

A Real, Affordable Mortgage

Homeownership has long been a cherished American goal. Fostered by various tax and financial policies of governments at all levels, but particularly at the federal level, the homeownership rate rose steadily and strongly from the 1940s through the 1970s.

But many now find that homeownership is no longer possible. The National Association of Realtors estimates that the median household income of potential first-time homebuyers is only about three-quarters that required to afford the median-priced starter home. Even those who are able to acquire homes often find that a painfully large part of their income is initially devoted to housing expenses. As a consequence, the decade of the 1980s was the first since the Great Depression during which the aggregate homeownership rate fell. Declines in homeownership rates were particularly large for younger households.

The inability of millions of households to purchase what is deemed to be reasonable housing has been termed the "affordability crisis." But rather than just reflecting house prices, "affordability" is typically measured by the burden of initial mortgage payments relative to the homebuyer's current income. In other words, the amount of housing a household can "afford" depends not only on house prices, but also on household incomes and on housing finance conditions.

Since the 1930s, the dominant vehicle for financing home purchases has been the long-term, fixed-payment mortgage (FPM). When it was introduced and in the decades immediately thereafter, inflation over the life of the mortgage was expected to be negligible. In the absence of inflation, incomes tended to rise slowly. This made the FPM a sensible way to finance homeownership: the burden on the household budget of making payments remained relatively steady over the life of the mortgage.

But the level-payment feature also makes the FPM (and all other existing mortgages in this country) ill-suited to a world with even a moderate amount of inflation. Indeed, the combination of inflation and

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level-payment mortgages is probably the primary cause of the housing affordability crisis. Level-payment mortgages artificially constrain many households from purchasing homes of a quality consistent with their lifetime income and consumption levels. This constraint results in their not being homeowners, owning homes of a lower quality than their lifetime resources warrant, or devoting an unnecessarily large share of their current incomes to mortgage payments.

Fortunately, much of the crisis in housing not only arises from, but also has a ready remedy in, housing finance. The solution will not raise incomes or bring down house prices.¹ However, it can be expected to make housing finance, and thus housing, more affordable for more families.

The Price Level Adjusted Mortgage (PLAM) represents a genuine and substantial advance in housing finance in an inflationary environment. PLAMs rearrange the timing of the mortgage payments so that they are constant in real rather than in nominal terms. Rather than being high at the beginning and low at the end of the mortgage's life as with a level nominal payment mortgage, *real* payments on a PLAM are *constant*. Thus, PLAMs can be offered with payments that for several years are likely to be substantially below those on either fixed-rate or adjustable rate mortgages. Other things equal, this rearrangement of the real payment burden allows more potential homebuyers to qualify for mortgages. To the extent potential homeowners also face down payment constraints, measures that ease this second constraint will enhance the benefits from PLAMs.

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But for those who can qualify for level-payment mortgages or have accumulated sufficient down payments, adding PLAMs to the mortgage menu will allow them the option of purchasing larger houses sooner or shifting some of the payment burden into

the future when their incomes are likely to be higher.

PLAMs are also likely to benefit lenders. First, traditional lenders can avoid most of the interest rate risk associated with fixed-rate mortgages. This should make lenders willing to provide PLAMs at a lower cost than for level-payment mortgages. Furthermore, since defined-benefit pension plans' liabilities are tied to future wages, and thus in effect to inflation, anticipated or not, PLAM's inflation-proof, fixed real rate of return would make it a useful pension fund investment. A guaranteed real rate of return would be attractive to many individual savers as well. Given the potential benefits to both lenders and borrowers, PLAMs represent an effective, private-sector solution to the housing finance, and homeownership, problem.

I. "For Everything There Is a Season . . ."

The proportion of households that owned their home rose dramatically during the three decades following World War II. By 1980, the homeownership rate was over 65 percent, about one and one-half times the rate before World War II. Over the past decade, however, the rate has fallen, and age-specific homeownership rates indicate that the younger the households, the more severe the decline. In fact, the homeownership rates for those under 45 years old are lower now than they were 20 years ago.

Table 1 displays some of the factors that affected homeownership "affordability" over the past quarter-century. Column 3 shows that, while house prices have risen markedly, they have not greatly outstripped the rise in incomes of potential first-time homebuyers.² Over the entire 1965-89 period, the ratio of house prices to incomes rose by less than 3 percent. Measured from 1970 to 1989, however, the increase is much larger: 24 percent. Column 5 shows the annual mortgage payment required on a 10 percent down, 30-year mortgage based on the house prices in column 1 and the mortgage rates in column 4. Column 6 shows the corresponding payment-to-income ratio. That ratio rose slightly in the late 1960s, nearly doubled between 1970 and 1980, and then receded.

Columns 8 and 9 assign the change in the payment-to-income ratio in column 7 to its determinants: the change in the mortgage interest rate and the change in the ratio of house prices to incomes. Between 1965 and 1975, interest rates rose enough to raise the payment-to-income ratio even though house

Table 1
Factors Affecting Housing Affordability

Year	House Price ^a (1)	Income ^b (2)	House Price/ Income (1)/(2) (3)	Contract Interest Rate (4)	Annual Mortgage Payment ^c (5)	Payment-to- Income Ratio (5)/(2) (6)	Change in Col. (6) since 1965		
							Actual (7)	Due to: ^d	
								House Prices (8)	Interest Rates (9)
1965	20,000	6,101	3.28	5.83	1272	.208			
1970	24,783	9,126	2.72	8.22	2005	.220	.012	-.035	.057
1975	36,884	12,777	2.89	8.92	3182	.249	.041	-.024	.075
1980	64,058	17,724	3.61	12.45	7357	.415	.207	.022	.168
1985	79,710	22,321	3.57	11.93	8809	.395	.187	.019	.154
1989	86,957	25,800	3.37	10.21	8388	.325	.117	.006	.108

^aThe 1965 value is the actual median new house price. The later values are calculated using the Census Bureau quality-adjusted (1982 base year) house price index.

^bMedian money income for male, year-round, full-time workers aged 25-34. The 1989 value is estimated by the authors.

^cAssuming 10 percent down payment and a 30-year term fixed-rate mortgage.

^dColumn 8 calculated using 1965 value of the interest rate. Column 9 calculated by constraining house prices to rise at the same rate as income. Consequently, columns 8 and 9 will not sum to the exact value of column 7.

Source: Columns (1) and (2), U.S. Bureau of the Census; Column 4, Mortgage Interest Rate Survey provided by Federal Home Loan Bank of Boston.

prices rose less than incomes. Between 1975 and 1980, the price-to-income ratio and interest rate increases combined to raise the payment-to-income ratio by two-thirds. Since 1980, the price-to-income ratio has fallen nearly to its 1965 level, while interest rates have remained historically high. Thus, the higher interest rate accounts for almost all of the 56 percent increase in the payment-to-income ratio since the mid-1960s.

This suggests that the combination of inflation and level-payment mortgages is primarily responsible for the housing affordability crisis. The level-payment mortgage was not designed for a world with inflation and it is not well suited to it. When inflation was low and steady enough to be negligible, the long-term, fixed-payment mortgage (FPM) was a sensible instrument for borrowers and lenders alike. In the absence of inflation, the level payments of an FPM allowed borrowers to spread evenly over time the real burden of housing expenses. But with inflation, the real payment burden over the life of the mortgage is rearranged. Inflation "tilts" the real payment stream, reducing the real value of these constant nominal payments over time. Furthermore, by raising interest rates, inflation reduces the amount that a homebuyer can borrow with a level-payment mortgage, whether fixed or adjustable rate.³ This reflects lenders' practice of determining the maximum size of the mortgage obtainable based on the

interest rate and the homebuyer's income at the time of origination.⁴

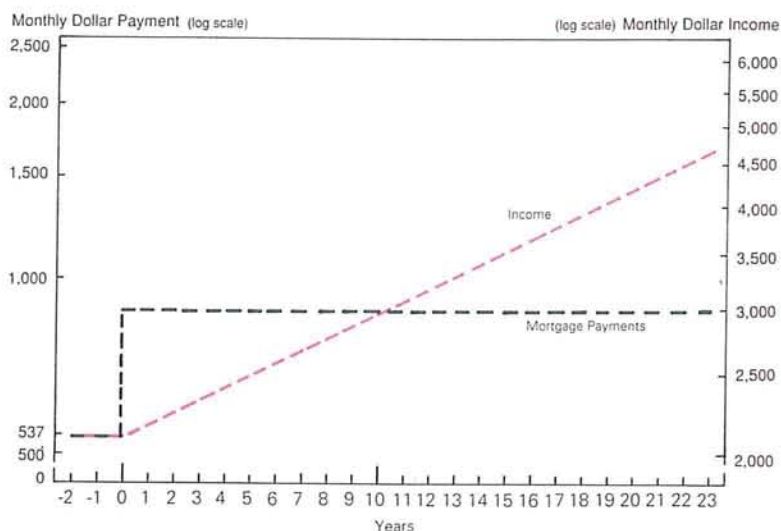
As Figure 1 indicates, interest rates and income respond very differently to inflation. The onset of (expected) inflation tends to raise interest rates rather abruptly to a higher level. The associated mortgage payments also step up and remain at the higher level. By contrast, incomes, and by definition the average of prices of goods and services generally (including rent), begin, and continue, to rise.

To demonstrate how this happens, suppose that at a zero inflation rate, a homebuyer earning gross monthly income of \$2,148 borrows \$100,000 with a 30-year, 5 percent, fixed-rate mortgage. The monthly payments of \$537 imply a 25 percent payment-to-income ratio, as long as income does not change. Now suppose that the inflation rate and the mortgage interest rate each rise by 5 percentage points, thereby leaving the real interest rate unchanged.⁵ (Note that a 5 percentage point increase in both inflation and interest rates approximates actual changes since the 1950s.) A \$100,000, 10 percent, 30-year mortgage requires monthly payments at a level of \$878 for the entire term of the mortgage. Even though the real mortgage interest rate and thus average real payments remain unchanged, mortgage payments are initially 64 percent higher.⁶

Inflation would affect income as well, but in a very different way. Figure 1 shows monthly income

Figure 1

Mortgage Payments and Income Respond Differently to an Increase in the Inflation Rate



Source: Authors' calculations.

gradually and continually rising from its initial level of \$2,148 at the 5 percent inflation rate. One year after the 5 percent inflation began, the borrowers' monthly income would be \$2,255 ($= \$2,148 \times 1.05$). But housing expenses as a share of the household budget have risen more than 50 percent. Presuming no increase in real income, the continuing 5 percent inflation will raise income by 5 percent each year. With the mortgage payment remaining constant at \$878, the payment-to-income ratio will slowly decline from nearly 40 percent to only 10 percent over the life of the mortgage. This pattern of the initial heavy burden of mortgage payments being eroded by the inflation-driven increases in incomes is familiar to those who have made mortgage payments during the past 25 years.

Alternatively, suppose lenders impose a 25 percent ceiling on the payment-to-income ratio.⁷ In that case, the mortgage size falls rather than the payment size rising. Given the initial income level, the jump in the interest rate from 5 to 10 percent will reduce the allowable mortgage size by 39 percent. And at 10 percent inflation and a 15 percent mortgage interest rate, the borrowing limit would decline by nearly 60 percent.

Thus, at higher levels of inflation and nominal interest rates, the potential homebuyer relying on level-payment mortgage financing must do one or

more of the following: provide a larger down payment, shoulder a heavier initial payment burden, purchase a less expensive house, or delay the purchase. The first two options may be particularly unattractive, or even impossible, for young, first-time homebuyers, given the typical upward tilt in household income (and wealth) over one's working life. Even if borrowers and lenders agree that higher inflation alone should not reduce real borrowing, the higher real initial mortgage payments leave less real cash flow for other household purchases early in the term of the mortgage.

The third option entails households buying lower-quality houses than their lifetime incomes warrant. As a consequence, only a few years after struggling to get into and beginning to make payments on their first home, their rising incomes allow homeowners to borrow more and thereby consume housing more in line with their lifetime resources and tastes. This "moving up" in mortgage size and house quality involves substantial pecuniary and non-pecuniary costs. Nonetheless, it often happens several times in a lifetime, even in the absence of any significant revision of lifetime earnings prospects.

Finally, the affordability problem cannot be overcome by waiting. A potential homebuyer who waited the ten-plus years required for income to "catch up" to the 64 percent higher mortgage payments in the

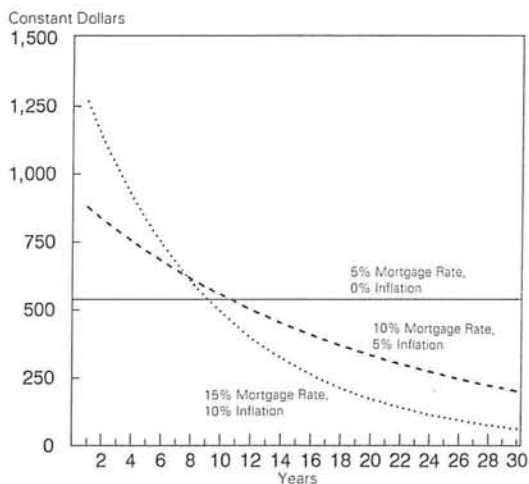
above example would find that payments had risen even further (by about as much as incomes), not because of higher mortgage rates, but because house prices rose over time due to inflation.

The borrowing constraint hypothesis helps explain why the rise in homeownership rates has slowed more for younger households than for older households.⁸ Younger households tend to have incomes that are low relative to other households and low relative to the incomes that they reasonably expect for themselves in the future. When lenders apply the same lending criteria without regard to borrowers' ages, the young are more likely to be "liquidity constrained."⁹ Second, higher interest rates directly affect homebuyers, as opposed to homeowners. Since older households are more likely to own homes already, relatively fewer of them will seek new financing. Thus, increases in interest rates and the associated borrowing constraints are likely to impinge more on the young.¹⁰

But higher initial payments are not the whole story. The higher real costs in the early years of a FPM are balanced by lower real costs later on. Figure 2 shows the pattern of the real, or price-level-adjusted, levels of monthly payments on \$100,000

Figure 2

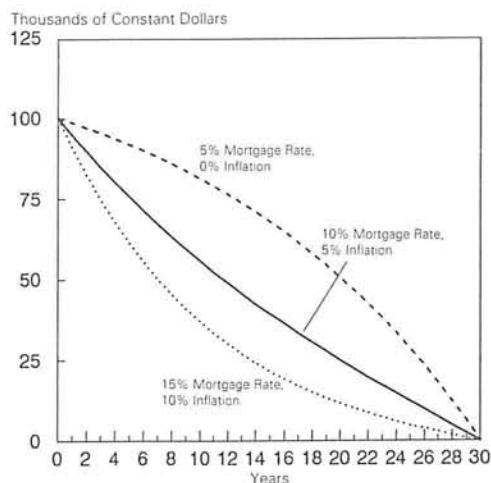
Inflation Initially Raises and Then Lowers the Payment Burden of a Fixed Payment Mortgage



Source: Authors' calculations.

Figure 3

Fixed Payment Mortgage Real Balance Outstanding



Source: Authors' calculations.

FPMs. These payments are shown for inflation rates of 0, 5, and 10 percent and for mortgage rates of 5, 10, and 15 percent. The real mortgage interest rate is 5 percent, and thus the real payment on average over the life of the loan is the same for each inflation rate scenario.¹¹ Figure 2 shows the important, *real* difference that inflation does make, even when real interest rates and thus the *average* real burden of mortgage payments is unchanged: the higher the inflation rate that is incorporated into mortgage rates, the higher the real burden of initial payments. The 5 percent mortgage with zero inflation entails a level monthly payment of \$537, which is also level in real terms over the life of the mortgage. The 10 percent mortgage associated with a 5 percent inflation rate has a monthly payment of \$878, whose real value will fall by 5 percent each year. The 15 percent mortgage has payments of \$1,264 per month, fully 235 percent of that in the zero inflation case, which will decline by 10 percent each year in real terms.

The higher real initial payments due to inflation reduce the real value of the remaining principal faster the higher the inflation rate, as shown in Figure 3. Thus, in real terms, inflation forces FPM borrowers to accelerate their repayment of the loan.

The "tilt" problem with FPMs in an inflationary environment has long been recognized (for example, Poole 1972; Lessard and Modigliani 1975; Cohn and Fischer 1975). In practice, one response to higher inflation and nominal interest rates has been to extend the maturity of FPMs. Though that does not remove the "tilt," longer mortgage terms do reduce the real payment burden in the early years. Another

Prospective homebuyers often find that they cannot nearly afford housing of the caliber that they rent. How can they afford the rent?

response has been to ease qualification standards by raising payment-to-income ceilings. This allows borrowers to qualify for larger loans, but only at even higher payment levels and thus even heavier initial payment burdens.

An additional response has been the creation of alternative mortgage instruments that generate lower initial payments. The most popular innovation has been adjustable (or variable) rate mortgages (ARMs). The attraction of ARMs is that their interest rates are expected (but not guaranteed) on average to be lower than on fixed-rate mortgages.¹² Borrowers "earn" that lower rate by taking on interest rate risk. However, since ARM payments are fundamentally level, if variable and lower, they still do not eliminate the basic problem—that the real burden of initial payments is higher when even low rates of inflation occur.

The graduated payment mortgage (GPM) addresses the tilt problem by offering lower, but rising, initial payments, and higher level payments later on. In theory, the "tilt" would be eliminated by a GPM whose payments rose over the life of the mortgage at a pre-set rate equal to the average inflation rate. In practice, GPMs have been structured with fairly steep graduation (payment increase) schedules that span only the first few years of the mortgage term. That, and the inability to predict inflation, prevents GPM payment schedules from mimicking in practice the level real burden of FPMs in the zero inflation case.

Thus, inflation removes one of the primary ben-

efits of the long-term mortgage—namely, the ability to distribute the costs of a house over time in order to more closely parallel the flows of housing services and borrower incomes, thereby making homeownership more affordable.¹³ When inflation is widely anticipated, lenders and borrowers reasonably expect incomes, and the ability to make mortgage payments, to rise with the overall level of prices. This is especially true for young, potential homebuyers since, on average, real incomes rise over most of one's working life. Thus, the young reasonably anticipate future income that not only keeps pace with, but grows faster than, the overall level of prices. Their initially low, but rising, ability to pay is particularly badly matched to constant mortgage payments.¹⁴

Figure 1 does provide a hint as to the solution to the problem of high initial payments: arrange payments to fit homebuyers' ability to pay. Prospective homebuyers often find that they cannot nearly afford housing of the caliber that they rent. How can they afford the rent? A principal reason is that rent payments are not level over time, but tend to rise with the general levels of prices and incomes.

II. How PLAMs Work

The payment pattern over time of the Price Level Adjusted Mortgage (PLAM) differs fundamentally from *all* other existing mortgages. PLAMs are long-term, fully amortizing mortgages whose monthly payments are constant in real, or price-level-adjusted, terms. The mechanics of the PLAM are quite simple. At the end of each period, both the payment and the remaining loan balance in dollar terms are increased by the increase in the price level during the period.

Typically, PLAM payments start much lower than fixed-rate (or adjustable rate) mortgage payments and remain considerably below them for a number of years. Although nominal dollar PLAM payments are expected to rise eventually above fixed-rate mortgage payments, they are unchanged in real terms. Thus, the PLAM allows a rearranging of payments to more closely fit the financial circumstances of homebuyers by removing the "tilt" in the real mortgage payment stream. Even if a household's income grows no faster than the general price level, the payment-to-income ratio (the payment burden) does not rise. If inflation turns out to be higher or lower than originally expected, payments still track the overall cost of living since they reflect actual, not

expected, price changes. In any event, borrowers pay and savers earn a known, constant, *real* rate of interest.

When the price level is constant (zero inflation), both PLAMs and FPMs have level payments in dollar and in real terms. The important difference with PLAMs is that inflation does not affect the pattern of real payments. Rather than producing higher but level payments, inflation raises PLAM payments over time only as prices rise, thereby leaving real payments constant. Thus, PLAM payments start at the

low level of FPM payments in a world of zero inflation and rise at the same rate as typical prices households pay for goods and services.

Tables 2 and 3 present features of fixed-rate and PLAM mortgages. The tables show the pattern over time of payments, the remaining principal, the loan-to-value ratio, and homeowner's equity. In each table, a \$100,000, 30-year mortgage and a 10 percent down payment are used to purchase a \$111,111 house. The general price level and the level of house

Table 2
Fixed Payment Mortgage

Year	Monthly Payment	Dollar Balance	House Price	Loan-to-Value Ratio (Percent)	Owner's Equity	Real Payment	Real Balance
		\$100,000	\$111,111	90	\$ 11,111		
1	884	99,392	116,667	85	17,275	\$842	\$94,659
2	884	98,723	122,500	81	23,777	802	89,545
3	884	97,988	128,625	76	30,637	764	84,646
4	884	97,179	135,056	72	37,878	727	79,949
5	884	96,289	141,809	68	45,521	693	75,445
6	884	95,309	148,900	64	53,590	660	71,121
7	884	94,233	156,344	60	62,112	628	66,969
8	884	93,048	164,162	57	71,114	598	62,978
9	884	91,745	172,370	53	80,625	570	59,139
10	884	90,311	180,988	50	90,677	543	55,443
11	884	88,734	190,038	47	101,303	517	51,881
12	884	87,000	199,540	44	112,540	492	48,445
13	884	85,092	209,517	41	124,425	469	45,126
14	884	82,993	219,992	38	136,999	446	41,917
15	884	80,685	230,992	35	150,307	425	38,811
16	884	78,145	242,542	32	164,396	405	35,799
17	884	75,352	254,669	30	179,317	386	32,876
18	884	72,279	267,402	27	195,123	367	30,033
19	884	68,899	280,772	25	211,873	350	27,266
20	884	65,181	294,811	22	229,630	333	24,566
21	884	61,091	309,551	20	248,460	317	21,928
22	884	56,592	325,029	17	268,436	302	19,346
23	884	51,644	341,280	15	289,637	288	16,814
24	884	46,200	358,344	13	312,144	274	14,325
25	884	40,212	376,262	11	336,049	261	11,875
26	884	33,626	395,075	9	361,449	249	9,457
27	884	26,380	414,828	6	388,448	237	7,066
28	884	18,410	435,570	4	417,159	226	4,696
29	884	9,644	457,348	2	447,705	215	2,343
30	884	0	480,216	0	480,216	205	0

Note: For ease of presentation, calculations assume one payment at the end of each year rather than monthly payments. Since monthly rather than annual payment levels are more familiar, the payment entry in the table is the annual payment divided by 12 and is referred to as the "monthly" payment in the text. Data are rounded to nearest dollar amount.

Source: Authors' calculations.

Table 3
Price Level Adjusted Mortgage

Year	Monthly Payment	Dollar Balance	House Price	Loan-to-Value Ratio (Percent)	Owner's Equity	Real Payment	Real Balance
		\$100,000	\$111,111	90	\$ 11,111		
1	\$ 569	103,420	116,667	89	13,247	\$542	\$98,495
2	598	106,848	122,500	87	15,652	542	96,914
3	628	110,270	128,625	86	18,355	542	95,255
4	659	113,665	135,056	84	21,391	542	93,513
5	692	117,013	141,809	83	24,796	542	91,683
6	726	120,290	148,900	81	28,610	542	89,762
7	763	123,466	156,344	79	32,878	542	87,745
8	801	126,510	164,162	77	37,651	542	85,627
9	841	129,386	172,370	75	42,984	542	83,403
10	883	132,052	180,988	73	48,936	542	81,068
11	927	134,461	190,038	71	55,576	542	78,617
12	974	136,561	199,540	68	62,978	542	76,042
13	1,022	138,292	209,517	66	71,224	542	73,339
14	1,073	139,588	219,992	63	80,405	542	70,501
15	1,127	140,372	230,992	61	90,620	542	67,521
16	1,183	140,560	242,542	58	101,982	542	64,392
17	1,242	140,057	254,669	55	114,611	542	61,107
18	1,305	138,758	267,402	52	128,644	542	57,657
19	1,370	136,542	280,772	49	144,230	542	54,034
20	1,438	133,278	294,811	45	161,533	542	50,231
21	1,510	128,816	309,551	42	180,736	542	46,237
22	1,586	122,990	325,029	38	202,039	542	42,044
23	1,665	115,616	341,280	34	225,665	542	37,641
24	1,748	106,487	358,344	30	251,858	542	33,018
25	1,836	95,373	376,262	25	280,889	542	28,164
26	1,928	82,018	395,075	21	313,056	542	23,067
27	2,024	66,139	414,828	16	348,690	542	17,715
28	2,125	47,417	435,570	11	388,153	542	12,096
29	2,231	25,501	457,348	6	431,847	542	6,195
30	2,343	0	480,216	0	480,216	542	0

Note: For ease of presentation, calculations assume one payment at the end of each year rather than monthly payments. Since monthly rather than annual payment levels are more familiar, the payment entry in the table is the annual payment divided by 12 and is referred to as the "monthly" payment in the text. Data are rounded to nearest dollar amount. Because the first payment does not occur until the end of the first year, it exceeds the value of the constant real payment by a factor equal to the increase in the price level between the origination date and the date of the first payment (here 5 percent).

Source: Authors' calculations.

prices are both assumed to rise 5 percent each year. The real interest rate is 5 percent on both the FPM (10 percent less 5 percent inflation) and the PLAM.

Table 2 shows that constant monthly payments of \$884 for 30 years are required to service the fixed-payment mortgage loan. Table 3 shows that the first-year PLAM payment is only \$569, 36 percent less than the FPM payment. The assumed inflation rate of 5 percent means that on average consumer prices and

PLAM payments both rise 5 percent each year. Thus, the second-year payment is 1.05 times that for year 1: $\$598 = 1.05 \times \569 . The third-year payment is 1.05 times that for year 2: $\$628 = 1.05 \times \598 . The real, or price-level-adjusted, payment is constant for the entire life of the loan at \$542. Different assumptions about the real interest rate, term to maturity, down payment, and inflation will affect some of these magnitudes for a PLAM. Regardless, the loan is fully

amortizing, payments rise no faster and no slower than the overall cost of living, and the real balance of the mortgage loan falls with each payment.

While a PLAM eases one financing constraint, the payment-to-income ratio, it does not address the other, the down payment constraint. To the extent that lenders perceive PLAMs as being more risky because of the potential for higher loan-to-value ratios in the early years of the mortgage, they may require larger down payments. For "move-up" buyers with capital gains accrued on their previous home, the down payment problem is much less likely to be a binding constraint. For those facing a binding down payment constraint, mortgage insurance may substitute for a higher down payment. While this will raise the monthly payment somewhat until the loan-to-value ratio declines sufficiently to discontinue insurance coverage, the initial payments including the insurance premium will still be well below those on the corresponding noninsured FPM.

III. Benefits and Risks of PLAMs

PLAMs can be expected to have a number of advantages for borrowers: lower initial payments, larger origination amounts, less payment shock compared to ARMs, and lower interest costs. At the same time, borrowers face both more interest rate risk compared to FPMs and the risk that their incomes and house prices may not rise as fast as the general price level. For lenders, unless PLAMs have higher down payments and/or shorter maturities, loan-to-value ratios will be above those for FPMs in the early critical years of the mortgage's life, raising default risk. And, while lenders no longer face inflation risk, they still bear real interest rate and liquidity risk.

Benefits

An earlier example showed how the initial payments on the PLAM could be 36 percent lower than on the FPM. Or, for the same initial payment required for an FPM, a household could obtain a 36 percent larger PLAM. Most borrowers would probably choose something in between, with a larger mortgage (and house) and a lower payment-to-income ceiling, thereby reducing the financial pressure on the remainder of the household budget. By allowing first-time homebuyers to obtain more expensive homes, the number of lifetime moves per household, and the transaction costs

associated with them, could be reduced.

And, unlike an ARM (especially of the teaser type), this increased borrowing capacity is highly unlikely to subject the borrower to dramatic payment shock. ARM payments are tied to nominal interest rates, and therefore may change substantially when the expected inflation rate rises. PLAM payments cannot go up or down by more than the average price level. In that regard, real PLAM payments can be expected to fluctuate less than real rents, for example.

PLAMs are also likely to entail lower real borrowing costs for two reasons. PLAMs allow both borrowers and lenders to avoid the gamble on long-term inflation that they now take, however unwittingly, by setting payments on the basis of actual, rather than expected, circumstances. Thus, the borrower no longer pays an inflation risk premium. Second, PLAMs are much less likely to be prepaid. Prepayments are affected by the relation of the interest rate on outstanding mortgages relative to the currently prevailing rate. PLAMs lock in a real, as opposed to a nominal, interest rate. Since real long-term interest rates vary relatively little compared to nominal, or market, interest rates, PLAM prepayments are much less likely to occur.

Risks for Borrowers

PLAMs entail more risks to the borrower than do fixed-rate mortgages, but are likely to involve fewer risks than do ARMs. While FPMs allocate all interest rate risk to lenders, uncapped ARMs shift it all to borrowers. If interest rate adjustments are capped, as with most ARMs, borrowers absorb the risk of interest rate fluctuations within the caps and lenders absorb the risk of interest rates exceeding the caps. PLAMs also distribute the interest rate risk between borrowers and lenders. Real interest rate risk is borne by lenders and the inflation risk by borrowers. Because wages and salaries tend to rise with, and normally faster than, the general price level, homeowners seem to be well positioned to handle the inflation risk in PLAMs.

Although PLAM payments are fixed in real terms, future dollar payments depend on the future level of prices and therefore cannot be known ahead of time. Nor can income. The risk to borrowers is not that payments will rise, but that they will rise faster than incomes. While incomes and the general price level track each other fairly closely, incomes and the level of nominal interest rates do not. This makes PLAM risks for borrowers considerably smaller than

those of ARMs. Although borrowers have no guarantee that their income will keep up with the general price level, even a prolonged gradual erosion in real income will not have a dramatic effect on the payment-to-income ratio. Suppose one's real income were to fall at 2 percent per year for ten straight years. This would represent a truly extraordinary long-term income decline. Even so, under such a scenario a payment-to-income ratio that was initially 25 percent would still be less than 31 percent at the end of the ten-year period. To put this in perspective, note that this is a much smaller increase in the payment-to-income ratio than that experienced by an ARM borrower with a 2 percentage point teaser that vanishes after one year.

The outcomes associated with PLAMs need to be evaluated in light of the alternatives. While the likelihood of the PLAM payment burden increasing is less than that for an ARM, it is greater than for an FPM. But many potential homebuyers find the FPM to be an irrelevant alternative. When the choice is to become a PLAM borrower or to remain a renter, the household faces similar (or even less) risk. Rents do not remain constant, they rise, on average, with the general price level. In fact, as can be seen in Figure 4, FPM payments are about the only category in a household's budget whose cost remains constant.

The positive correlations of PLAM payments,

incomes and house prices are apparent in Figure 4. They closely track the general price level. It is their ratios to the price level, or real values, that tend to be stable over time. Although relative price changes do occur, in the long run real shifts tend to be reversed much more than nominal ones. Thus, changes in payment-to-income ratios would, for the most part, be of relatively short duration, although supply shocks that result in a reduction in the real wage, such as sharp increases in oil prices, could present a problem.

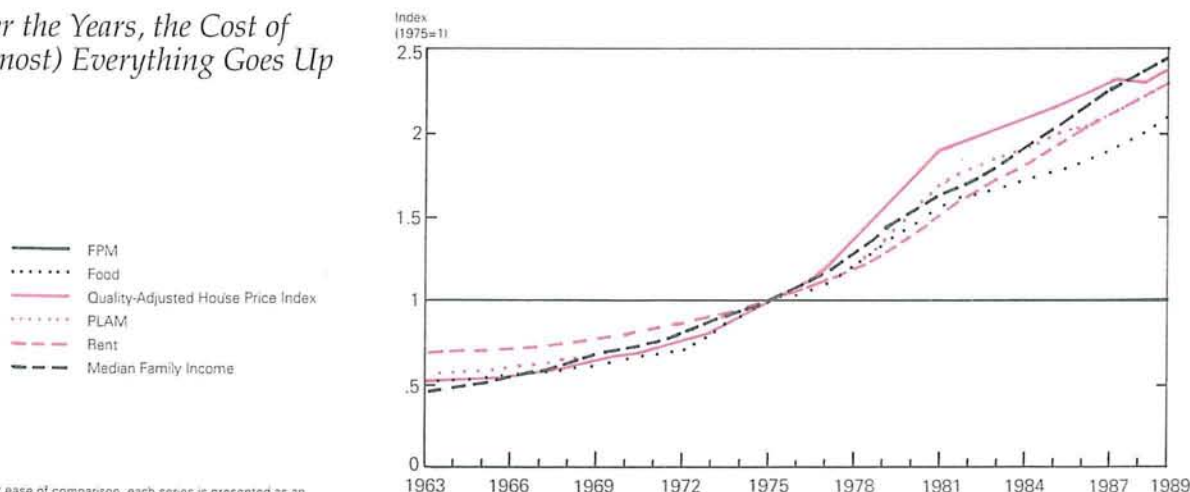
Of course, borrower-specific income shocks can cause payment difficulties. But such problems are not specific to PLAMs. Those who become unemployed, for example, often have problems making mortgage payments whether on a PLAM, an ARM, or an FPM (or, for that matter, rent).

Risks for Lenders

The loan-to-value ratio is the key determinant of defaults. If the loan-to-value ratio rises above unity, the loan is no longer fully secured and the borrower may have enough incentive to default. Lower initial payments mean that the equity for a PLAM borrower will build more slowly. With a fixed-rate mortgage, most defaults occur within the first three or four years, while the loan-to-value ratio is still high. As

Figure 4

Over the Years, the Cost of (Almost) Everything Goes Up



Note: For ease of comparison, each series is presented as an index with its 1975 value equal to one.
Source: *Economic Report of the President 1990*, Data Resources, Inc., and U. S. Bureau of the Census.

the years pass, house price appreciation and loan amortization can add substantially to the homeowner's equity. If house prices move proportionately with the general level of prices, the PLAM's loan-to-value ratio will continually fall. If house prices rise more slowly, the loan-to-value ratio will not fall as fast, and may rise. Still, it will take a substantial and sustained fall in real house prices to overcome the effects of real amortization on the loan-to-value ratio.

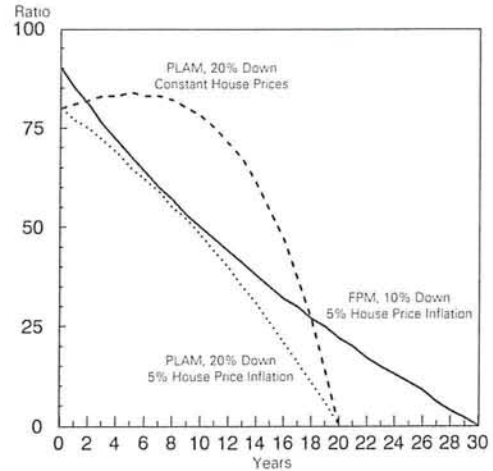
Higher down payments or shorter maturities can reduce PLAM default risk to approximately that of FPMs. Figure 5 shows the loan-to-value ratios for a 30-year, 10 percent down payment FPM and a 20-year, 20 percent down payment PLAM in an environment where both house prices and the general price level are rising at 5 percent per year. There the PLAM loan-to-value ratio, and thus default risk, is always below that for the FPM. If house prices remain constant while the general price level rises at a 5 percent rate, real house prices collapse, falling 62 percent in real terms over the 20-year term of the PLAM. Even so, as shown in Figure 5, the PLAM loan-to-value ratio reaches a maximum of 84 percent, still well below the initial 90 percent ratio of the FPM. With a 10 percent down payment, even this dramatic, sustained decline in relative house prices fails to raise the 20-year PLAM loan-to-value ratio above 94 percent.

Although PLAMs help lenders avoid the inflation risk, they still must face real interest rate risk. This risk could be reduced if lenders issue Price Level Adjusted Deposits (PLADs). Even so, they will have a maturity mismatch if their deposits are short-term and their PLAMs are long-term. Because PLAM payments are not front-loaded like FPM payments, the duration (average life) of a PLAM is longer than that of an FPM of the same term, aggravating the maturity mismatch problems faced by financial intermediaries with short-term liabilities. In addition, the expected duration of a PLAM is lengthened further since, as discussed above, a PLAM is less likely to prepay than an FPM.

PLAM lenders will also face a cash flow, or liquidity, risk, especially during the transition of their mortgage portfolio from FPMs and ARMs to PLAMs. As the FPMs in the lender's portfolio age, the front-loaded pattern in their payments becomes a problem when they are replaced with the evenly loaded payment stream of PLAMs. Even after the transition, lenders that rely on short-term nominal deposits will be squeezed when the expected inflation rate increases. The nominal interest rates paid on deposits

Figure 5

Loan-to-Value Ratios with a 5 Percent Inflation Rate



Source: Authors' calculations

jump immediately, yet the nominal payments on their PLAM assets rise only gradually over time as the price level actually rises. In a sense, the "tilt" problem has been shifted from the borrower to the lender.

The tax treatment of PLAM interest compounds the cash flow problems for lenders. While the borrower is allowed to deduct the entire PLAM payment until the mortgage balance declines below the initial loan amount, lenders are taxed on the entire accrued interest (interest payment plus negative amortization), even though this substantially exceeds their cash receipts in the early years of a PLAM. Such tax treatment is likely to severely restrain the demand for PLAMs in the portfolios of taxable lenders such as deposit institutions.

IV. The Market for PLAMs: Back to the Future

Why have PLAMs not yet appeared in the United States? It is generally not possible to know with certainty why a specific, known product has not yet surfaced or succeeded. Business history is replete with examples of products that succeeded only after unsuccessful attempts or succeeded only when rein-

roduced after a substantial time had elapsed. The elements of change and timing should not be underestimated in this regard. To give a familiar example, diet beer was a product failure, in the sense that it was introduced, promoted, and proved unprofitable. "Lite" beer, which seems no different in substance from diet beer, has been an equally resounding success.

Price-level adjustments in financial arrangements other than mortgages are now generally more widespread than in previous decades. But few of them arose quickly in response to inflation. Indexing of social security benefits began in the mid-1970s. Indexing of income tax brackets began in the mid-1980s. Commercial leases that specify payments as a percentage of sales are effectively indexed to the price level (as well as other factors) and became common only after inflation had continued for some years. Financing commercial or rental property with PLAMs would help match such lease or rental cash flows, thereby drastically reducing the negative cash flow that is common in the early years of such projects.

Closer to the topic at hand is the example of home equity loans. In their previous incarnation as "second mortgages," home equity loans were neither widely used nor particularly well regarded. That product was anything but glamorous. By the end of the 1980s, the size and image of that market had changed. Several reasons can be offered for the current popularity of home equity loans, but some are especially instructive with regard to mortgage design and to PLAMs in particular. First, homeowners now appear to have much less resistance than had been presumed to negative amortization, that is, an increase in the mortgage balance remaining. Second, many, having become homeowners, willingly slow the repayment of their mortgage debt in order to have more access to cash. By lowering payments for several years, PLAMs do this automatically.

PLAMs do exist in countries with economic circumstances and financial markets and institutional arrangements much like those of the United States, as well as in countries with substantially higher inflation rates. PLAMs exist in Canada, Australia, Brazil, Colombia, Paraguay, Peru, and Finland. The World Bank has helped introduce PLAMs in Mexico, Argentina, Chile, Ecuador, Ghana, and Turkey.¹⁵ PLAMs are the only form of mortgage available in Israel. And Hungary may soon join the list of PLAM countries.

Why are PLAMs not generally available in the United States? Until recently, lenders were uncertain about whether and how various tax laws, interest rate

ceilings, and disclosure rules and regulations might apply to PLAMs. Now various agencies of the federal government have published tax rulings and other regulations involving disclosure, rate caps, and other mortgage features that pertain to PLAMs. The stumbling blocks posed by these uncertainties have now been pushed aside.

Other reasons are sometimes given for the absence of PLAMs in the United States. One is that

PLAMs exist in countries with economic circumstances and financial markets and institutional arrangements much like those of the United States.

homeowners prefer not to have negative amortization. PLAMs do not allow for negative amortization in real terms, though it may well occur in dollar terms. Most homeowners who refinance their homes do choose to raise the remaining balance. Home equity loans also effectively raise the amount that a home is mortgaged. Many adjustable rate mortgages permit the outstanding balance in dollar terms and in real terms to rise above its current and even its original balance. Last, though many may prefer not to have negative amortization, many would-be and current homeowners would willingly choose the PLAM amortization schedule in order to be able to more easily afford homeownership. Thus, the possibility of negative amortization probably should no longer be regarded as a major deterrent to PLAMs.

Nor is the argument compelling that the uncertainty of future prices, and therefore mortgage payments, prevents the PLAM market from being viable. In the current economic life of renters, for example, probably not a single important item exists whose future price can be known with much certainty. By design, PLAM payments track the average cost of living. They cannot go up more (or less) than that. That is more certainty than can be attached to prices for food, medical care, transportation, or indeed, to rent. In practice, increases in income levels tend to track, and somewhat exceed, increases in the aggregate price level. Thus, a PLAM is likely to deliver less "payment shock" than do ARMs. It is, of course, true

that an FPM delivers the most certain dollar payment requirement, but FPMs are unsatisfactory on other counts.

In the current economic environment, PLAMs might well be structured similarly to mortgages of the 1950s, an era with little inflation, when 4½ to 5½ percent interest rates and maturities of twenty years were common.¹⁶ A viable PLAM for the 1990s might have the following characteristics: a 4 percent real interest rate, a 20-year term, 20 percent initial payment-to-income ceiling, and a 20 percent down payment (the "20/20/20 PLAM").¹⁷ Table 4 contains the same information for this PLAM as that presented in Tables 2 and 3. For ease of comparison, a house of \$125,000 rather than \$111,000 is used to accommodate the 20 percent down payment, leaving the initial mortgage balance at \$100,000 as in the previous examples.

Why anticipate a 4 percent real interest rate for

the PLAM? Comparison of recent FPM interest rates (about 10 percent) and the expected ten-year average inflation rates (about 4½ percent) suggests a 5½ percent real interest rate for recently originated FPMs.¹⁸ That 5½ percent FPM real rate may contain a prepayment premium about 1 full percentage point above the one PLAMs would carry. (See, for example, Hendershott and Buser 1984; Handorf and Sachlis 1990, Woodward 1990.) PLAM borrowers could probably save at least another full percentage point through a lower inflation risk premium (see, for example, Sharplin and Mabry 1982). Thus, 1½ percentage points appears to be a conservative estimate of the reduction in the real interest rate achieved by going from FPMs to PLAMs.¹⁹

To a large degree, the easing of FPM qualification criteria over the past two decades represents attempts to avoid the distorting effects of inflation on level-payment mortgages. Payment-to-income ceilings

Table 4
Price Level Adjusted Mortgage

Original Balance		\$100,000		Real Interest Rate	4%		
Term (years)		20		Inflation Rate	5%		
Down Payment		20%		House Price Inflation	5%		
Year	Monthly Payment	Dollar Balance	House Price	Loan-to-Value Ratio (Percent)	Owner's Equity	Real Payment	Real Balance
1	\$ 644	\$100,000	\$125,000	80	\$ 25,000	\$613	\$96,642
2	676	101,474	131,250	77	29,776	613	93,149
3	710	102,697	137,813	75	35,115	613	89,517
4	745	103,627	144,703	72	41,076	613	85,740
5	783	104,217	151,938	69	47,721	613	81,811
6	822	104,414	159,535	65	55,121	613	77,725
7	863	104,159	167,512	62	63,353	613	73,476
8	906	103,388	175,888	59	72,499	613	69,057
9	951	102,029	184,682	55	82,653	613	64,461
10	999	100,000	193,916	52	93,916	613	59,681
11	1049	97,215	203,612	48	106,397	613	54,710
12	1099	93,573	213,792	44	120,219	613	49,541
13	1156	88,968	224,482	40	135,514	613	44,164
14	1214	83,278	235,706	35	152,428	613	38,573
15	1275	76,371	247,491	31	171,120	613	32,757
16	1338	68,100	259,866	26	191,766	613	26,709
17	1405	58,303	272,859	21	214,556	613	20,420
18	1476	46,802	286,502	16	239,700	613	13,878
19	1549	33,400	300,827	11	267,428	613	7,075
20	1627	17,879	315,869	6	297,990	613	0
		0	331,662	0	331,662	613	0

Note: See Table 3
Source: Authors' calculations.

were typically 20 percent before inflation became a consideration, but were raised to 25 and then to 28 percent, and have sometimes gone considerably higher (McCulloch 1986). PLAMs are likely to be underwritten with qualification criteria more like those observed in the pre-inflation era since inflation cannot be expected to reduce the payment-to-income or loan-to-value ratios.

Similarly, as nominal interest rates rose in response to higher inflation, the maturity of the typical FPM lengthened as borrowers sought to reduce the real cash-flow burden of initial payments (Figure 6). Since PLAMs remove this incentive, many borrowers are likely to find that they need not stretch the mortgage term beyond twenty years.

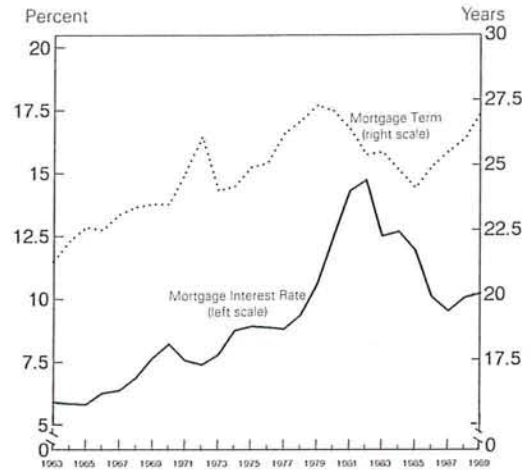
When PLAMs are issued in the United States, who will hold them? The most natural owners of PLAM assets are defined-benefit pension plans.²⁰ In fact, the price-level-adjusted bonds issued by the government of the United Kingdom are typically held by pension funds and insurance companies, although they can, of course, be held by individuals as inflation-proof investments. Cash-flow considerations and some aspects of income tax regulations (for example, being taxed on an accrual rather than a cash basis) make it unlikely that PLAMs will be held by banks, thrifts, or other originators. The ability to originate, collect origination fees (and perhaps retain servicing rights and fees), and then sell such mortgages would have even more appeal to originators at a time when concern about capital is so prevalent.

Pension plans, on the other hand, do not face the same income tax considerations. Nor, importantly, do they face the same cash flow considerations as deposit intermediaries. By holding the appropriate share of their portfolios in PLAMs, defined-benefit pension plans could increase the long-run inflation protection offered to their members.

This would simultaneously address the problems caused by inflation for potential first-time home buyers and for those retired individuals who rely on private sector pensions. The combination of PLAMs and indexed pensions would remove both the real mortgage payment "tilt" and the real private pension benefit "tilt," helping individuals during the most vulnerable parts of their lifetimes, when they are very young and very old. At the same time, this combination would not involve a financial intermediary taking on substantial inflation risk by having indexed instruments on only one side of its balance sheet, that is, by offering only PLAMs or only indexed pensions and annuities.

Figure 6

Fixed Payment Mortgage Terms Rose with Interest Rates



Source: Mortgage Interest Rate Survey provided by Federal Home Loan Bank of Boston

VI. Conclusions

Despite two decades of non-negligible inflation, financial markets have adapted to it only partially. Rather than directly addressing the distortions brought on by inflation, they have made approximate, indirect, and incomplete adjustments. Economists have long advocated a more direct, effective, and simple response to the reality of a rising price level: the Price Level Adjusted Mortgage. PLAMs eliminate the unintentional, but all too real, pain of inflation. They do so by tailoring mortgage payments more closely to the ability to pay. In this way they eliminate the underwriting hurdle placed in the paths of potential homebuyers by level-payment mortgages in an inflationary environment. The affordability problem is not that the economic cost of housing is "too high," or that lifetime income is "too low," but that level-payment mortgages make the real payment burden in the early years of the mortgage unnecessarily high if inflation in even modest amounts is present.

Public policy might usefully support the initiation of a market in PLAMs, although on economic grounds alone no compelling case can be made for a long-standing government commitment to PLAMs.

In that sense, however, the opportunity to "jump start" the market represents an attractive use of public policy, similar to that implemented much earlier with the introduction of long-term, fixed-rate mortgages. Public policy could act as a catalyst for innovation and improvement without taking on an uncertain commitment. The public sector could "declare victory and withdraw" once a sufficient push toward development of the PLAM market had been achieved. If PLAMs then do not pass the market test, further involvement may not be justified.²¹

This start could be accomplished in various ways. The federal government might agree to provide, for a pre-specified period, actuarially appropriate mortgage insurance. Or, as it has done with a program called the "Reverse Annuity Mortgage," it could run a demonstration project to provide information to the private sector. In fact, the 1983 Housing and Urban-Rural Recovery Act authorized the Department of Housing and Urban Development (HUD) to conduct a PLAM demonstration program with a volume of as much as 10 percent of the previous year's FHA originations. While a smaller demonstration program has been under consideration, it has not yet been implemented (Woodward 1990). Such stimulation could be expected to lead to development of a secondary market in PLAMs. Since the originators and the ultimate PLAM lenders are unlikely to be the same entities, a secondary market is especially attractive, and quite likely necessary.

Since potential homebuyers may face minimum down payment as well as maximum payment-to-income constraints, easing one constraint may have a limited impact on effective housing demand if potential homebuyers are then bound by the other con-

straint. PLAMs ease only the payment-to-income constraint, and may make the down payment constraint more binding to the extent PLAMs require larger down payments compared to FPMs or ARMs. While this may not present a problem for "move up" homebuyers who have accumulated a significant equity position in their current home, first-time homebuyers on average have less wealth available for down payments. Public policy can play an important role in this regard to ensure that both constraints are eased in tandem. For example, FHA and VA low down payment programs could be expanded to include PLAMs. In addition, the government could introduce savings programs targeting first-time homebuyers. Already the Administration has proposed easing the requirements on Individual Retirement Accounts to allow savers to withdraw funds for first-time home purchases and creating tax-favored Family Savings Accounts that could be used to accumulate a down payment (*Economic Report of the President 1990*, p. 139).

PLAMs put more housing within the reach of more families of all ages. Young families are especially likely to benefit from this advance. But PLAMs can also benefit the not-so-young. PLAMs make available an inflation-proof asset for pension funds and other saving institutions and thereby make it feasible for them to offer completely inflation-proof benefits and savings plans. Pension plan members, including those who look forward to retirement benefits as well as those already retired, can gain from this development. In this regard, PLAMs preserve the ability of the young to provide themselves with appropriate housing and retirement saving options.

¹ In fact, by opening the housing market to many households previously excluded based on current cash flow requirements, housing demand would be increased. Thus house prices would likely rise somewhat.

² The house price series is based on the Census Bureau quality adjusted series (1982 base year). The income series is the median money income for male, year-round, full-time workers aged 25 to 34. We have chosen this series rather than a measure of household or family income to abstract from the effects of increased labor force participation. If median family income is used in column 2, between 1965 and 1989 the house price-to-income ratio falls by nearly 10 percent rather than rising by 3 percent. This mitigates the rise in the payment-to-income ratio and substantially increases the importance of higher interest rates, with higher interest rates now accounting for all of the rise in the payment-to-income ratio as well as serving to offset the benefits of family incomes rising faster than house prices during this period.

³ In the text, FPM refers to a long-term, level-payment, fixed-rate mortgage. An adjustable rate mortgage can, in a sense,

be thought of as a very short-term, level-payment, fixed-rate mortgage. Our arguments regarding the unsuitability of the FPM during inflationary periods apply equally well to ARMs since they, too, base their payments on nominal interest rates and are mortgages whose payments are expected typically to fluctuate around an unchanging level.

⁴ In addition to being constrained by their expected lifetime resources, prospective homebuyers face two additional constraints set by lenders that limit the amount of the mortgage: minimum down payment and maximum payment-to-income requirements. Potential homebuyers may find themselves bound by either constraint. This article focuses on the latter constraint whereby level-payment mortgages constrain mortgage size, and thus the demand for housing, when even a modest amount of inflation occurs.

⁵ Technically, the relationship between nominal (i) and real (r) interest rates is $(1 + r) = (1 + i)/(1 + \pi)$, where π is the inflation rate. Thus, $i = r + \pi + r\pi$. The interaction term, $r\pi$, is typically ignored, being of second-order magnitude. Similarly, the *expected* real rate is equal to the nominal rate less the *expected* inflation rate.

We also ignore income tax considerations for the time being, though they are likely to be relevant in practice. See, for example, Peek and Wilcox (1984).

⁶ This, and all other examples below, is on a pretax basis. If pretax real interest rates are unchanged, the tax deductibility of interest payments would actually reduce the after-tax cost as inflation rises.

⁷ In choosing payment-to-income ceilings, lenders may make some allowance for increases in incomes and the resulting declines in the payment-to-income ratio that can be expected as inflation (and careers) continue.

⁸ Homeownership rates really understate the severity of the problem in that they only measure "attainability," that is, whether or not a household has been able to attain homeowner status. As discussed above, many households that are able to purchase homes are restricted to buying lower-quality houses than their lifetime incomes warrant and/or face extremely heavy cash flow payment burdens during the early years of the mortgage term.

⁹ The relatively large number of young people (the baby boom cohort) during this period may have also depressed their per capita earnings relative to what they would have been otherwise and in this way had an effect on their demand for housing. It may have also lowered their early-career earnings relative to what they can expect later on.

¹⁰ Though economics always focuses on action subject to constraints, this particular liquidity constraint is one that operates in addition to economic considerations. In the case at hand, it is an artificial constraint caused by the use of a financing instrument not well-suited to the (inflationary) environment. See, for example, Wilcox (1989).

¹¹ Technically, for the hypothetical cases given, the after-tax real cost of the mortgages would decline as the inflation rate rose for those individuals who itemize deductions since the entire interest payment, including any inflation premium, is deductible, not just the real interest component.

¹² ARMs often had "teaser" rates that provided temporarily lower initial rates and thereby enhanced their affordability and

attractiveness to borrowers. These "teasers" largely disappeared from the market after the Savings and Loan cleanup began in earnest. For a discussion of the benefits and risks of ARMs, see Peek (1990).

¹³ This argument applies to long-term financing generally.

¹⁴ Of course, with perfect capital markets and no transactions costs, cash flow might be irrelevant and the timing of the payment stream would not be an issue. The household could finance the higher real mortgage payments in the early years by borrowing against its higher expected future income.

¹⁵ See Woodward (1990).

¹⁶ FHA-insured mortgages often carried interest rates that were about one-quarter percentage point lower and maturities that were a few years longer. See Guttentag and Beck (1970) for a more detailed description of mortgage terms in the 1950s.

¹⁷ McCulloch (1986) proposes somewhat looser underwriting criteria, with terms of 20, 25 and 30 years corresponding to down payments of 5, 10, and 20 percent, all with initial payment-to-income ratios of 20 percent. He finds such PLAMs to be safer than either the standard FPM, the GPM or the ARM. At the same time, the lower initial payment associated with any given size of loan allows the homebuyer to qualify for a larger loan, even with the lower payment-to-income ceiling.

¹⁸ The expected inflation rate is taken from the Decision-Makers Survey conducted by Richard Hoey. Since the expected life of a 30-year FPM is in the vicinity of 10 years, the 10-year term for the expected inflation rate is appropriate for calculating the real interest rate for FPMs.

¹⁹ The attractiveness of holding PLAMs in investor portfolios may lead to an even greater real interest differential between fixed-rate and real-rate mortgages. See Bodie (1990) for evidence suggesting that it could be much larger.

²⁰ See Lovell (1981) and Munnell and Grolnic (1986).

²¹ Although the logic behind reverse annuity mortgages is also quite compelling, they have not (yet) accounted for a significant share of mortgage originations.

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