The Wealth Building Home Loan[★]

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December 2017

Abstract

The Wealth Building Home Loan (WBHL) represents a class of shorter-maturity mortgages that provide a low-risk path to homeownership and wealth accumulation while maximizing buying power. WBHLs are easy-to-understand loans that combine standard mortgage features in a novel way. Importantly, they require little or no downpayment. The WBHLs in the market today are 15- and 20-year loans, some with fixed rates and others structured as adjustable-rate mortgages (ARMs). We show that a 20-year WBHL can be structured to have greater buying power than the typical FHA 30-year fixed rate mortgage (FRM), due in part to the use of an ARM structure with a low initial rate. Shorter-maturity ARMs carry much less risk of payment shock, and hence are a safer choice, than 30-year ARMs. We also show that the use of 15- and 20-year loans would have greatly reduced the incidence of negative equity during the financial crisis and that the actual default rates on these loans during that period were much lower than for observably equivalent 30-year FRMs. These results highlight that widespread use of WHBLs would have substantial benefits for borrowers, lenders, and the financial system as a whole.

1. Introduction

The promotion of homeownership has been a central feature of housing policy in the United States for nearly a century. Among the early proponents, Herbert Hoover, then Secretary of Commerce, stated in 1923 that "The present large proportion of families that own their homes is … the foundation of a sound economic and social system …" (foreword to Gries and Taylor, 1923). Along the same lines, Richard Ely, one of the most influential real estate economists in the 1920s, declared "… there is no question that home ownership is a safeguard against poverty, and it aids thrift and prosperity for the many" (Ely, 1926, p. 181).[1]

In the aftermath of the Great Depression, the newly-created Federal Housing Administration (FHA) examined which features of mortgage design had worked and which had not. Fully amortizing loans with a term of 10 to 15 years and a downpayment of 20 percent or more had generally worked. These were a staple of building and loan associations, savings banks, and Sears, Roebuck and Co., which sold factory-built homes. Banks, in contrast, were constrained by state and federal banking regulations to make first mortgages with a term of five years or less, followed by a balloon payment, and were limited to a maximum loan-to-value ratio (LTV) of 50 or 60 percent. The LTV maximum led to the prevalent use of second mortgages, often provided by the home seller at a high cost to the borrower. And the balloon payments forced borrowers to refinance frequently, which carried the risk that a decline in house prices would make it impossible to do so.

To support sustainable homeownership and minimize the risk of loan default, FHA redesigned the mortgage finance system in the United States to conform with the National

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[1] However, as noted in FHA (1935, p. 3), this push for homeownership was not paired with a template for sound lending: "Home ownership has been preached for many years. But the ways and means to home ownership provided for the public at large have been largely based upon many unsound principles and faulty theories."

Housing Act of 1934 and its own review of previous lending practices. As mandated by the Act, FHA required loans it guaranteed to "Contain complete amortization provisions … requiring periodic payments by the mortgagor not in excess of his reasonable ability to pay."[2] To avoid the need for balloon payments and second mortgages, loan terms were allowed to be as long as 20 years with LTVs up to 80 percent. In addition, the home value used to set the maximum mortgage amount was determined through a rigorous appraisal process.[3]

The FHA program worked extremely well during its first two decades, contributing to a sharp rise in the homeownership rate with very few loan defaults (Pinto, 2015). Indeed, Herzog (2009) reports that of the 2.9 million loans insured by FHA from 1934 to 1954, only 0.3 percent went to foreclosure.

However, starting in about 1960, foreclosures on FHA loans moved up dramatically, reflecting a loosening of FHA guarantee standards that began in the mid-1950s (Herzog and Early, 1970). This easing marked the beginning of a shift in federal government policy away from promoting sustainable, low-debt homeownership toward expanding access to credit, a shift that continues today.[4]

To show how much underwriting standards have changed, consider the profile of FHA loans originated between January and August 2017 to first-time buyers. Virtually all of these borrowers opted for a 30-year loan and 93 percent made a downpayment of 5 percent or less. Consequently, these borrowers had little or no equity at origination and, given the slow amortization of principal with 30-year loans, are almost entirely dependent on house price gains

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[2] Section 203 of the National Housing Act, 73rd Congress, H.R. 9620, available at https://fraser.stlouisfed.org/files/docs/historical/martin/54_01_19340627.pdf.
[3] See FHA (1936) and Pinto (2014) for more detail on the FHA's loan guarantee standards.
[4] For histories of the U.S. mortgage market, see Allen, Barth and Yago (2012), Jaffee and Quigley (2013), and Wallison (2015).

to build equity. Slightly more than half of the borrowers had debt-to-income ratios (DTIs) above

the 43 percent limit set by the Consumer Financial Protection Bureau as part of the ability-to-

repay standards developed after the financial crisis. And about 40 percent of the borrowers had a

credit score below 660, the standard definition of a subprime loan.[5] Tracy and Lee (2017) show

that FHA's weak underwriting standards have been associated with poor borrower outcomes.

They examine FHA's first-time buyer originations from 2002 to 2010, and find that more than 15

percent of the loans in each origination year ended either in default or with the homeowner

paying off the loan and returning to renter status; at least 30 percent of the originations in each

year from 2003 to 2008 ended in this way.

Against this backdrop, two authors of this paper (Oliner and Pinto) developed the Wealth

Building Home Loan (WBHL) to provide a low-risk path to homeownership and wealth

accumulation while maximizing buying power. The WBHL is not a specific product, but rather

an umbrella concept that gives lenders the freedom to structure loans to suit their needs subject to

four requirements: the loan must (1) fully amortize over a period markedly shorter than 30 years,

(2) be prudently underwritten, with monthly payments that fit comfortably within the borrower's

budget, (3) have little or no downpayment, and (4) have an interest rate that is either fixed for the

life of the loan or that adjusts after a minimum of five years with no more than a modest increase

in monthly payments. The first and second requirements, which echo the original FHA

standards, generate rapid equity accumulation and reduce default rates. The third requirement

addresses one of the main hurdles to homeownership – that qualified borrowers may have little

accumulated saving for a downpayment and other closing costs. With shorter-term loans, the

borrower builds equity rapidly through amortization, making a downpayment unnecessary,

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[5] These statistics are calculated from AEI's National Mortgage Risk Index dataset, which includes a near-census of
FHA and other government-guaranteed loans (see https://www.housingrisk.org/category/mortgage-risk/).

provided that the loan has been underwritten to reduce the risk of default before the borrower has built an equity cushion. The final requirement enables borrowers to benefit from the reduction in early-year payments by using an adjustable-rate mortgage (ARM) without the risk of a large payment shock at rate resets.

WBHLs are easy-to-understand loans that combine standard mortgage features in a novel way. The key insight is that shorter-term mortgages make it possible to eliminate downpayments and enhance buying power through an ARM rate structure while keeping default risk low. Stated differently, the 30-year fixed-rate mortgage – the centerpiece of the U.S. mortgage finance system – is actually a poor loan instrument for first-time buyers.

Nearly 20 community banks and credit unions and a national non-profit organization currently offer WBHLs. All the WBHLs in the market today are 15-year or 20-year loans, with a mix of fixed and adjustable rate structures. At present, lenders must hold WBHLs in portfolio as there is no vehicle for selling or securitizing the loans. Developing such an option would broaden the market for WBHL loans considerably.

The WBHL can be viewed as a specific type of alternative mortgage contract. Garmaise (2017) surveys the literature on these contracts, focusing on those that shift payments from the early years of the loan to later years, such as interest-only mortgages. He concludes that these products are best suited for young, highly educated homebuyers who expect their income to rise sharply, but likely are of limited value to other potential first-time buyers. In contrast, WBHLs – especially those with an ARM rate structure – enhance access to homeownership for a much broader population and do so with less risk than alternative mortgage products that build little or no equity.[6]

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[6] Passmore and von Hafften (2017) propose a new mortgage product, the "Fixed-COFI mortgage," which is similar to the WBHL in that it requires no downpayment and builds equity more rapidly than a 30-year fixed-rate loan. In

The WBHL also connects to the literature on behavioral economics. Concerns about inadequate retirement saving have led to the growing use of default "opt-in" enrollment in employer 401(k) plans, which has been found to increase participation in these plans (see Madrian and Shea, 2001, and Choi et al., 2004, for example). Once the employee has opted-in via this "nudge," saving occurs automatically. The WBHL provides the same type of automatic saving through the rapid build-up of home equity through regular monthly payments. In addition, with little or no downpayment and the use of an ARM rate structure that reduces initial payments, WBHLs can provide a nudge to opt into this form of saving.[7]

The rest of the paper is organizing as follows. Section 2 describes the WBHL in more detail and discusses government programs that attempt to support homeownership by providing guarantees for mortgage loans. The FHA has the largest program that competes directly with the WBHL. Notably, we show that the 20-year WBHL with a specific ARM rate structure has greater buying power than the standard 30-year FHA fixed-rate loan, overturning the usual result that borrowers who opt for shorter-maturity mortgages inevitably sacrifice buying power.

Section 3 analyzes the potential payment shock for borrowers taking out WBHLs with an ARM rate structure. We show that WBHLs provide substantially greater protection against payment shock than do 30-year ARMs, for the simple reason that more of the principal has been paid down by the time of a rate reset. Indeed, as long as the initial rate stays fixed for seven or ten years, as in standard 7/1 or 10/1 ARMs, the maximum potential payment increase with either a 15-year or 20-year WBHL can be kept in line with, or even below, typical increases in wages

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their mortgage, borrowers make a fixed mortgage payment over the life of the loan, but interest accrues in accord with an adjustable rate index. The difference between the fixed payment and the amount due based on the index is used to pay down the loan balance over and above the usual 30-year fixed-rate amortization. Their mortgage, although not especially complex, likely would take more effort to explain to borrowers than would the WBHL.

[7] Writing in the midst of the financial crisis, Thaler and Sunstein (2009, p. 271) suggested that "private and public institutions could try to reintroduce an old social norm: try to pay off the mortgage sooner rather than later, and at the latest by the time you retire." The WBHL does exactly that.

and salaries. This finding represents one of the central insights in the paper – that the ARM structure is much better suited to 15- and 20-year loans than to 30-year loans and can provide a safe way to hold down initial monthly payments.

Section 4 turns to the issue of equity accumulation through house price gains versus the paydown of mortgage debt. Using data at the zip-code level for the largest 100 metropolitan areas in the U.S., we show that relying on house price gains has been a risky proposition, especially in the part of a metro area with low-priced homes, where first-time buyers tend to concentrate. To our knowledge, the results in this section represent the most comprehensive analysis to date of house price changes by market tier. We then compare the equity that would be built through loan amortization with WBHLs versus a 30-year FHA loan. The results show that the WBHLs result in far more equity in the early years of the loan than does the FHA loan. The WBHL borrower, in effect, locks in a rapid pace of risk-free equity accumulation by paying down debt.

Section 5 examines the degree to which WBHLs can help insure against the incidence of negative equity when house prices decline. We conduct two exercises. The first uses granular house price measures for the Washington, DC, metropolitan area to simulate the equity position of homebuyers taking out WBHLs and 30-year loans in the years leading up to the financial crisis. The second exercise focuses on 30-year loans nationwide that defaulted during and after the financial crisis, analyzing how the substitution of a WBHL for the 30-year loan would have affected the borrower's equity position at the time of default and thereafter. Both exercises demonstrate that the WBHL would have provided considerable protection against negative equity. Had WBHLs been widely adopted before the financial crisis, these results suggest that defaults would have been much less common.

To provide evidence on this issue, Section 6 assesses the actual default performance of 15-year and 20-year fixed-rate mortgages (FRMs) versus 30-year FRMs during the financial crisis. The analysis uses loan-level data for about 2.5 million primary owner-occupied home purchase loans originated in 2005-2007 and acquired by Fannie Mae or Freddie Mac. After controlling for a variety of risk factors, we find that the 20-year loans defaulted only about half as often as 30-year loans, and the 15-year loans defaulted only about one-third as often. The shorter-maturity loans performed especially well in areas that experienced large house price declines. These results imply that WBHLs can be expected to have substantially lower default rates than 30-year loans under stressed conditions.

2. What is the Wealth Building Home Loan?

2.1. Main features

Two authors of this paper (Oliner and Pinto) developed the WBHL in 2014 to provide homebuyers with a reliable and effective means to build wealth while preserving the buying power of the traditional 30-year FRM to the maximum possible extent. There is no rigid definition of the WBHL. Instead, we set out basic principles that loans must meet to quality as WBHLs, leaving lenders the freedom to structure WBHLs that suit their business model and the markets in which they operate.

The principles that define WBHLs are as follows. First, to build equity, the loan must have a term that is materially shorter than 30 years and must fully amortize over the stated term. All the WBHLs currently in the market have a term of 15 or 20 years, but these two options do not exhaust the range of possibilities. Second, the loan must require little or no downpayment in order to make homeownership accessible to a broad range of qualified buyers. Third, because the borrower has little or no equity at the time of origination, the loan must be prudently

underwritten so that early payment defaults are rare. The key element of prudent underwriting involves making sure that the loan's monthly payments fit comfortably in the borrower's budget.[8] Finally, to avoid payment shocks after origination, the loan must have either a fixed interest rate or a rate that adjusts after a minimum of five years with no more than a modest increase in monthly payments.[9]

Loans adhering to these principles provide much safer access to homeownership for first-time buyers and lower- and moderate-income households than the 30-year loans with high payment burdens that are commonplace today. Although defaults are expected to be infrequent, a WBHL borrower who encounters payment difficulties should have good options for remediation because, in all likelihood, the borrower will have substantial equity in the home. With equity at stake, the borrower has a strong incentive to remain current after a loan modification, which makes remediation attractive to the lender.

2.2. Existing WBHL programs

The first WBHL was introduced in September 2014 through a collaboration between AEI and the Neighborhood Assistance Corporation of America (NACA), a national nonprofit organization that promotes affordable homeownership and healthy neighborhoods. With subsidized funding from Bank of America and Citibank, NACA offers a 15-year fixed-rate version of the WBHL for lower-priced homes through its more than 40 offices nationwide (see https://www.naca.com/).

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[8] As part of this determination, we strongly recommend that lenders use the residual-income test currently employed by the Department of Veterans Affairs (VA) and previously used by the FHA. This test checks whether the borrower would have sufficient income left over after their housing payments and other required monthly payments to cover an estimate of living expenses that varies with family size and location. See Goodman, Seidman, and Zhu (2014) for more on the residual-income test.

[9] For additional information about the WBHL, see the FAQs posted at https://www.housingrisk.org/wbhl-frequently-asked-questions/.

The first lender to offer an unsubsidized WBHL was Androscoggin Bank, a community lender in Lewiston, ME. Androscoggin launched its 15-year WBHL in December 2014 and subsequently added a 20-year version of the loan. Both of the loans feature a two-step rate structure, with a low initial rate for the first seven years, which then converts to a stepped-up rate for the remaining life of the loan.[10] The low initial rate enhances buying power relative to a fixed-rate loan, and as we discuss in Section 3, the rate adjustment in year eight has only a small effect on monthly payments. A major benefit for borrowers is that neither WBHL requires any downpayment. The only upfront payment for the 15-year loan, other than typical closing costs, is a 3 percent payment to buy down the initial interest rate. The 20-year loan has no rate buydown, but requires a 2 percent upfront payment to purchase mortgage insurance for the life of the loan. Androscoggin's WBHLs have proven to be popular with borrowers, with the 15-year and 20-year loans together accounting for about 30 percent of the bank's total mortgage originations.

Nearly 20 community banks and credit unions, including Androscoggin, offer WBHLs through a mortgage insurance program developed by MGIC specifically for these loans.[11] MGIC's program covers primary owner-occupied home purchase loans with terms of 20 years or less. No downpayment is required, and lenders have the freedom to structure the WBHLs they offer within the broad parameters of the MGIC program.[12]

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[10] The 15-year loan has an initial interest rate of 1.75 percent, which steps up to 5 percent, while the 20-year loan has an initial rate of 2.99 percent, which steps up to 5.25 percent. Unlike typical adjustable-rate mortgages, the borrower knows at origination how the rate will adjust.

[11] Androscoggin participates in the MGIC program for its 20-year WBHL but self-insures its 15-year loan.

[12] For details about the MGIC program, see https://www.mgic.com/-/media/MGIC/playbook/71-43616-WealthBuilderPro-Description.pdf?la=en.

2.3. Related government programs

The federal government attempts to support homeownership through a variety of programs that provide guarantees for home mortgage loans. The agencies offering guarantees include the FHA, which largely focuses on first-time buyers and lower- and moderate-income households nationwide; the Rural Housing Service (RHS), which pursues essentially the same objective in rural areas; the VA, which serves active-duty military, veterans, and spouses of service members who died in service; and the government-sponsored agencies (GSEs), Fannie Mae and Freddie Mac, which target lower-income households and lower-income areas through their affordable housing goals.

Table 1 shows the number of primary owner-occupied home purchase loans guaranteed by these agencies in 2016. Although the GSEs dominate this market as a whole, their importance shrinks relative to the other agencies when considering first-time buyers, and fades further for first-time buyers making little or no downpayment (those with combined loan-to-value ratios (CLTVs) above 95 percent).[13] For this group of first-time buyers, FHA accounts for nearly two-thirds of the government-guaranteed loans. FHA remains dominant, though a bit less so, for the subset of these borrowers who meet the DTI and credit score requirements for MGIC's mortgage insurance program. Thus, FHA is the largest government program that competes directly with the WBHL, and in the remainder of the paper, we compare the WBHL along several dimensions to a standard 30-year FHA fixed-rate loan.

State housing finance agencies have their own programs to support homeownership. These programs typically combine a low-downpayment first mortgage with a second lien or outright grant to cover the downpayment or closing costs. These loans are generally targeted to

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[13] The CLTV includes not only the first mortgage loan but also any subordinate liens taken out at origination.

first-time buyers (subject to income limits) and to other groups that include active-duty military, veterans, and public service workers such as the police, firefighters, and teachers. These programs are very widespread: 48 states and the District of Columbia offer at least one first-mortgage program.[14]

For our purpose, the key feature of these state programs is their near-exclusive use of 30-year loans. Only two states, Minnesota and Oregon, have programs that include 15-year loans, and none appear to include 20-year loans. This is a missed opportunity to promote wealth building, which could be addressed by adding the WBHL to the lineup of loans offered by state programs.

2.4. Buying power

A perceived drawback of shorter-maturity mortgages is that one cannot buy as much house as with a 30-year loan because the faster amortization of principal raises monthly payments. Table 2 addresses this issue, comparing the buying power of the 15- and 20-year WBHLs offered by Androscoggin Bank versus a standard 30-year fixed-rate FHA loan. The FHA loan has an interest rate of 4.25 percent, a 3.5 percent downpayment (the minimum allowed), and a 1.75 percent upfront mortgage insurance premium that is assumed to be rolled into the loan amount, the standard practice for FHA borrowers.[15] The FHA loan also has a separate annual insurance premium of 0.85 percent of the loan balance. The table shows the monthly payments across the three loans for a $200,000 home. A higher monthly payment for one loan indicates that it has less buying power than the other two – that is, a buyer would have

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[14] The Federal Deposit Insurance Corporation (FDIC) publishes detailed information about these state programs; see FDIC (2016).

[15] The assumed 4.25 percent interest rate equals the median note rate on 30-year fixed-rate FHA home purchase loans originated from January through August 2017. We calculated the median rate from AEI's National Mortgage Risk Index dataset, which includes a near-census of government-guaranteed loans.

to purchase a home costing less than $200,000 to maintain the monthly payment associated with the other two loans.

To begin the comparison, rows 1-3 show that the FHA loan entails a larger initial payment at closing than either WBHL because the FHA downpayment exceeds the 3 percent rate buydown on the 15-year WBHL and the 2 percent upfront mortgage insurance premium on the 20-year WHBL. We assume that that buyer keeps the upfront savings in a bank account earning zero interest and uses the savings as an offset against the monthly payments for the WBHLs over an assumed seven-year life of the loan, as shown in row 6.

The resulting monthly payment – which includes principal and interest, the ongoing FHA insurance premium, and the offset from the use of upfront savings with the WBHLs – is shown in row 7. The key result is that the 20-year WBHL has a slightly *lower* monthly payment than the 30-year FHA loan. The WBHL's advantage arises from two factors. First, the cost of credit enhancement is considerably lower than for the FHA loan, owing to the reduced default risk. And second, the WBHL's two-step rate structure holds down monthly payments during the initial seven-year period compared with a fixed-rate loan. Given that the 20-year WBHL has greater buying power than the FHA loan and allows the borrower to build equity more rapidly, any borrower who qualifies for the 20-year WBHL should forgo the FHA loan in favor of the WBHL.

For the 15-year WBHL, the very rapid equity buildup leaves the monthly payment about $150 above that with the FHA loan. This difference implies that the buyer using a 15-year WBHL would need to reduce the purchase price of the house from $200,000 to about $176,500 in order to maintain the same monthly payment as with the other two loans. The 15-year WBHL

would appeal to buyers who place a high premium on building equity and are less concerned about the size of the monthly payments.

To sum up, any borrower who qualifies for a 20-year WBHL on the terms offered by Androscoggin should take it over a 30-year FHA loan. This choice is optimal regardless of the borrower's propensity to save. Borrowers with an especially strong desire to build equity might choose the 15-year WBHL over the 20-year version, but no qualified borrower should opt for the FHA loan.

3. ARMs and payment shock

The previous section showed that a large majority of the WBHLs offered by private lenders have been structured as ARMs of some type. The ARM structure enhances buying power by lowering the initial interest rate relative to the FRM rate. Nonetheless, in the broader mortgage market, FRMs generally have been much more popular than ARMs.[16] This preference suggests that mortgage borrowers value the stability of monthly payments with FRMs and have concerns about the potential for increases in monthly ARM payments when rates reset after the initial fixed period. This section examines the potential payment shock for 15- and 20-year WBHLs relative to standard 30-year ARMs, showing that WBHLs greatly reduce this risk.

We focus on ARMs with an initial fixed period of five, seven, or ten years. Although ARMs with shorter fixed periods – typically one or three years – are widely available in the market, these loans expose borrowers to considerable payment shock regardless of loan term,

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[16] Using data from the Mortgage Bankers Association, Passmore and von Hafften (2017) calculated that ARMs represented 17.4 percent of mortgage applications from 1990 to 2008 and that the ARM share has dropped since then, averaging 5.6 percent from 2009 through early 2017. Over shorter periods, there has been substantial variation in the ARM share, largely driven by changes in the configuration of long-term versus short-term interest rates. For analyses of the choice between ARMs and FRMs, see Koijen, van Hemert, and van Nieuwerburgh (2009), Krainer (2010), and Moench, Vickery, and Aragon (2010).

and hence fail to meet the core WBHL principle that increases in monthly payments over the life of the loan must be modest.

The ARMs that we examine have interest rates that reset annually after the initial fixed period, the most common reset interval. Loans with five-year, seven-year, and ten-year initial fixed periods followed by annual resets are known in the market as 5/1, 7/1, and 10/1 ARMs. For each of these loans, we analyze two common structures for the caps on rate increases after the expiration of the initial fixed period – the so-called 2/2/5 and 5/2/5 caps. The first number in the cap description shows the maximum increase in the interest rate at the first reset (in percentage points), the second number shows the maximum increase at any subsequent reset, and the third number shows the maximum increase over the life of the loan. Thus, for a 2/2/5 cap structure, the rate can rise as much as 2 percentage points at the first rate reset, 2 percentage points at each subsequent reset, and 5 percentage points in total relative to the initial fixed rate. The 5/2/5 cap structure differs from the 2/2/5 structure by allowing the first rate increase to be as much as 5 percentage points. Clearly, the 2/2/5 cap provides more protection for borrowers by delaying the earliest possible date at which the full 5 percentage point increase could occur.

Table 3 shows the maximum rise in principal and interest payments for 5/1, 7/1, and 10/1 ARMs with either a 2/2/5 or 5/2/5 cap and a loan term of 15, 20, or 30 years. The table displays both the total percentage increase in principal and interest payments, along with that increase expressed at an average annual rate over the period from loan origination to the date when the lifetime cap kicks in. The average annual rate can be compared with wage growth and inflation to gauge the burden of the payment change in real terms. The table also indicates whether each particular ARM is currently eligible for purchase by the GSEs. The ARM interest rates used to generate the results in the table were representative of market rates in September 2017.

For ARMs with a 30-year term, the top panel of the table shows that the potential payment shock is very large. Indeed, for a 5/1 ARM with a 5/2/5 cap structure, principal and interest payments could rise 63 percent at the beginning of year six, which implies an average increase of more than 10 percent annually. Although lengthening the initial fixed period or using the safer 2/2/5 cap structure reduces the payment shock, all of the 30-year ARMs eligible for purchase by the GSEs have potential payment increases of 50 percent or more, which translates to an annual rate of at least 4.1 percent. With general price inflation running below 2 percent and indexes of wages and salaries rising less than 3 percent annually, all of the 30-year, GSE-eligible ARMs carry the risk of a sizable real payment shock.

Moving to a 20-year ARM reduces the potential payment shock, and a 15-year ARM does so even more. The potential payment shock falls with the loan term because more of the loans balance has been repaid by the date that the lifetime rate first hits. For example, with a 15-year 7/1 ARM, only 59 percent of the original principal remains at the end of year seven, while for a 30-year 7/1 ARM, 85 percent is still unpaid. With the faster payoff of a shorter-term mortgage, the rate reset applies to a smaller remaining loan balance, which tempers the increase in the monthly payment.

As shown in the middle panel, switching to a 20-year ARM reduces the maximum payment shock by roughly one-third to one-half relative to a 30-year ARM, with the largest proportionate decline for the 10/1 loans. The 15-year ARM, shown in the lower panel, reduces the maximum payment shock by as much as three-quarters relative to a 30-year ARM. Using the 10/1 structure for 20-year ARMs and either the 7/1 or 10/1 structure for 15-year ARMs ensures that the maximal rise in payments will be less than 3 percent at an annual rate. No 30-year ARM in the table delivers this level of protection from payment shock.

The results in table 3 pertain to standard cap structures. Even more insurance against payment shock can be achieved with other rate resets. For example, as noted in Section 2, the Androscoggin 20-year WBHL has a 2.99 percent initial rate that adjusts to 5.25 percent at the end of year seven for the remaining life of the loan. This adjustment boosts the initial monthly principal and interest payment by 14.4 percent, which translates to 1.9 percent at an average annual rate over the seven years after origination. This result shows that 20-year ARMs can be structured to have modest payment shock with a seven-year initial fixed period.

To summarize, these findings highlight the potential payment shock with 30-year ARMs. This risk can be reduced dramatically through the use of shorter-term loans. As long as the initial fixed period is seven years or longer, the maximum potential payment increase with either a 15-year or 20-year ARM can be kept in line in with, or even below, typical increases in wages and salaries. This finding leads to one of the central insights of our research – that the ARM structure is much better suited to 15- and 20-year loans than to 30-year loans and can provide a safe way to hold down initial monthly payments.

4. Home prices and equity accumulation

Homeowners can accumulate equity though price appreciation or by paying down mortgage debt. This section examines the historical record of house price changes at the zip-code level to assess the typical strategy of relying primarily on price appreciation to build equity. We show that this has been a risky proposition, especially in the parts of a metro area with low-priced homes, where first-time buyers tend to concentrate. We then quantify the amount of equity that can be built by shifting from a 30-year FHA fixed-rate loan to a 15-year or 20-year WBHL.

4.1. Historical house price changes

We study the behavior of house prices in the 100 largest metropolitan areas (CBSAs) in the United States ranked by 2010 population. Our analysis uses house price indices published by the Federal Housing Finance Agency (FHFA) for five-digit zip codes. As described in Bogin, Doerner, and Larson (2016), the FHFA indices are repeat-sales measures constructed from purchase and refinance transactions that involve mortgages acquired by the GSEs. We use the zip codes in the top 100 CBSAs with indices back at least to 1990. Although FHFA publishes indices for some zips as far back as 1975, an earlier start date than 1990 would have substantially reduced the coverage.

Because first-time homebuyers tend to purchase lower-priced homes, we divide the zips in each CBSA into three price tiers to estimate price changes in different parts of the housing market. Zip codes are assigned to price tiers using Zillow's estimates of the median house price in each zip in 2000.[17] Zips with an estimated median house price in the bottom third, middle third, and top third of all the zips in its CBSA are placed in the bottom, middle, and top price tiers, respectively. We believe the results presented here represent the most comprehensive analysis to date of house-price changes by market tier.[18]

Table 4 shows the share of zip codes for which the FHFA house price index declined in nominal terms over adjacent five-year periods starting in 1990-1995 and ending in 2010-2015. The results are presented both for the entire set of zip codes and for the zip codes in each price tier. During 1995-2000 and 2000-2005, the national housing boom lifted home prices almost

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[17] The zip-level data are posted at https://www.zillow.com/research/data/ under the link labelled "ZHVI All Homes (SFR, Condo/Co-op) Time Series ($)". We use median prices in 2000 to assign zips to price tiers because that year is roughly the midpoint of our 1990-2015 analysis period; assigning zips to price tiers based on the ranking in other years has little effect on the results.

[18] The best-known house price indices by market tier are the S&P CoreLogic Case-Shiller indices, which cover 17 large metropolitan areas back to the late 1980s or early 1990s. These indices are available at https://us.spindices.com/index-family/real-estate/sp-corelogic-case-shiller under the link labelled "Additional info".

everywhere. However, a sizable share of zips experienced price declines during the other five-year periods. Between 1990 and 1995, 34.5 percent of all included zips saw nominal house prices fall on net; this share rose to nearly 79 percent of zips over the 2005-2010 period that overlapped with the housing bust. Even after the bust gave way to recovery (the 2010-2015 period), prices declined on balance in almost 29 percent of zip codes.

The table also shows that price declines during 1990-1995, 2005-2010, and 2010-2015 were more widespread in the bottom-tier zips than in the middle-tier and top-tier zips. Notably, during the most recent five-year period, the FHFA price index fell in almost 43 percent of bottom-tier zips, compared with declines in only 15 percent of the top-tier zips. These results raise a caution flag about price risk for households just entering the housing market. Moreover, the results understate the risk of a price decline for any individual house, as the zip-level indices represent averages over the homes used to calculate the index.

Table 5 supplements this analysis by showing the average annual rate of price change over each of the five-year periods and the entire 25-year period from 1990 to 2015. The main takeaway is that over the past quarter century, the average rate of house price appreciation has been slow and subject to substantial volatility. Averaging across the full set of zips, the FHFA price index increased at a 2.8 percent annual pace from 1990 to 2015, reflecting two five-year periods with sizable gains (1995-2000 and 2000-2005), two periods with meager increases (1990-1995 and 2010-2015), and one period with falling prices.[19]

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[19] The 2.8 percent average annual increase in nominal house prices over 1990-2015 implies a real increase of only 0.4 percent annually over this period relative to the rise in the consumer price index (accessed from the FRED data repository at the Federal Reserve Bank of St. Louis, https://fred.stlouisfed.org/series/CPIAUCSL). This modest real increase over 1990-2015 matches the result obtained by Robert Shiller over the long historical period from 1890 to 2016. Shiller's house price series are posted at http://www.econ.yale.edu/~shiller/data.htm under the link labelled "US Home Prices 1890-Present".

The outcomes for buyers in bottom-tier zips are worse than for buyers in top-tier zips, with lower average appreciation and greater volatility. For bottom-tier zips, house prices rose 2.5 percent annually on average over 1990-2015, compared with the 3.1 percent pace in the top-tier zips. The difference in volatility was especially pronounced during the housing boom (2000-2005) and bust (2005-2010). In the boom period, house prices in the bottom tier rose about 2 percentage points faster per year than in the top tier. This pattern then reversed during the bust, with prices in the bottom tier falling about 2¼ percentage points more rapidly per year.

The worse track record for house prices in bottom-tier zips likely reflects at least two factors. First, the widening of income equality has boosted buying power in areas with expensive homes relative to lower-price areas, contributing to the gap in average price appreciation. And, second, cyclical swings in mortgage lending standards have a greater impact on first-time buyers than on repeat buyers.[20] Because first-time buyers tend to purchase relatively inexpensive homes, this cyclical influence on house prices is strongest in bottom-tier areas.[21]

All in all, this analysis shows that homebuyers – especially those in the lower part of the market – cannot count on home price appreciation to build equity. The only sure way to accumulate equity is to pay down mortgage debt.

4.2. Equity accumulation through debt paydown

Figure 1 compares the equity accumulation over the first five years of a 30-year FHA loan, a 20-year WBHL, and a 15-year WBHL. The two WBHLs are those offered by

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[20] See Duca, Muellbauer, and Murphy (2013) for evidence covering the late 1990s to mid-2000s and AEI's National Mortgage Index (NMRI) for the period since 2013. During both periods, lending standards eased for first-time buyers but changed little for repeat buyers.

[21] The NMRI data show that in 2016, the median price of homes purchased by first-time buyers was $195,000, compared with a median price of $261,000 for repeat buyers. These figures pertain to homes financed with a federally-guaranteed loan.

Androscoggin Bank; these loans have no downpayment, so the borrower's equity starts at zero. The FHA loan has a 3.5 percent downpayment and a 1.75 percent upfront mortgage insurance premium that is assumed to be rolled into the loan amount, leaving the borrower with an initial equity position of about 1.8 percent of the home value.[22] The assumed interest rate on the 30-year FHA loan is 4.25 percent, the average rate on 2017 FHA home purchase originations through August (the latest month of data). All three loans in the comparison are used to purchase a $200,000 house. We assume that the value of the house remains unchanged to measure the equity that accrues solely from paying down the mortgage balance.

Despite having no downpayment, the 15-year WHBL has built considerably more equity than the FHA loan by the end of year one, while the 20-year WBHL has pulled slightly ahead. These gaps widen year-by-year over the simulation period. By the end of the fifth year, the WBHL borrower has accumulated roughly $61,000 in equity with the 15-year loan and $39,000 with the 20-year loan, well ahead of the FHA borrower's $21,500 in equity. These figures can be converted into the rate of house price appreciation that would be required to yield the same equity position with no repayment of loan principal. For the 15-year WBHL, the home's price would have to rise at an average annual rate of 5.5 percent to achieve a $61,000 equity position at the end of the fifth year. For the 20-year WBHL, the rate of price appreciation would be 3.7 percent, and for the FHA loan, 2.1 percent. Thus, the two WBHLs build equity at a rate that well outpaces the average pace of home price appreciation over the past 25 years without the risk associated with relying on price gains to generate equity.

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[22] The 1.2 percent equity position is derived as follows. The borrower's loan-to-value ratio at origination is 0.965 + 0.0175*0.965 ≈ 0.982, reflecting the combined effect of the 3.5 percent down payment and the upfront mortgage insurance premium that the vast majority of FHA borrowers roll into the loan. With a total loan-to-value ratio of 98.2 percent, the borrower's equity at origination is 1.8 percent of the home value.

5. Protection against negative equity

In this section, we conduct two exercises to assess the degree to which WBHLs can help insure against the incidence of negative equity. The first exercise simulates the equity position of homeowners taking out 30-year loans and WBHLs in the years preceding the financial crisis using very granular house price measures for the Washington, DC, metropolitan area. In the second exercise, we focus on 30-year loans that defaulted during and after the financial crisis, analyzing how the substitution of a WBHL for the 30-year loan would have affected the loan's CLTV at the time of default and thereafter.

5.1. Simulation exercise for the Washington, DC, metro area

Using house-level price indices from Weiss Analytics for more than 530,000 single-family homes in seven Washington, DC, jurisdictions, we simulate the equity position associated with three alternative fixed-rate mortgages: a 30-year FHA loan, a 20-year WHBL, and a 15-year WBHL. The seven jurisdictions covered by the analysis are the District of Columbia; Arlington, Fairfax, Loudoun, and Prince William Counties in Virginia; and Montgomery and Prince George's Counties in Maryland. As documented in Davis et al. (2017), the house price declines after the financial crisis varied widely across these jurisdictions, ranging from severe price drops throughout Prince George's County and many parts of Prince William and Loudoun Counties to little or no decline in most of Arlington County and parts of the District of Columbia.

At the purchase date, a buyer's equity position, expressed as a percentage of the home's value, equals 100 minus the initial loan-to-value ratio. From this starting point, the equity position evolves with the change in the home's value and the change in the principal balance of the loan. For example, if the home's value rises 10 percent over the first year and the loan

balance declines 3 percent over the same period from an initial loan-to-value ratio of 95 percent, the homebuyer's equity position would rise from 5 percent initially to 16.2 percent a year later.[23]

For each home, we track the borrower's equity for seven years from an assumed purchase at the beginning of 2004. We then repeat this exercise for an assumed purchase at the beginning of 2005, 2006, and 2007, generating four seven-year equity paths for each home. For each home, we compute a preliminary path of home value using the monthly house-specific price indices from Weiss Analytics. The Weiss indices allow us to account for the differing paths for home values within zip codes. To ensure that the Weiss indices aggregate to known zip-level measures of house prices, we adjust all the Weiss indices in a given five-digit zip code by a yearly zip-level factor that equals the median Weiss index value for homes in that zip to the house price index published by FNC, Inc.[24]

On the mortgage side, we set the initial loan-to-value ratio to 100 percent for both WBHLs and 98 percent for the 30-year FHA loan (3.5 percent down payment, offset partly by an upfront 1.5 percent insurance premium rolled into the loan).[25] The mortgage amortizes over the stated term based on an assumed interest rate. For the FHA loan, we use the average interest rate on 30-year fixed-rate loans for the year of purchase with CLTVs of 95 percent or more,

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[23] With the home value rising to 110 and the mortgage balance declining to 92.15 (95*0.97), the homeowner's equity position becomes $(110 - 92.15)/110 \approx .162$.

[24] The zip-level FNC price indices are constructed from a spatial hedonic model; see Dorsey et al. (2010) for details. We use the FNC indices for this benchmarking rather than the better-known FHFA house-price indices for two reasons. First, and most important, the FNC indices are based on all home purchases, while the FHFA indices for five-digit zip codes are limited to transactions with GSE financing. Because many of the worst loans during the housing boom were too risky to qualify for a GSE guarantee, the zip-level FHFA indices tend to understate house price volatility. Second, the FNC indices are available on a monthly basis, while the FHFA indices for five-digit zips are published only on an annual basis. The monthly frequency for the FNC indices lines up with the frequency of the house-specific Weiss indices. We use the monthly data to construct beginning-of-year Weiss indices and the corresponding FNC-based adjustment factors from the average index values in the fourth quarter of the preceding year and the first quarter of the year in question.

[25] Although FHA's upfront mortgage insurance premium is currently 1.75 percent, it was 1.5 percent during the origination years covered by this analysis.

computed from the GSEs' publicly available loan-level datasets.[26] For the WBHLs, we estimate

the average annual rate spreads between 15-year, 20-year, and 30-year fixed-rate mortgages with

a CLTV of 95 percent or more using the GSE data after controlling for the borrower's credit

score and debt-to-income ratio. For 2004, the spreads are calculated with data from Fannie Mae

alone, as the 2004 Freddie data do not include loans with 15- or 20-year terms. The 15-year and

20-year loan rates in the analysis equal the 30-year rate reduced by the calculated spread and by

an additional 75 basis points to reflect the rate buydown that could be obtained by converting the

3.5 percent FHA down payment to the payment of upfront discount points.[27]

　　We distill the large set of simulations for each loan type into a single summary measure –

the average share of properties with negative equity at the end of each of the seven tracking years

for each of our four origination years. Figure 2 displays the results of this exercise for the

Washington area jurisdictions taken together and each one individually. Panel A compares the

average share of properties that would have registered a negative equity position of any amount

by loan type while Panel B compares the share with severe negative equity, which we define to

be negative equity of 20 percent or more.[28]

　　For the jurisdictions taken together, Panel A shows that the 30-year FHA loan generates

negative equity of some amount 42 percent of the time. The 15-year WBHL cuts this likelihood

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[26] The data come from Fannie Mae's Single-Family Loan Performance Dataset and Freddie Mac's Single-Family Loan-Level Dataset, which are posted at http://www.fanniemae.com/portal/funding-the-market/data/loan-performance-data.html and http://www.freddiemac.com/research/datasets/sf_loanlevel_dataset.html, respectively.

[27] A standard rule-of-thumb is that each percentage point paid upfront buys down the interest rate on a 15-year fixed-rate loan by 20 to 25 basis points. Thus, paying 3.5 points yields a range for the rate buydown of 70 to 87.5 basis points, which includes our assumed 75 basis point buydown. We apply this estimate to the 20-year loan as well.

[28] To our knowledge, there is no standard definition of severe negative equity. We chose a threshold of 20 percent based on the results in Bhutta, Dokko, and Shan (2017). They showed that for negative equity of less than 20 percent, defaults are largely driven by the borrower's inability to pay and are not closely linked to the depth of negative equity. However, when negative equity exceeds 20 percent, strategic considerations come into play. As the degree of negative equity rises from that level, borrowers increasingly default even if they could continue making their mortgage payments with limited or no financial hardship.

nearly in half, while the 20-year WBHL falls roughly in the middle of these outcomes. Panel B indicates that the two WBHLs provide even greater protection against severe negative equity, with the 15-year WBHL cutting the risk of this outcome for all jurisdictions together by about two-thirds compared with the 30-year FHA loan; the 20-year WBHL reduces the risk by about one-third. Qualitatively, these results for the all-jurisdiction aggregate hold as well for the individual jurisdictions.

The simulated performance of the 30-year FHA loan varies greatly by jurisdiction, especially with regard to the incidence of severe negative equity. For example, in the District of Columbia and Arlington County, less than 5 percent of our hypothetical borrowers would have experienced severe negative equity with the 30-year loan. By contrast, in Prince William, Prince George's, and Loudoun Counties, the analogous share ranges from 25 to 33 percent, driven by the steep decline in house prices.

The greatest benefit of either WBHL comes in areas where the 30-year FHA loan performed the worst. In particular, the simulation shows that moving from the 30-year loan to the 15-year WBHL would have reduced the incidence of severe negative equity by 20 percentage points in Prince William County and 18 percentage points in Prince George's County but only by 3 percentage points in the District of Columbia and less than 2 percentage points in Arlington County. The upshot from these results is that the 30-year FHA loan is a very risky choice in areas with volatile house prices and that widespread adoption of the WBHL in these areas would be especially valuable as protection against negative equity.

5.2. Analysis of CLTVs at default

Our second simulation focuses on 30-year FRMs that defaulted during and after the financial crisis, analyzing how the substitution of a WBHL for the 30-year loan would have

affected its CLTV at the time of default and thereafter. The data come from CoreLogic's Loan Level Market Analytics (LLMA) dataset.

The roughly 220,000 defaulted loans used in this analysis consist of 30-year FRMs originated from 2004 to 2007 with a CLTV at origination of 95 percent or more and sufficient information to determine the date of default. A loan is deemed to have defaulted if (1) it was ever at least 180 days delinquent, (2) was classified as real estate owned or foreclosed prior to a 180+ day delinquency, or (3) was 90 days or more delinquent on December 31, 2012, the final date at which we track loan performance. The date of default is the first month in which any of these conditions is satisfied. The CLTV at default equals the remaining loan balance divided by the estimated house price at the time of default. The remaining loan balance is calculated by amortizing the original loan amount over the 30-year term using the mortgage rate described in the previous section. The estimated house price equals the price at origination moved forward to the date of default using the FNC, Inc. house price index for the home's five-digit zip when that index is available, and the FHFA all-transactions index for five-digit zips when the FNC index is not available.[29]

For each 30-year FRM in the dataset, we also calculate a counterfactual CLTV at default for 15-year and 20-year WHBLs. The counterfactual CLTVs use the same estimated house-price path as for the 30-year loan but build in the faster paydowns for 15-year and 20-year loans. The mortgage rates used to calculate the amortization for the counterfactual WBHLs are those described in the previous section.

Figure 3 shows the distribution of CLTVs at default by loan origination year for the 30-year loans (the green bars) and the counterfactual 15-year WBHLs (the unshaded bars). For the

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[29] An FNC index is available for about 75 percent of the zip codes in the dataset. If neither the FNC nor FHFA indices are available, we omit the loans in that zip; this occurs for less than 3 percent of zip codes.

30-year loans, the distributions of estimated CLTVs at default are very wide, ranging from 90 percent or less at the low end to 200 percent or more at the high end. The wide range is consistent with the distributions estimated by Bhutta, Dokko, and Shan (2017) and Gerardi et al. (2015).[30] These papers, among others, show that defaults at the lower end of the CLTV range largely reflect a job loss or some other income shock that makes it difficult to continue making payments. In our data, the majority of defaults occur at CLTVs below 120 percent, highlighting the importance of payment difficulties. But the distribution also has a long right-hand tail, consistent with the results in Bhutta, Dokko, and Shan (2017) showing that many borrowers are reluctant to walk away from their mortgages until they are very deeply underwater.

Figure 3 illustrates the benefits of faster equity accumulation with a counterfactual 15-year WBHL. As indicated by the inset box, the 30-year FRMs originated in 2004 had an average CLTV at default of 108 percent. The counterfactual 15-year WBHL would have reduced the average CLTV at that point to 81 percent, enabling a borrower suffering an income shock to sell the home rather than defaulting. As expected, the benefits from faster amortization were more pronounced for loans that had more time to build equity before the market peaked. Accordingly, for loans originated in 2007, switching from a 30-year FRM to a 15-year WBHL would have reduced the average CLTV at default a more modest 12 percentage points (from 124 percent to 112 percent). Nonetheless, for every origination year, a 15-year WBHL would have left a sizable fraction of borrowers with positive equity at the time they chose to default on their 30-year loan.

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[30] Gerardi et al. (2015) estimate, as we do, that some borrowers had positive equity at default. Bhutta, Dokko, and Shan (2017) truncate their distribution, excluding any CLTVs below 100 percent. In our data, defaults with positive equity are most likely explained by measurement errors in the estimated home value or by unobserved transaction costs that make it uneconomic to sell the house even though the borrower has positive equity.

Figure 4 shows the results from using a 20-year WBHL, instead of a 15-year WBHL, as the counterfactual loan. Compared with Figure 3, there is a smaller leftward shift in CLTVs from the baseline distribution for 30-year loans because the 20-year WBHL builds equity less rapidly than the 15-year WBHL. For example, for originations in 2004, the 20-year WBHL would have reduced the CLTV at the time of default to 96 percent compared with 81 percent with a 15-year WBHL.

Table 6 summarizes the equity positions at default displayed in Figures 3 and 4. The table shows both the share of defaults with negative equity of any amount (CLTV > 100 percent) and the share with severe negative equity (CLTV > 120 percent). The first line in the table displays the results for the 2004-2007 origination years combined; the results for each origination year separately are shown in the lines below. For the 2004-2007 originations taken together, 83 percent of the 30-year loans are estimated to have had negative equity at the time of default and 39 percent are estimated to have had severe negative equity. A 20-year WBHL would have reduced these shares to 70 percent and 32 percent, respectively, while a 15-year WBHL would have further lowered the shares, to 53 percent and 23 percent, respectively. These results primarily reflect the outcomes for the 2006 and 2007 originations, which account for the vast majority of defaults in the dataset. Even though these loans had limited time to amortize before the market downturn, the WBHLs would have produced a meaningful reduction in the incidence of negative equity. Defaults were less frequent among the 2004-2005 originations, but among those that did default, a WBHL would have greatly reduced the fraction with negative equity.

In the face of continuing house price declines, it is possible that WBHLs would have only delayed the date of default for many borrowers rather than preventing default altogether. To test

this hypothesis, we estimate the share of hypothetical WBHLs that never would have reached the estimated CLTV at default for 30-year FRMs. We generate these counterfactual "post-default" CLTVs by moving forward each home's estimated price and remaining loan balance beyond the observed default date.

Table 7 summarizes these results. For the 2004-2007 originations taken together, 35 percent never would have reached the estimated CLTV at default had the borrower chosen a 20-year WBHL and 62 percent never would have done so with a 15-year WBHL. These percentages differ by origination year, with the greatest benefit from WBHLs for the 2004 vintage and the smallest benefit for the 2007 vintage. Nonetheless, even for the 2007 vintage, a 20-year WBHL would have prevented 28 percent of borrowers from reaching the CLTV that triggered default, and a 15-year WBHL kept 53 percent of borrowers from getting to that point.[31]

6. Performance of shorter-maturity mortgages

The previous section showed that shorter-maturity mortgages would have reduced the incidence of negative equity during the financial crisis. This section builds on that analysis by estimating the actual default performance of 15-year and 20-year FRMs relative to 30-year FRMs during that period. We find that the 15-year and 20-year loans had substantially lower default rates than observably equivalent 30-year loans, consistent with the results for 15-year loans in An, Deng, and Gabriel (2016) and Courchane, Kiefer, and Zorn (2014) and for the combination of 15-year and 20-year loans in Fout, Li, and Palim (2017). Our results appear to be the first in the literature on the performance of 20-year loans per se. In addition, we go beyond

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[31] These figures may understate the actual share of borrowers whose CLTVs would have stayed below the estimated CLTV that triggered default. Had the use of WBHLs been widespread, the lower volume of foreclosures would have reduced the number of distressed properties, thereby tempering the decline in house prices – a benefit that would have been greatest in neighborhoods with many foreclosures.

the existing literature on shorter-maturity loans by examining performance conditional on the borrower's CLTV at origination and local movements in house prices.

The analysis covers about 2.5 million primary owner-occupied home purchase loans originated in 2005-2007 and acquired by the GSEs.[32] The loans are all fully documented, fully amortizing FRMs (i.e., plain-vanilla loans) with credit scores above 620. The properties purchased using these mortgages include all types of single-family homes except manufactured housing and leaseholds. We track a loan's performance from origination until year-end 2012. A loan is deemed to have defaulted if it was ever at least 180 days delinquent, was terminated involuntarily prior to a 180-day delinquency, or was 90 days or more delinquent on December 31, 2012 (the ending date for the analysis).

The analysis compares the relative performance of 15-year, 20-year, and 30-year FRMs after accounting for major risk factors. We control for the borrower's credit score, DTI, and CLTV through the use of risk buckets.[33] We also control for the extent of the decline in house prices after the loan was originated. To do this, we calculate the percent change in FHFA's quarterly (not seasonally adjusted) all-transactions price index for the loan's three-digit zip code, measured from the peak quarter in the loan's origination year to the trough quarter during 2008-2012.[34] We then pool the resulting set of percent changes, compute the median change, and divide the loans into two groups – those with above-median price declines and those with below-median price declines.

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[32] The data come from the Fannie Mae and Freddie Mac Loan-Level Datasets.

[33] There are four credit score buckets (620-659, 660-689, 690-739, and ≥ 740), two DTI buckets (1-33 percent, ≥ 34 percent), and two CLTV buckets (≤ 80 percent, > 80 percent).

[34] We use house price indices for three-digit rather than five-digit zip codes because the loan-level data from Fannie and Freddie only identify the loan's three-digit zip. Also, we use the FHFA house price indices rather than those from FNC, Inc., because we need a consistently-defined index across the all zips in the analysis, and the FNC indices don't have sufficient geographic coverage.

Table 8 displays the number of loans in the dataset by loan term, CLTV bin, and house price decline. As shown in the final column, the overwhelming majority are 30-year loans; 15-year loans make up about 6.5 percent of the total, and 20-year loans constitute less than 2 percent. The very small volume of 20-year loans with CLTVs above 80 percent indicates why we do not split these higher CLTV loans into more granular bins.

The explanatory variables in our logit default model include the buckets described above for credit scores, DTIs, CLTVs, and house-price declines, along with an indicator variable for loan term (15-year, 20-year, or 30-year). The model interacts all of these variables to allow the various risk factors to have different effects by loan term. Given the logit results, we estimate the average predicted default rate for each of the 12 combinations of loan term, CLTV bucket, and price decline bucket shown in Table 8.[35]

Table 9 shows the predicted default rates for these 2005-2007 originations under the stressed conditions during and after the financial crisis. Robust standard errors for the predicted default rates are in parentheses. As shown in the final column, the overall predicted default rate is 2.8 percent for 15-year loans, 3.8 percent for 20-year loans, and 7.8 percent for 30-year loans, demonstrating the superior performance of shorter-maturity loans. The columns to the left disaggregate these results by CLTV bin and the zip-level house price decline. We find that default rates varied significantly along both dimensions. For each loan term, loans with CLTVs of 80 percent or less have predicted defaults rates that are well below the predicted defaults for the loans with higher CLTVs (holding the extent of house price decline fixed). Similarly, loans

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[35] The exact procedure for calculating the predicted default rates can be illustrated by focusing on loans in a single cell of Table 8 (for example, 15-year loans with CLTVs greater than 80 percent and an above-median zip-level price decline). We calculate the predicted default rate for every loan in the dataset using its actual credit score bucket and actual DTI bucket, setting loan term, CLTV bucket, and price-decline bucket to the combination under consideration, and then taking the average of the predicted default rates. We then repeat this process for all the other loan term/CLTV/price decline combinations. This process ensures that the predicted default rates show the marginal effects of changing loan term, CLTV bucket, or house price decline.

in zips with below-median declines in house prices have predicted default rates that are well below the predicted defaults in zips with above-median drops in house prices (holding the CLTV bin fixed).

Table 10 quantifies the performance improvement of 15-year and 20-year loans relative to 30-year loans in the aggregate and for each combination of CLTV and house price decline. The final column shows that 15-year loans defaulted overall only about one-third as often as 30-year loans, and 20-year loans defaulted only about half as often, holding risk factors constant. Shorter-maturity loans outperformed 30-year loans by a wide margin in each of the eight separate combinations of CLTV and house price decline, with the default ratios ranging from 0.29 to 0.61. All of these default ratios are significantly different than one at the one-percent level.

The table provides evidence that the performance of shorter-maturity loans was especially good in the areas where house prices fell the most. For example, for loans with CLTVs at or below 80 percent, the 15/30 default ratio is 0.37 in zips with below-median house-price declines but is even lower (0.29) in zips with above-median declines. The same pattern holds for the other blocks of the table. The change in the default ratio is statistically significant at the one-percent level for each block except for the 20/30 ratios for loans with CLTVs above 80 percent. The lack of significance likely reflects the small number of 20-year loans with high CLTVs. Nonetheless, taken together, these results suggest that the protection against negative equity provided by 15-year and 20-year loans can explain part of the superior performance of these mortgages.

Most of the performance gain, however, likely owes to unobservable characteristics of the borrowers taking out these loans. Borrowers may self-select into 15-year and 20-year loans

because of a preference towards saving and wealth building or greater financial literacy, characteristics that make default less likely in the first place.[36]

To summarize, we find that 15-year and 20-year loans defaulted much less frequently than 30-year loans in the wake of the financial crisis, after controlling for observable risk factors. In addition, there is evidence that 15-year and 20-year loans performed especially well in areas that experienced large house price declines. These results imply that WBHLs can be expected to have substantially lower default rates than 30-year loans under stressed conditions and that WBHLs likely would be particularly valuable in areas with volatile house prices.

7. Conclusion

Many households today finance their home purchases with high-risk mortgages that build equity very slowly. The WBHL provides a safer path to homeownership and generates equity at a rapid rate. It can be viewed as a "throwback" to an earlier era of low-risk mortgage lending, in which homebuyers purchased homes that fit comfortably within their budget and paid down the mortgage over 20 years or less. The WBHL retains these features, but also recognizes that shorter-term mortgages make it possible to eliminate downpayments and enhance buying power through an ARM rate structure that poses minimal risk of payment shock.

We show that the use of shorter-term mortgages would have greatly reduced the incidence of negative equity during the financial crisis and that the actual default rates on these loans during that period were much lower than for observably equivalent 30-year loans. These results highlight that widespread use of WHBLs would have substantial benefits for borrowers, lenders, and the financial system as a whole.

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[36] See for example, Hertzberg, Liberman, and Paravisini (2015), who conclude that shorter maturities signal greater ability to pay in the future, and An, Bostic, and Yao (2015), who find that lower financial literacy is associated with default.

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Table 1: 2016 Loan Counts, Primary Owner-Occupied Home Purchase Loans, by Agency
(thousands of loans, rounded to nearest thousand)

	GSEs	FHA	VA	RHS	FHA Share (percent)
Total	**1,611**	**873**	**359**	**113**	**30**
First-time buyers	713	646	188	91	39
CLTV > 95%	101	596	165	84	63
DTI ≤ 43% & credit score ≥ 680	78	148	60	37	46

Note: Data pertain to 1-4 unit properties.
Source: AEI, National Mortgage Risk Index data.

Table 2: Comparison of Monthly Payments

$200,000 home purchase price	30-year FHA	20-year WBHL	15-year WBHL
1. Down payment (percent)	3.50	None	None
2. Other initial payments (percent)	None	2.00	3.00
3. Total initial payment	$7,000	$4,000	$6,000
4. Mortgage rate (percent)	4.25	2.99	1.75
5. Monthly payment (P&I plus MIP for FHA)	$1,105	$1,108	$1,264
6. Contribution from upfront savings (vis-à-vis FHA)	$0	$36	$12
7. Net monthly payment	**$1,105**	**$1,072**	**$1,252**

Note: The results are based on the following assumptions. <u>FHA loan</u>: 1.75 percent upfront mortgage insurance premium (MIP), which is rolled into loan balance, and annual MIP of 0.85 percent. Mortgage rate of 4.25 percent equals the median rate on 30-year FHA home purchase loans for January through August 2017, as shown in AEI's National Mortgage Risk Index data. <u>WBHLs</u>: Have a two-step rate structure. Interest rate shown is the initial rate, which steps up at end of year 7. 15-year WBHL has 3 buydown points and no MIP. 20-year WBHL has no buydown points but a upfront 2 percent single-payment MIP. Both WBHLs are offered with these terms and no subsidy by Androscoggin Bank of Lewiston, ME. <u>Upfront savings vis-à-vis FHA</u>: $3,000 for 20-year WBHL, $1,000 for 15-year WBHL, each spread over 7-year assumed period for keeping the mortgage.
Source: Authors' calculations.

Table 3: ARM payment shock

Type of ARM	Caps	Currently purchased by the GSE?	Percent rise in P&I at lifetime cap	
			Total	Annual rate
30-year loan term				
5/1	5/2/5	Yes	63.2	10.2
5/1	2/2/5	Yes	60.2	7.0
7/1	5/2/5	Yes	57.2	6.7
7/1	2/2/5	No	55.0	5.0
10/1	5/2/5	Yes	49.9	4.1
10/1	2/2/5	No	47.5	3.3
20-year loan term				
5/1	5/2/5	Yes	38.2	6.7
5/1	2/2/5	Yes	36.4	4.5
7/1	5/2/5	Yes	33.1	4.2
7/1	2/2/5	No	31.2	3.1
10/1	5/2/5	Yes	25.4	2.3
10/1	2/2/5	No	23.5	1.8
15-year loan term				
5/1	5/2/5	Yes	25.6	4.7
5/1	2/2/5	Yes	23.6	3.1
7/1	5/2/5	Yes	20.4	2.7
7/1	2/2/5	No	18.5	1.9
10/1	5/2/5	Yes	12.8	1.2
10/1	2/2/5	No	10.8	0.9

Note: Assumed initial mortgage rates for 5/1, 7/1, and 10/1 ARMs are 3⅛ percent, 3¼ percent, and 3⅜ percent, respectively. These rates represent the median rates shown by Bankrate.com as of September 11, 2017.
Source: Authors' calculations.

Table 4: Percent Share of Five-digit Zip Codes in Top 100 CBSAs with a Decline in House Prices

	1990-1995	1995-2000	2000-2005	2005-2010	2010-2015
All zips	**34.5**	**0.9**	**0.1**	**78.7**	**28.7**
By price tier within CBSA					
Top-tier zips	27.3	0.4	0.0	71.4	15.4
Middle-tier zips	35.9	0.5	0.0	82.5	29.6
Bottom-tier zips	41.2	2.0	0.2	82.9	42.7

Note: Top 100 CBSAs are based on 2010 population. House prices are measured with the Federal Housing Finance Agency (FHFA) annual all-transactions house price indices for five-digit zip codes. The analysis uses all five-digit zip codes in these CBSAs with a FHFA house price index back to 1990 or earlier and a Zillow median house price in 2000, about 5,300 zips in total. The Zillow median house price is based on all single-family residences in the zip. Zip codes with a median house price in 2000 in the bottom third, middle third, and top third of all the zips in its CBSA are placed in the bottom, middle, and top price tiers, respectively.
Source: Authors' calculations using FHFA house price indices and Zillow median house price data.

Table 5: Average House Price Change for Five-digit Zip Codes in Top 100 CBSAs
(percent, average annual rate)

	1990-1995	1995-2000	2000-2005	2005-2010	2010-2015	*1990-2015*
All zips	**1.3**	**4.9**	**9.3**	**-2.8**	**1.9**	*2.8*
By price tier within CBSA						
Top-tier zips	1.7	5.3	8.4	-1.7	2.2	*3.1*
Middle-tier zips	1.4	4.8	9.2	-2.8	1.9	*2.8*
Bottom-tier zips	0.8	4.6	10.3	-3.9	1.7	*2.5*

Note: See note to Table 4 for information on the included CBSAs and classification of the zip codes. The price changes in the table are unweighted averages across the included zip codes.
Source: Authors' calculations using FHFA house price indices and Zillow median house price data.

Table 6: CLTV at Default, 30-year FRM vs. Counterfactual WBHLs, by Origination Year

Year	Defaults	Percent share with CLTV > 100%			Percent share with CLTV > 120%		
		30-year FRM	20-year WBHL	15-year WBHL	30-year FRM	20-year WBHL	15-year WBHL
All years	**220,030**	**83**	**70**	**53**	**39**	**32**	**23**
2004	9,651	59	30	9	19	8	2
2005	27,210	72	50	28	29	19	9
2006	65,218	84	70	53	41	33	23
2007	117,951	87	77	63	42	36	28

Note: See notes to Figures 3 and 4.
Source: Authors' calculations using loan origination and default data from CoreLogic©, combined with house price indices from FNC, Inc. and FHFA.

Table 7: Share of Counterfactual WBHLs that Never Would Have Reached the Estimated CLTV at Default for 30-year FRMs, by Origination Year

Year	Defaults	20-year WBHL (percent)	15-year WBHL (percent)
Total	**220,030**	**35**	**62**
2004	9,651	69	94
2005	27,210	53	83
2006	65,218	36	65
2007	117,951	28	53

Note: See notes to Figures 3 and 4.

Source: Authors' calculations using loan origination and default data from CoreLogic©, combined with house price indices from FNC, Inc. and FHFA.

Table 8: Number of Loans Used in Logit Default Analysis

Loan term (years)	Percent drop in zip-level house prices	CLTV		Total count by loan term
		≤ 80%	> 80%	
15	Below median	67,072	15,090	164,220
	Above median	72,834	9,224	
20	Below median	16,513	6,966	44,166
	Above median	16,697	3,990	
30	Below median	407,556	417,383	2,322,369
	Above median	846,954	650,476	

Note: The loans used in the analysis are fixed-rate home purchase loans originated in 2005-2007 and acquired by Fannie Mae and Freddie Mac. The loans consist of first liens that fully amortize over the stated loan term and have full documentation and credit scores ≥ 620. The percent drop in house prices is measured as the zip-level decline from the peak during the housing boom to the subsequent trough using the quarterly, all-transactions house price index for three-digit zip codes published by the Federal Housing Finance Agency (FHFA).
Source: Authors' calculations using the Fannie Mae and Freddie Mac Loan-Level Datasets and FHFA house price indices.

Table 9: Expected Default Rates for 15-year, 20-year, and 30-year Fixed-Rate Loans by House Price Decline and CLTV
(percent)

Loan term (years)	Percent drop in zip-level house prices	CLTV		Overall, by loan term
		≤ 80%	> 80%	
15	Below median	0.8 (.05)	2.2 (.12)	2.8 (.08)
	Above median	2.0 (.07)	5.1 (.24)	
20	Below median	1.4 (.11)	2.7 (.19)	3.8 (.14)
	Above median	2.7 (.15)	7.1 (.40)	
30	Below median	2.3 (.03)	4.7 (.03)	7.8 (.02)
	Above median	7.0 (.03)	14.0 (.02)	

Note: See note to Table 8 for the description of the data and the text for the estimated logit regression. The expected default rate for 15-year loans equals the average fitted default rate across all loans in the dataset, with loan term set to 15 years and all other loan characteristics set to their actual values. The expected default rates for 20-year and 30-year loans are calculated analogously, with loan term set to 20 years and 30 years, respectively. Robust standard errors shown in parentheses.
Source: Authors' calculations.

Table 10: Expected 15/30 Year and 20/30 Year Default Ratios for Fixed-Rate Loans by House Price Decline and CLTV

Loan term (years)	Percent drop in zip-level house prices	CLTV		Overall default ratio to 30-year
		≤ 80%	> 80%	
15/30 year	Below median	.37* (.02)	.46* (.03)	.36* (.01)
	Above median	.29* (.01)	.37* (.02)	
20/30 year	Below median	.61* (.05)	.58* (.04)	.48* (.02)
	Above median	.38* (.02)	.50* (.03)	

Note: See notes to Tables 8 and 9. Robust standard errors shown in parentheses. * denotes that the ratio is significantly different than one at the one-percent level.
Source: Authors' calculations.

Figure 1: Equity Accumulation on a $200,000 Home for a 30-year FHA Loan vs. WBHLs
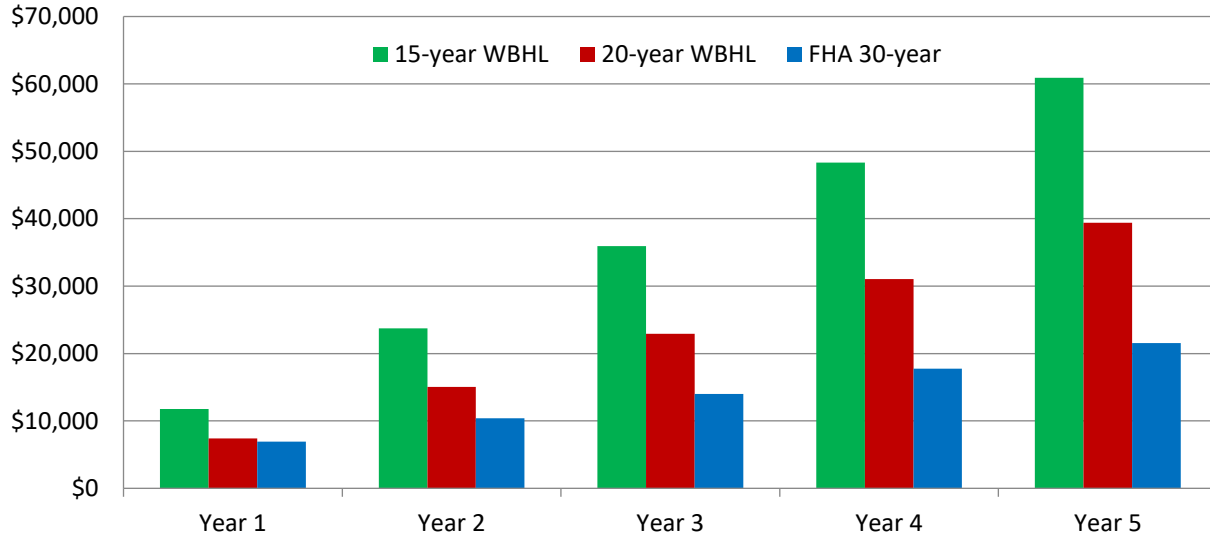
Note: Both WBHLs have an initial LTV of 100 percent. The 15-year WBHL has an interest rate of 1.75 percent for the first 7 years and 5 percent for the remaining 8 years; the 20-year WBHL has an interest rate of 2.99 percent for the first 7 years and 5.25 percent for the remaining 13 years. Both WBHLs are offered with these terms by Androscoggin Bank of Lewiston, ME. Only the initial interest rates are relevant for the five-year period covered in the figure. The FHA 30-year loan has a 4.25 percent interest rate, 3.5 percent down payment, and a 1.75 percent upfront mortgage insurance premium rolled into the loan amount, for an effective initial LTV of 98.19 percent. Nominal house price is assumed to be unchanged.
Source: Authors' calculations.

Figure 2: Estimated Share of Loan-Years with Negative Equity for 2004-07 Originations in the Washington, DC Metro Area

Panel A: Share of loan-years with negative equity of any amount

Panel B: Share of loan-years with negative equity of 20% or more
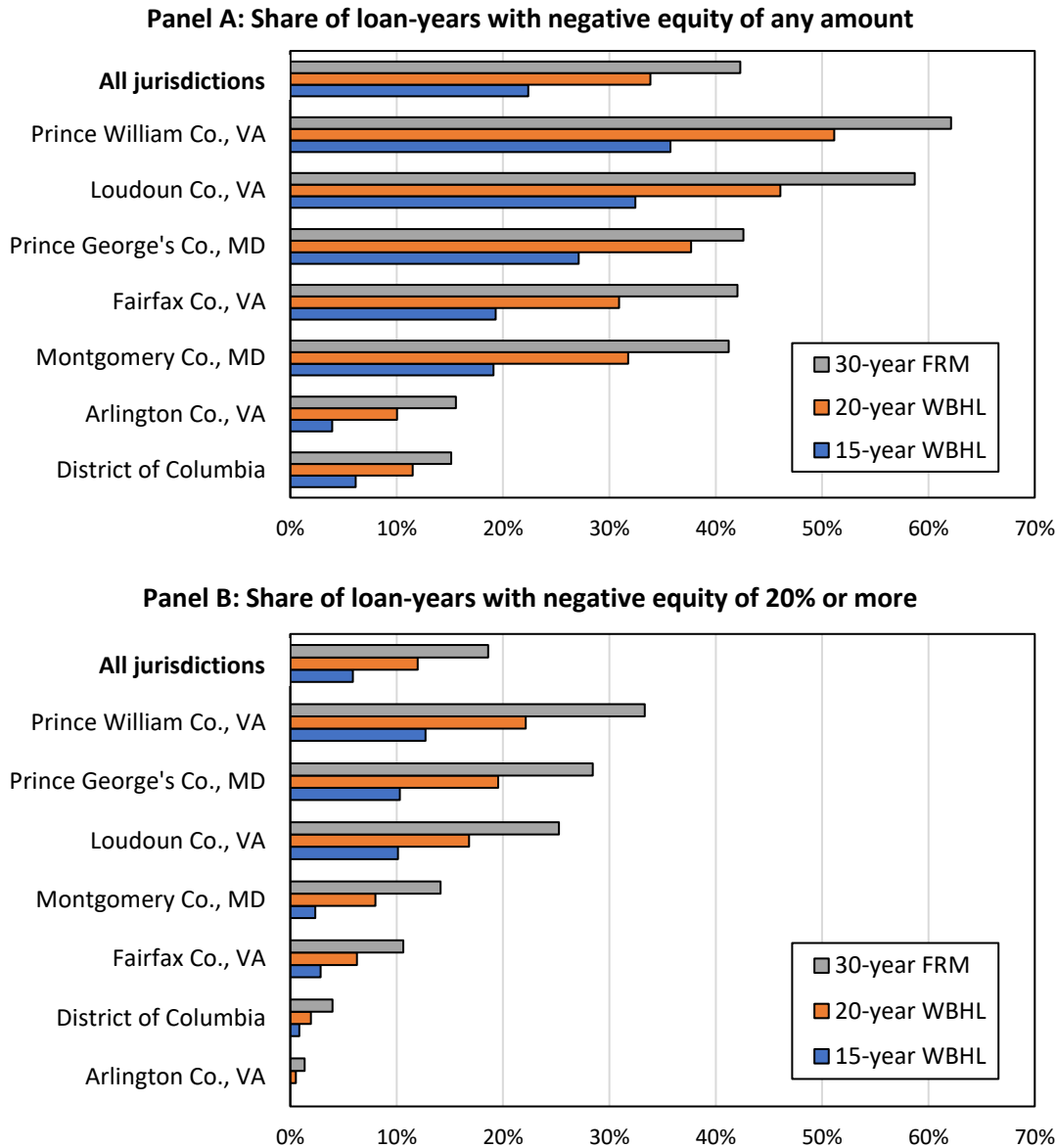
Note: The results pertain to a fixed set of more than 530,000 detached single-family homes in the jurisdictions shown. For each home, we track the borrower's equity for seven years from an assumed purchase at the beginning of 2004. We then repeat this exercise for an assumed purchase at the beginning of 2005, 2006, and 2007, generating four seven-year equity paths for each home. The chart shows the share of loan-years in each jurisdiction with negative equity. The path of each home's value tracks house-specific price indices from Weiss Residential Research (adjusted so that the median Weiss index in the zip code tracks the FNC index for that zip). The initial loan-to-value ratio is 100 percent for both WBHLs and 98 percent for the FHA loan (3.5 percent downpayment, offset partly by an upfront 1.5 percent insurance premium rolled into the loan). The mortgage amortizes over the stated term based on the assumed interest rate. See the text for details about the calculation of the interest rates for the 30-year FHA loan and the WBHLs.

Source: Authors' calculations using data from FNC, Inc., Weiss Analytics, and the Fannie Mae and Freddie Mac Loan-Level Datasets.

Figure 3: CLTV at Default, 30-year FRM vs. Counterfactual 15-year WBHL, by Origination Year
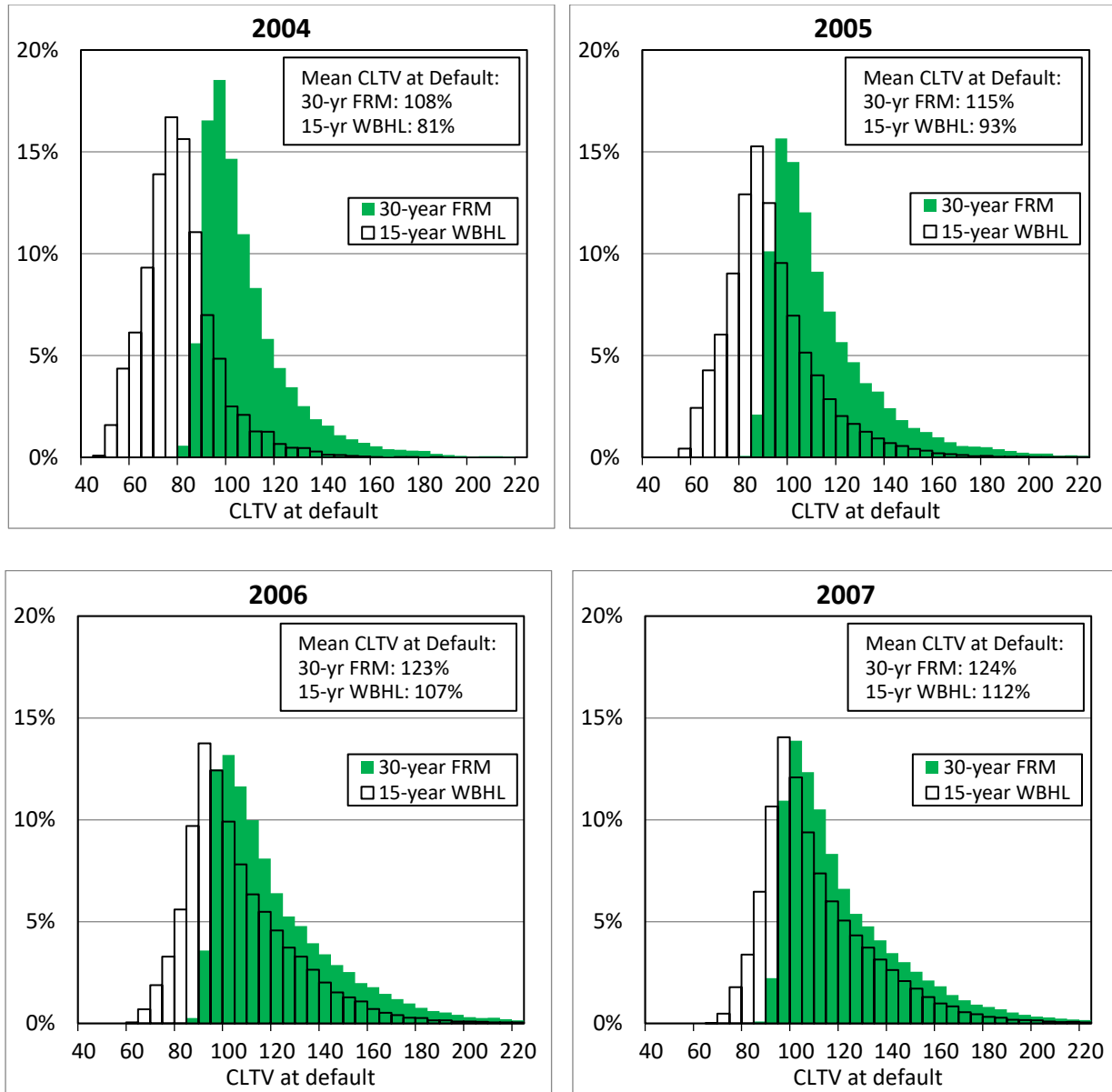
Note: The loans used in this analysis consist of 30-year fixed-rate loans with a CLTV at origination of 95 percent or more and sufficient information to determine the date of default. A loan is deemed to have defaulted if (1) it was ever at least 180 days delinquent, (2) was classified as real estate owned or foreclosed prior to a 180+ day delinquency, or (3) was 90 days or more delinquent on December 31, 2012. The date of default is the first month in which any of these conditions is satisfied. The CLTV at default equals the remaining loan balance divided by the estimated house price at the time of default. This estimated house price equals the house price at origination moved forward to the date of default using the FNC, Inc. house-price index for the five-digit zip in which the house is located when that index is available, and the Federal Housing Finance Agency (FHFA) five-digit-zip index when the FNC index is not available. The counterfactual CLTV at default for the 15-year WHBL is calculated by using the remaining loan balance for a 15-year fixed-rate loan with the same estimated house price.
Source: Authors' calculations using loan origination and default data from CoreLogic©, combined with house price indices from FNC, Inc. and FHFA.

Figure 4: CLTV at Default, 30-year FRM vs. Counterfactual 20-year WBHL, by Origination Year
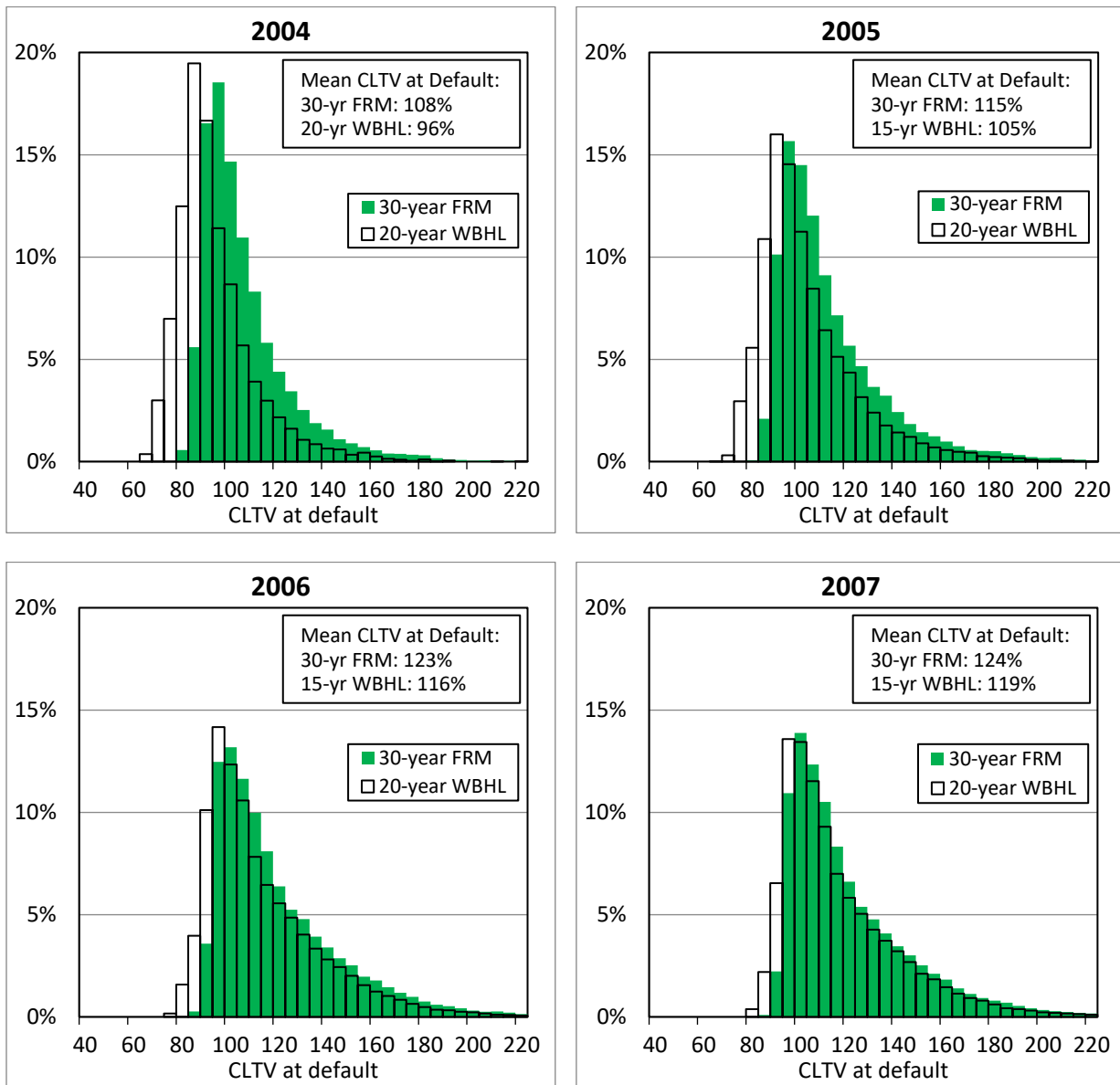
Note: See note to Figure 3. The only difference from Figure 3 is that the counterfactual WBHL has a 20-year term instead of a 15-year term.
Source: Authors' calculations using loan origination and default data from CoreLogic©, combined with house price indices from FNC, Inc. and FHFA.