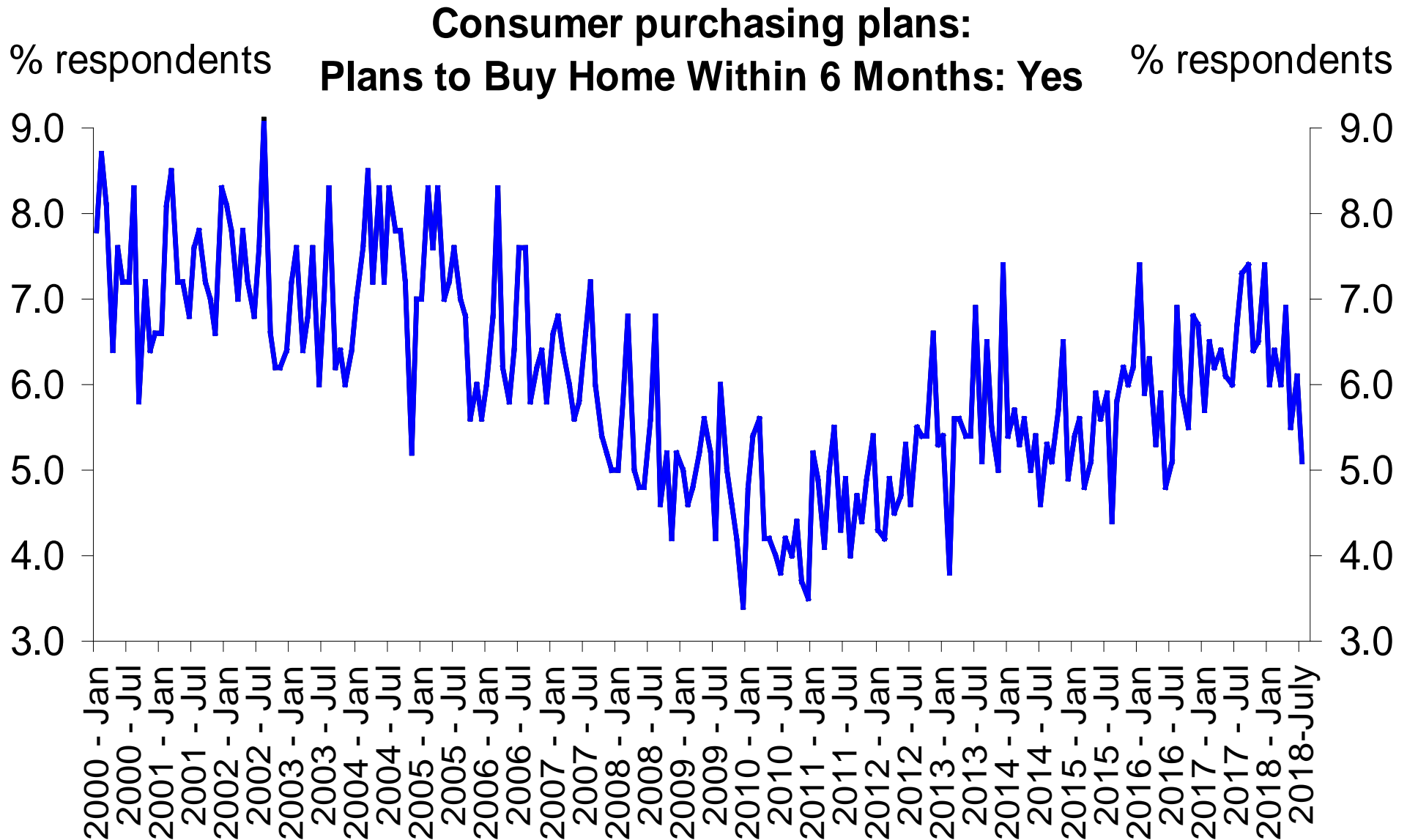
## Smaller lots, bigger homes



Source: Zillow, DB Global Research



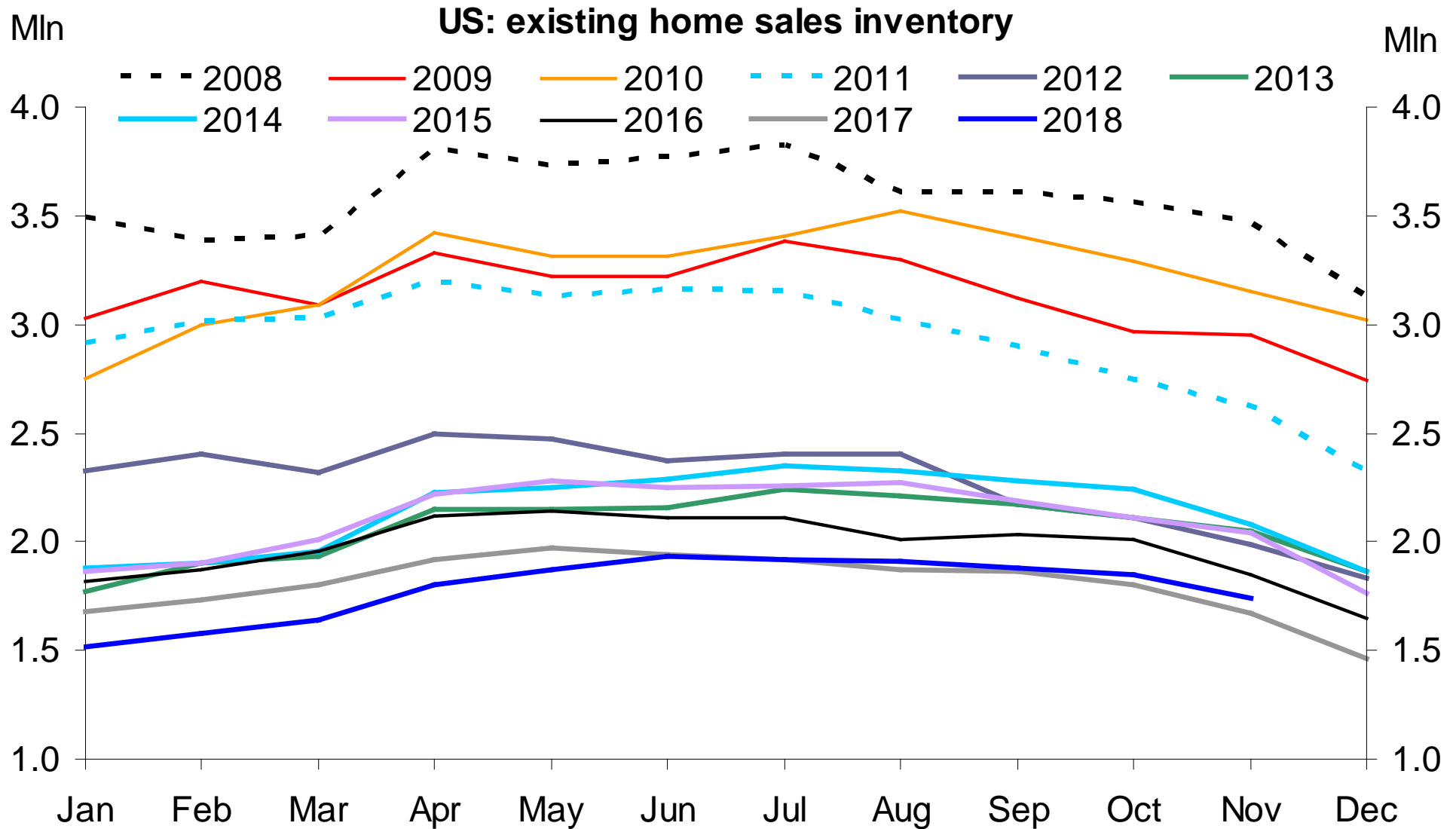
# Consumer interest in buying a home falling sharply



Source: The Conference Board, Haver Analytics, DB Global Research



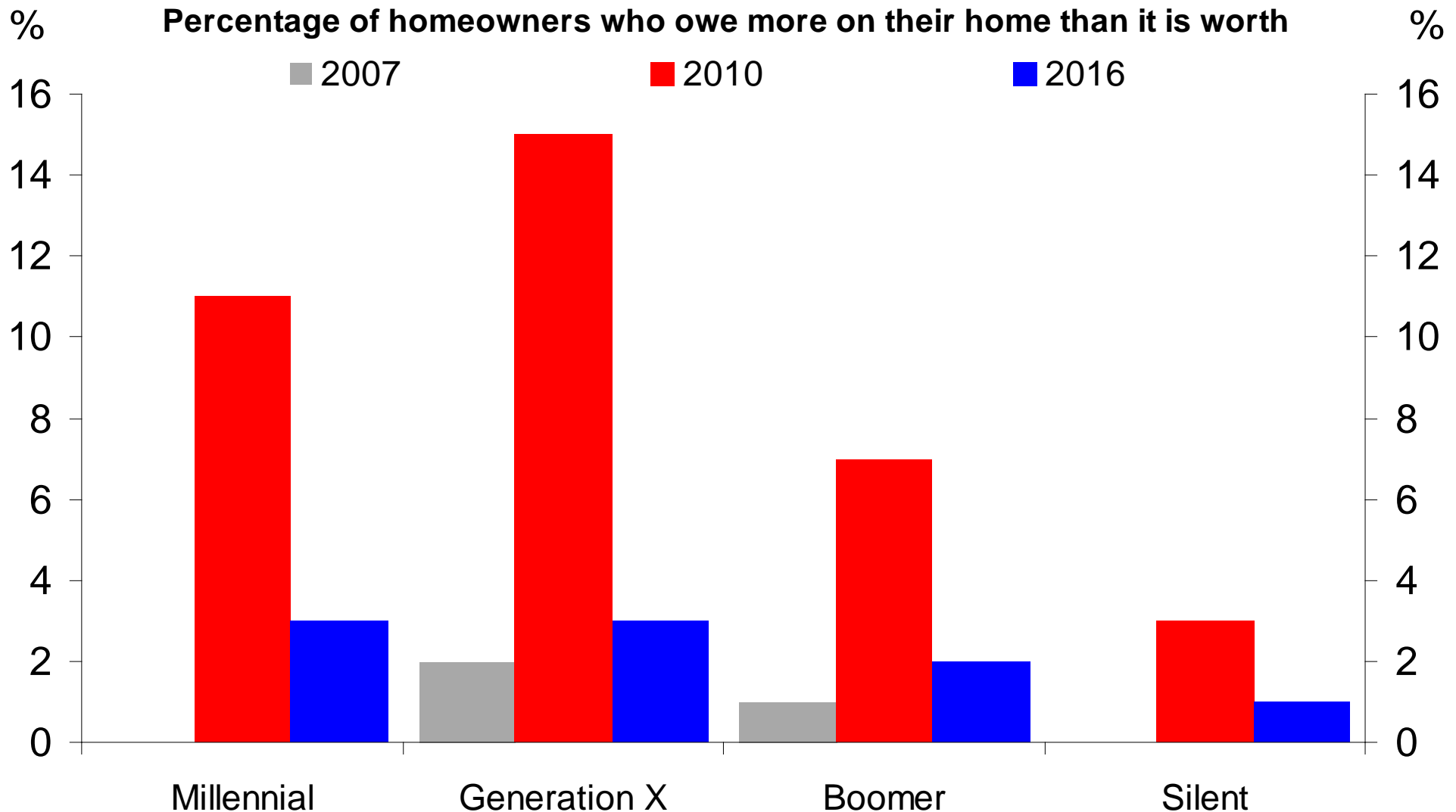
## Housing inventory coming down



Source: National Assoc. of Realtors, Bloomberg Finance LP, DB Global Research



# Home equity by generation

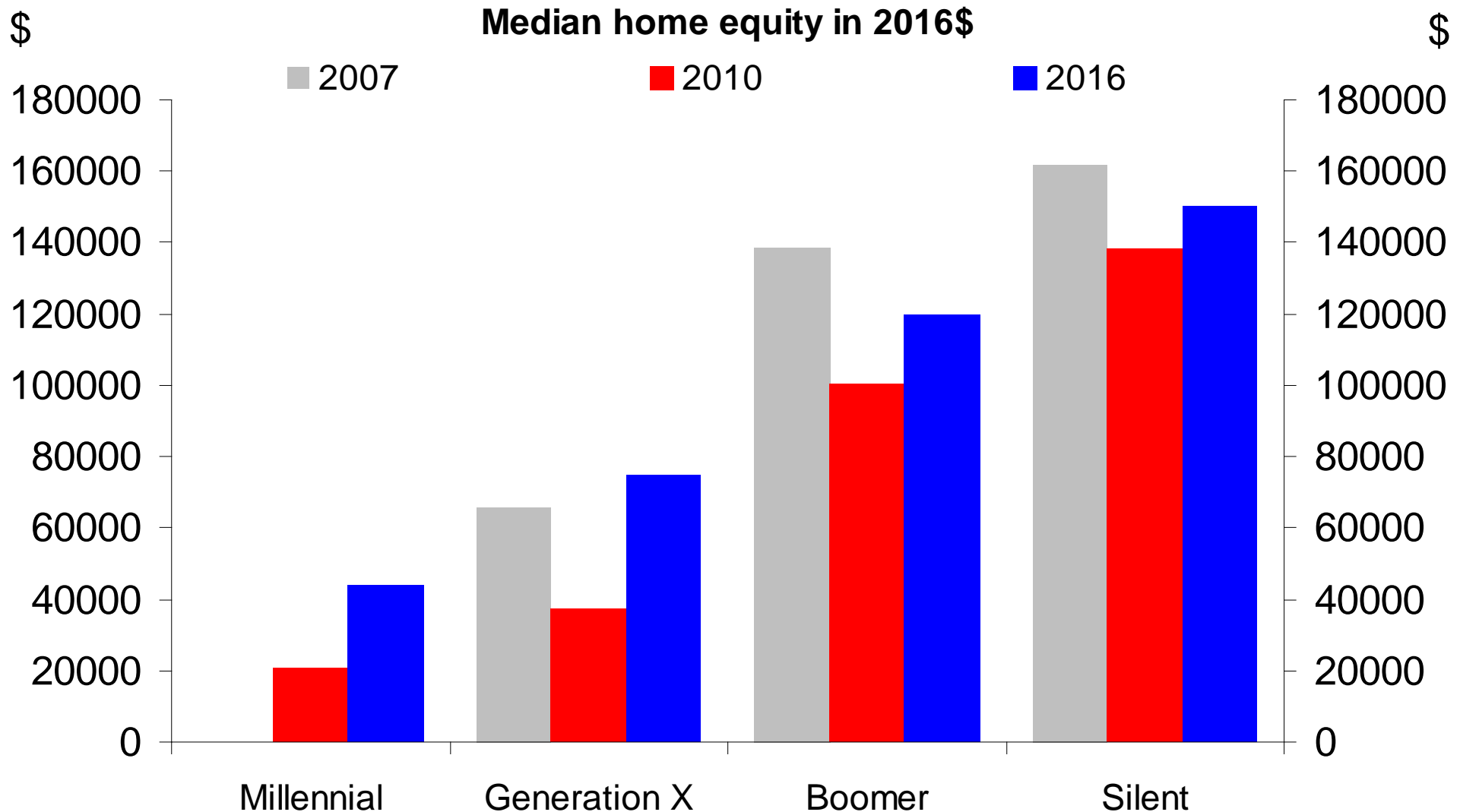


*Note: For Millennial 2007 data is not available and % was zero for Silent in 2007. Millennial generation: Born 1981 to 1996; Generation X: Born 1965 to 1980; Baby Boom: Born 1946 to 1964 & Silent Generation: Born 1928 to 1945.*

Source: PEW analysis of SCF database, DB Global Research



## Silent generation has highest median home equity



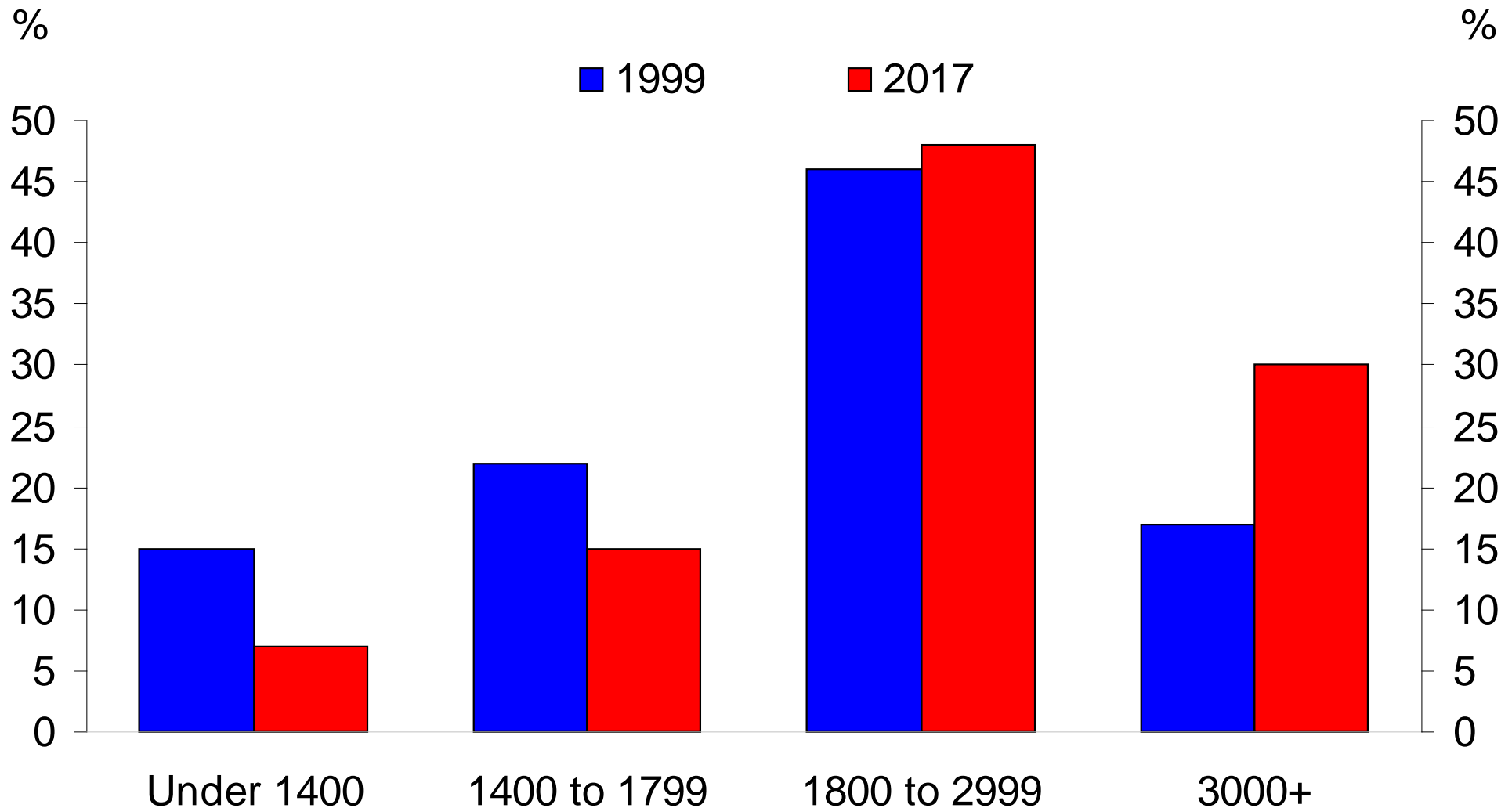
*Note: For Millennial 2007 data is not available and % was zero for Silent in 2007. Millennial generation: Born 1981 to 1996; Generation X: Born 1965 to 1980; Baby Boom: Born 1946 to 1964 & Silent Generation: Born 1928 to 1945.*

Source: PEW analysis of SCF database, DB Global Research



Most new homes are 1800 to 2900 sq feet

## Percent of single-family new homes completed by size



Source: Census, DB Global Research



## Peter Hooper

**Managing Director, Chief Economist**

**Deutsche Bank Securities, Inc.**

**+1 (212) 250-7352**

**[peter.hooper@db.com](mailto:peter.hooper@db.com)**

**Peter Hooper** is currently Managing Director and Chief Economist for Deutsche Bank Securities. He joined Deutsche Bank Securities in the fall of 1999, first as Chief International Economist and shortly thereafter as Chief US Economist. He became Chief Economist and co-head of global economics in 2006. Prior to joining Deutsche Bank, Hooper enjoyed a distinguished 26-year career at the Federal Reserve Board in Washington, D.C. While rising to senior levels of the Fed staff, he held numerous positions, including as an economist on the FOMC and as Deputy Director of the Division of International Finance.

Hooper produces weekly and quarterly publications for Deutsche Bank with a focus on US and global economic developments and Fed policy; he also comments on US and global economic and financial developments in the news media. His US Economics team has been ranked No. 1 in fixed income research by Institutional Investor in 2010 and 2011. Hooper currently serves as a member of the Economic Advisory Panel of the Federal Reserve Bank of New York, a member and former chairman of the Economic Advisory Committee of the American Bankers Association, a founding member of the US Monetary Policy Forum, a member of the Economic Leadership Council for the University of Michigan, and a member of the Forecasters' Club of New York.

Hooper earned a BA in Economics (cum laude) from Princeton University and an MA and Ph.D. in Economics from University of Michigan. He has published numerous books, journal articles, and reviews on economics and policy analysis.



## Brett Ryan

Director

Deutsche Bank Securities, Inc.

- Brett Ryan joined Deutsche Bank's US Economics Research team in May 2010. Prior to joining the team, Brett spent five years at Deutsche Bank in the institutional equity research sales group. Brett has a Bachelor of Arts degree from the University of Pennsylvania; majoring in politics, philosophy and economics.



Matthew Luzzetti  
212-250-6161  
[Matthew.luzzetti@db.com](mailto:Matthew.luzzetti@db.com)

Matthew Luzzetti received a Ph.D. in Economics from the University of California, Los Angeles, focusing on macroeconomics. Prior to that he worked as a research analyst at the Federal Reserve Bank of Philadelphia. Matt joined Deutsche Bank in September 2012 and is part of DB's top II ranked economics team.





## Torsten Slok, Ph.D.

**Chief International Economist, Managing Director  
Deutsche Bank Securities, Inc.**

- Torsten Slok joined Deutsche Bank Securities in the fall of 2005.
- Mr. Slok's Economics team has been top-ranked by Institutional Investor in fixed income and equities for the past five years. Slok currently serves as a member of the Economic Club of New York
- Prior to joining the firm, Mr. Slok worked at the OECD in Paris in the Money and Finance Division and the Structural Policy Analysis Division. Before joining the OECD he worked for four years at the IMF in the Division responsible for writing the World Economic Outlook and the Division responsible for China, Hong Kong, and Mongolia.
- Mr. Slok studied at University of Copenhagen and Princeton University. He has published numerous journal articles and reviews on economics and policy analysis, including in Journal of International Economics, Journal of International Money and Finance, and The Econometric Journal.



# Appendix 1

## Important Disclosures

### \*Other Information Available upon Request

Prices are current as of the end of the previous trading session unless otherwise indicated and are sourced from local exchanges via Reuters, Bloomberg and other vendors. Other information is sourced from Deutsche Bank, subject companies, and other sources. For disclosures pertaining to recommendations or estimates made on securities other than the primary subject of this research, please see the most recently published company report or visit our global disclosure look-up page on our website at <https://research.db.com/Research/Disclosures/CompanySearch>. Aside from within this report, important conflict disclosures can also be found at <https://research.db.com/Research/Topics/Equities?topicId=RB0002> under the "Disclosures Lookup" and "Legal" tabs. Investors are strongly encouraged to review this information before investing.

#### Analyst Certification

The views expressed in this report accurately reflect the personal views of the undersigned lead analyst about the subject issuers and the securities of those issuers. In addition, the undersigned lead analyst has not and will not receive any compensation for providing a specific recommendation or view in this report. Torsten Slok



## Additional Information

The information and opinions in this report were prepared by Deutsche Bank AG or one of its affiliates (collectively "Deutsche Bank"). Though the information herein is believed to be reliable and has been obtained from public sources believed to be reliable, Deutsche Bank makes no representation as to its accuracy or completeness. Hyperlinks to third-party websites in this report are provided for reader convenience only. Deutsche Bank neither endorses the content nor is responsible for the accuracy or security controls of those websites.

If you use the services of Deutsche Bank in connection with a purchase or sale of a security that is discussed in this report, or is included or discussed in another communication (oral or written) from a Deutsche Bank analyst, Deutsche Bank may act as principal for its own account or as agent for another person.

Deutsche Bank may consider this report in deciding to trade as principal. It may also engage in transactions, for its own account or with customers, in a manner inconsistent with the views taken in this research report. Others within Deutsche Bank, including strategists, sales staff and other analysts, may take views that are inconsistent with those taken in this research report. Deutsche Bank issues a variety of research products, including fundamental analysis, equity-linked analysis, quantitative analysis and trade ideas. Recommendations contained in one type of communication may differ from recommendations contained in others, whether as a result of differing time horizons, methodologies, perspectives or otherwise. Deutsche Bank and/or its affiliates may also be holding debt or equity securities of the issuers it writes on. Analysts are paid in part based on the profitability of Deutsche Bank AG and its affiliates, which includes investment banking, trading and principal trading revenues.

Opinions, estimates and projections constitute the current judgment of the author as of the date of this report. They do not necessarily reflect the opinions of Deutsche Bank and are subject to change without notice. Deutsche Bank provides liquidity for buyers and sellers of securities issued by the companies it covers. Deutsche Bank research analysts sometimes have shorter-term trade ideas that may be inconsistent with Deutsche Bank's existing longer-term ratings. Some trade ideas for equities are listed as Catalyst Calls on the Research Website (<https://research.db.com/Research/>), and can be found on the general coverage list and also on the covered company's page. A Catalyst Call represents a high-conviction belief by an analyst that a stock will outperform or underperform the market and/or a specified sector over a time frame of no less than two weeks and no more than three months. In addition to Catalyst Calls, analysts may occasionally discuss with our clients, and with Deutsche Bank salespersons and traders, trading strategies or ideas that reference catalysts or events that may have a near-term or medium-term impact on the market price of the securities discussed in this report, which impact may be directionally counter to the analysts' current 12-month view of total return or investment return as described herein. Deutsche Bank has no obligation to update, modify or amend this report or to otherwise notify a recipient thereof if an opinion, forecast or estimate changes or becomes inaccurate. Coverage and the frequency of changes in market conditions and in both general and company-specific economic prospects make it difficult to update research at defined intervals. Updates are at the sole discretion of the coverage analyst or of the Research Department Management, and the majority of reports are published at irregular intervals. This report is provided for informational purposes only and does not take into account the particular investment objectives, financial situations, or needs of individual clients. It is not an offer or a solicitation of an offer to buy or sell any financial instruments or to participate in any particular trading strategy. Target prices are inherently imprecise and a product of the analyst's judgment. The financial instruments discussed in this report may not be suitable for all investors, and investors must make their own informed investment decisions. Prices and availability of financial instruments are subject to change without notice, and investment transactions can lead to losses as a result of price fluctuations and other factors. If a financial instrument is denominated in a currency other than an investor's currency, a change in exchange rates may adversely affect the investment. Past performance is not necessarily indicative of future results. Performance calculations exclude transaction costs, unless otherwise indicated. Unless otherwise indicated, prices are current as of the end of the previous trading session and are sourced from local exchanges via Reuters, Bloomberg and other vendors. Data is also sourced from Deutsche Bank, subject companies, and other parties.

The Deutsche Bank Research Department is independent of other business divisions of the Bank. Details regarding our organizational arrangements and information barriers we have to prevent and avoid conflicts of interest with respect to our research are available on our website (<https://research.db.com/Research/>) under Disclaimer.

Macroeconomic fluctuations often account for most of the risks associated with exposures to instruments that promise to pay fixed or variable interest rates. For an investor who is long fixed-rate instruments (thus receiving these cash flows), increases in interest rates naturally lift the discount factors applied to the expected cash flows and thus cause a loss. The longer the maturity of a certain cash flow and the higher the move in the discount factor, the higher will be the loss. Upside surprises in inflation, fiscal funding needs, and FX depreciation rates are among the most common adverse macroeconomic shocks to receivers. But counterparty exposure, issuer creditworthiness, client segmentation, regulation (including changes in assets holding limits for different types of investors), changes in tax policies, currency convertibility (which may constrain currency conversion, repatriation of profits and/or liquidation of positions), and settlement issues related to local clearing houses are also important risk factors. The sensitivity of fixed-income instruments to macroeconomic shocks may be mitigated by indexing the contracted cash flows to inflation, to FX depreciation, or to specified interest rates – these are common in emerging markets. The index fixings may – by construction – lag or mis-measure the actual move in the underlying variables they are intended to track. The choice of the proper fixing (or metric) is particularly important in swaps markets, where floating coupon rates (i.e., coupons indexed to a typically short-dated interest rate reference index) are exchanged for fixed coupons. Funding in a currency that differs from the currency in which coupons are denominated carries FX risk. Options on swaps (swaptions) the risks typical to options in addition to the risks related to rates movements.

Derivative transactions involve numerous risks including market, counterparty default and illiquidity risk. The appropriateness of these products for use by investors depends on the investors' own circumstances, including their tax position, their regulatory environment and the nature of their other assets and liabilities; as such, investors should take expert legal and financial advice before entering into any transaction similar to or inspired by the contents of this publication. The risk of loss in futures trading and options, foreign or domestic, can be substantial. As a result of the high degree of leverage obtainable in futures and options trading, losses may be incurred that are greater than the amount of funds initially deposited – up to theoretically unlimited losses. Trading in options involves risk and is not suitable for all investors. Prior to buying or selling an option, investors must review the "Characteristics and Risks of Standardized Options", at <http://www.optionsclearing.com/about/publications/character-risks.jsp>. If you are unable to access the website, please contact your Deutsche Bank representative for a copy of this important document.



Participants in foreign exchange transactions may incur risks arising from several factors, including the following: (i) exchange rates can be volatile and are subject to large fluctuations; (ii) the value of currencies may be affected by numerous market factors, including world and national economic, political and regulatory events, events in equity and debt markets and changes in interest rates; and (iii) currencies may be subject to devaluation or government-imposed exchange controls, which could affect the value of the currency. Investors in securities such as ADRs, whose values are affected by the currency of an underlying security, effectively assume currency risk.

Unless governing law provides otherwise, all transactions should be executed through the Deutsche Bank entity in the investor's home jurisdiction. Aside from within this report, important conflict disclosures can also be found at <https://research.db.com/Research/> on each company's research page. Investors are strongly encouraged to review this information before investing.

Deutsche Bank (which includes Deutsche Bank AG, its branches and affiliated companies) is not acting as a financial adviser, consultant or fiduciary to you or any of your agents (collectively, "You" or "Your") with respect to any information provided in this report. Deutsche Bank does not provide investment, legal, tax or accounting advice, Deutsche Bank is not acting as your impartial adviser, and does not express any opinion or recommendation whatsoever as to any strategies, products or any other information presented in the materials. Information contained herein is being provided solely on the basis that the recipient will make an independent assessment of the merits of any investment decision, and it does not constitute a recommendation of, or express an opinion on, any product or service or any trading strategy.

The information presented is general in nature and is not directed to retirement accounts or any specific person or account type, and is therefore provided to You on the express basis that it is not advice, and You may not rely upon it in making Your decision. The information we provide is being directed only to persons we believe to be financially sophisticated, who are capable of evaluating investment risks independently, both in general and with regard to particular transactions and investment strategies, and who understand that Deutsche Bank has financial interests in the offering of its products and services. If this is not the case, or if You are an IRA or other retail investor receiving this directly from us, we ask that you inform us immediately.

In July 2018, Deutsche Bank revised its rating system for short term ideas whereby the branding has been changed to Catalyst Calls ("CC") from SOLAR ideas; the rating categories for Catalyst Calls originated in the Americas region have been made consistent with the categories used by Analysts globally; and the effective time period for CCs has been reduced from a maximum of 180 days to 90 days.

United States: Approved and/or distributed by Deutsche Bank Securities Incorporated, a member of FINRA, NFA and SIPC. Analysts located outside of the United States are employed by non-US affiliates that are not subject to FINRA regulations.

Germany: Approved and/or distributed by Deutsche Bank AG, a joint stock corporation with limited liability incorporated in the Federal Republic of Germany with its principal office in Frankfurt am Main. Deutsche Bank AG is authorized under German Banking Law and is subject to supervision by the European Central Bank and by BaFin, Germany's Federal Financial Supervisory Authority.

United Kingdom: Approved and/or distributed by Deutsche Bank AG acting through its London Branch at Winchester House, 1 Great Winchester Street, London EC2N 2DB. Deutsche Bank AG in the United Kingdom is authorised by the Prudential Regulation Authority and is subject to limited regulation by the Prudential Regulation Authority and Financial Conduct Authority. Details about the extent of our authorisation and regulation are available on request.

Hong Kong: Distributed by Deutsche Bank AG, Hong Kong Branch or Deutsche Securities Asia Limited (save that any research relating to futures contracts within the meaning of the Hong Kong Securities and Futures Ordinance Cap. 571 shall be distributed solely by Deutsche Securities Asia Limited). The provisions set out above in the "Additional Information" section shall apply to the fullest extent permissible by local laws and regulations, including without limitation the Code of Conduct for Persons Licensed or Registered with the Securities and Futures Commission. .

India: Prepared by Deutsche Equities India Private Limited (DEIPL) having CIN: U65990MH2002PTC137431 and registered office at 14th Floor, The Capital, C-70, G Block, Bandra Kurla Complex Mumbai (India) 400051. Tel: + 91 22 7180 4444. It is registered by the Securities and Exchange Board of India (SEBI) as a Stock broker bearing registration nos.: NSE (Capital Market Segment) - INB231196834, NSE (F&O Segment) INF231196834, NSE (Currency Derivatives Segment) INE231196834, BSE (Capital Market Segment) INB011196830; Merchant Banker bearing SEBI Registration no.: INM000010833 and Research Analyst bearing SEBI Registration no.: INH000001741. DEIPL may have received administrative warnings from the SEBI for breaches of Indian regulations. The transmission of research through DEIPL is Deutsche Bank's determination and will not make a recipient a client of DEIPL. Deutsche Bank and/or its affiliate(s) may have debt holdings or positions in the subject company. With regard to information on associates, please refer to the "Shareholdings" section in the Annual Report at: <https://www.db.com/ir/en/annual-reports.htm>.

Japan: Approved and/or distributed by Deutsche Securities Inc.(DSI). Registration number - Registered as a financial instruments dealer by the Head of the Kanto Local Finance Bureau (Kinsho) No. 117. Member of associations: JSDA, Type II Financial Instruments Firms Association and The Financial Futures Association of Japan. Commissions and risks involved in stock transactions - for stock transactions, we charge stock commissions and consumption tax by multiplying the transaction amount by the commission rate agreed with each customer. Stock transactions can lead to losses as a result of share price fluctuations and other factors. Transactions in foreign stocks can lead to additional losses stemming from foreign exchange fluctuations. We may also charge commissions and fees for certain categories of investment advice, products and services. Recommended investment strategies, products and services carry the risk of losses to principal and other losses as a result of changes in market and/or economic trends, and/or fluctuations in market value. Before deciding on the purchase of financial products and/or services, customers should carefully read the relevant disclosures, prospectuses and other documentation. "Moody's", "Standard & Poor's", and "Fitch" mentioned in this report are not registered credit rating agencies in Japan unless Japan or "Nippon" is specifically designated in the name of the entity. Reports on Japanese listed companies not written by analysts of DSI are written by Deutsche Bank Group's analysts with the coverage companies specified by DSI. Some of the foreign securities stated on this report are not disclosed according to the Financial Instruments and Exchange Law of Japan. Target prices set by Deutsche Bank's equity analysts are based on a 12-month forecast period..



Korea: Distributed by Deutsche Securities Korea Co.

South Africa: Deutsche Bank AG Johannesburg is incorporated in the Federal Republic of Germany (Branch Register Number in South Africa: 1998/003298/10).

Singapore: This report is issued by Deutsche Bank AG, Singapore Branch or Deutsche Securities Asia Limited, Singapore Branch (One Raffles Quay #18-00 South Tower Singapore 048583, +65 6423 8001), which may be contacted in respect of any matters arising from, or in connection with, this report. Where this report is issued or promulgated by Deutsche Bank in Singapore to a person who is not an accredited investor, expert investor or institutional investor (as defined in the applicable Singapore laws and regulations), they accept legal responsibility to such person for its contents.

Taiwan: Information on securities/investments that trade in Taiwan is for your reference only. Readers should independently evaluate investment risks and are solely responsible for their investment decisions. Deutsche Bank research may not be distributed to the Taiwan public media or quoted or used by the Taiwan public media without written consent. Information on securities/instruments that do not trade in Taiwan is for informational purposes only and is not to be construed as a recommendation to trade in such securities/instruments. Deutsche Securities Asia Limited, Taipei Branch may not execute transactions for clients in these securities/instruments.

Qatar: Deutsche Bank AG in the Qatar Financial Centre (registered no. 00032) is regulated by the Qatar Financial Centre Regulatory Authority. Deutsche Bank AG - QFC Branch may undertake only the financial services activities that fall within the scope of its existing QFCRA license. Its principal place of business in the QFC: Qatar Financial Centre, Tower, West Bay, Level 5, PO Box 14928, Doha, Qatar. This information has been distributed by Deutsche Bank AG. Related financial products or services are only available only to Business Customers, as defined by the Qatar Financial Centre Regulatory Authority.

Russia: The information, interpretation and opinions submitted herein are not in the context of, and do not constitute, any appraisal or evaluation activity requiring a license in the Russian Federation.

Kingdom of Saudi Arabia: Deutsche Securities Saudi Arabia LLC Company (registered no. 07073-37) is regulated by the Capital Market Authority. Deutsche Securities Saudi Arabia may undertake only the financial services activities that fall within the scope of its existing CMA license. Its principal place of business in Saudi Arabia: King Fahad Road, Al Olaya District, P.O. Box 301809, Faisaliah Tower - 17th Floor, 11372 Riyadh, Saudi Arabia.

United Arab Emirates: Deutsche Bank AG in the Dubai International Financial Centre (registered no. 00045) is regulated by the Dubai Financial Services Authority. Deutsche Bank AG - DIFC Branch may only undertake the financial services activities that fall within the scope of its existing DFSA license. Principal place of business in the DIFC: Dubai International Financial Centre, The Gate Village, Building 5, PO Box 504902, Dubai, U.A.E. This information has been distributed by Deutsche Bank AG. Related financial products or services are available only to Professional Clients, as defined by the Dubai Financial Services Authority.

Australia and New Zealand: This research is intended only for "wholesale clients" within the meaning of the Australian Corporations Act and New Zealand Financial Advisors Act, respectively. Please refer to Australia-specific research disclosures and related information at <https://australia.db.com/australia/content/research-information.html> Where research refers to any particular financial product recipients of the research should consider any product disclosure statement, prospectus or other applicable disclosure document before making any decision about whether to acquire the product. In preparing this report, the primary analyst or an individual who assisted in the preparation of this report has likely been in contact with the company that is the subject of this research for confirmation/clarification of data, facts, statements, permission to use company-sourced material in the report, and/or site-visit attendance. Without prior approval from Research Management, analysts may not accept from current or potential Banking clients the costs of travel, accommodations, or other expenses incurred by analysts attending site visits, conferences, social events, and the like. Similarly, without prior approval from Research Management and Anti-Bribery and Corruption ("ABC") team, analysts may not accept perks or other items of value for their personal use from issuers they cover.

Additional information relative to securities, other financial products or issuers discussed in this report is available upon request. This report may not be reproduced, distributed or published without Deutsche Bank's prior written consent.

Copyright © 2019 Deutsche Bank AG