NBER WORKING PAPER SERIES

ACCELERATING INFLATION, NONASSUMABLE FIXED-RATE
MORTGAGES, AND CONSUMER CHOICE AND WELFARE

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Working Paper No. 755

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Abstract

This paper measures the impact of nonassumable, fixed-rate, long-term

mortgage financing on household mobility and housing demand during

a period of accelerating inflation (1965-74). We calculate that typical

households who bought houses during the 1964-71 period and utilized this

type of financing would not have moved until the 1975-77 period. And

this is in spite of rising incomes and a sharp fall in the real rental

price or user cost of housing.

We conclude that the nonassumable, fixed-rate mortgage is largely

responsible for both sluggish housing demand in the 1967-74 period and

its surge in the 1976-79 period. Housing activity would have been

far more stable had variable-rate mortgages been employed. Finally,

the enormous gap between current mortgage rates and those existing in the

1970s and the resultant huge capital gains on existing mortgages does not

bode well for housing activity in the near term future.

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Accelerating Inflation, Nonassumable Fixed-Rate
Mortgages, and Consumer Choice and Welfare

It is well established that the rental price or real user cost of

owner-occupied housing fell significantly between the middle 1960s and the

late 1970s.[1] This decline follows from two facts. First, the real user

cost depends positively on real after-tax interest rates. Second, during

this period nominal interest rates rose about one-for-one with the increase

in the inflation rate. Thus, the real user cost fell for those paying

positive taxes on interest income, and the fall was greater the higher the

tax rate (income level) of the household. As a result of both this decline

and the failure of the real user costs for nonresidential investments to

fall similarly (in fact, those costs appear to have risen), some have

argued that the U.S. economy has overinvested in housing at the expense of

industrial capital and has thus suffered substantial productivity losses.[2]

Somewhat surprisingly, the implied surge in housing demand did not develop

in the 1966-75 decade. Housing starts were no greater than in the previous

decade; the average quality per single family start was up by less than

5 percent from 1966-67 to 1974-75; and the real price of new single

family houses increased by less than 10 percent between 1965 and 1975.[3]

Not until 1976-79 was there a bonafide housing boom. In this period

[1]See Diamond (1980), Hendershott and Hu (1981), and Villani (1981).

[2]See Hendershott and Hu (1980)(1981) and Rosen (1979). The analysis of
de Leeuw and Ozanne (1981) is also consistent with this view.

[3]For the precise measurement of quality and price, see the notes on pages 17 and 28.

starts were up by 35 percent; the average quality rose by 7 percent; and the real price of a constant quality house increased by 21 percent.[4]

Explanations offered for the sluggishness of housing demand in the 1966-75 decade are based on increases in nominal, as opposed to real after tax, interest rates. In a world with deposit rate ceilings, an increase in open market interest rates retards deposit flows, restricting mortgage purchases of depository institutions. If other lenders do not make compensatory mortgage investments, then credit to homebuyers is rationed and, in the absence of other sources of funds, housing demand is impaired.[5] Even if credit funds are ample, lenders may not be willing to extend them in sufficient amounts to homebuyers. The real user cost declines because the current greater interest costs (after tax) are more than outweighed by future (expected) increases in the value of the house being financed. If lenders are unwilling to make funds available on the basis of these future expected gains and if households cannot either (1) meet the higher initial mortgage payments by borrowing in other forms, rechanneling their savings from other assets to housing equity, or increasing total income through greater work effort or (2) reduce the payments by allocating more wealth to housing at the time of purchase, the housing demand of these households will be reduced.[6] While these explanations obviously

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[4] The quality increase came between 1975:3 (third quarter) and 1977:2; the price increase occurred between 1975:3 and 1979:3.

[5] The principal advocates of this position are Jaffee and Rosen (1978)(1979).

[6] Kearl (1978)(1979) has emphasized this view.

appeal to some, many find their empirical importance severely limited by the extensive qualifiers attached to the explanations. When depository institutions have had insufficient funds to meet household demands for housing finance, other lenders have acted to fill the "mortgage gap"; mortgage purchases by the Federal National Mortgage Association, advances by the Federal Home Loan Banks, and the growth in GNMA pass-through securities are all means of channeling "capital market" money to the mortgage market.[7] Also numerous households have obviously responded to lenders restrictions by increasing their initial downpayment (especially those with capital gains on previous house purchases), by rechanneling saving away from financial assets, and by increasing labor force participation.

In this paper we offer a third explanation for the sluggishness of housing demand in the 1966-75 decade. This explanation is also based on increasing nominal mortgage rates during a period of accelerating inflation, but it does not require imperfect capital markets. Households that finance house purchases with long-term, fixed-rate mortgages find themselves with mortgage capital gains when nominal interest rates rise. If the mortgages are nonassumable, then the gains can only be reaped if the households maintain their existing mortgage (continue low rate financing while the house inflates rapidly in value). To the extent that this occurs, housing demand fails to rise not only in response to the decline in the real user cost but also in response to increases in real income. That is, the housing-income ratio falls rather than rises.

[7]For arguments and evidence that the mortgage market has become integrated with the bond market, see Hendershott and Villani (1980)(1981) and Hendershott (1980).

The results reported below suggest that the mortgage capital gains were likely an important deterrent to housing demand in the 1967-74 period for households that financed earlier purchases with nonassumable, long-term, fixed-rate mortgages. During this period, such households had to trade off expected rapid wealth accumulation (owing to a low mortgage rate in conjunction with rapid anticipated housing capital gains) against a progressively more "suboptimal" consumption bundle (too little housing given its falling real rental price and the household's rising real income). Until 1975, the optimizing choice for most such households was consumption of too little housing.

The analysis of this paper is divided into three sections. Section I contains a methodology for calculating the benefits and costs associated with moving and for determining when particular households who purchased houses in specific years would have subsequently moved. The calculations are presented in Section II. For purposes of comparison, similar calculations are performed based on the assumption that households had utilized variable rate, rather than fixed rate, financing. A measure of the social costs of fixed-rate mortgages owing to the suboptimal consumption pattern of households with mortgage capital gains is reported in Section III.

I. Measuring the Net Benefit from Moving

In measuring the benefits from moving to a new house, we use the equivalent-gain approach of King (1981) which follows the equivalent-variation approach of Hicks (1943). For this purpose, assume that the preferences of the representative households are defined over two goods: housing (x_h) and other (x_o):

$$u = u(x_h, x_o). \qquad (1)$$

Let the nominal disposable income of the household be Y, the price of nonhousing goods be p_o, and the rental price of housing be $p_h = p_h^A(r-\pi+\delta)$, where p_h^A is the asset price of the house, r is the after-tax housing financing rate, π is the inflation rate, and δ represents other costs (depreciation, maintenance, net property taxes) as a percent of the asset price. Maximizing (1) subject to the budget constraint that $p_h x_h + p_c x_o = Y$ gives the demand for each good as a function of income and prices. Upon substitution of these two demand functions into (1), we can express the household utility as an indirect function of income and prices:

$$v = V(Y, p_h, p_o). \qquad (2)$$

Because X_h^d, X_o^d and V are homogeneous of degree zero with respect to their arguments, it is convenient to normalize both disposable income and the user cost of housing in terms of units of nonhousing goods. That is,

$$x_h = X_h^d(Y/P_o, P_h/P_o, 1) = x_h^d(y, c) \tag{3}$$

$$x_o = X_o^d(Y/P_o, P_h/P_o, 1) = x_o^d(y, c) \tag{4}$$

$$v = V(Y/P_o, P_h/P_o, 1) = v(y, c), \tag{2'}$$

where y is real disposable income and c is the real user cost of housing.

We now define the equivalent gain. Suppose the budget position of the household changes from an original vector (y^o, c^o) to a new vector (y^n, c^n). More specifically, assume that the household's income has risen $(y^n > y^o)$ and that an increase in the inflation rate has lowered the real user cost of housing capital $(\Delta r < \Delta \pi$ so $c^n < c^o)$. The equivalent gain (EG) is defined to be the increase (above y^o) in income that would leave the household as well off at the initial price vector as it is at the new budget position. That is, EG is defined by

$$v(y^o + EG, c^o) = v(y^n, c^n). \tag{5}$$

The equivalent gain is illustrated graphically in Figure 1, where $y^o-(y^o/c^o)$ represents the original budget line and I^o, the original indifference curve reached. The new budget line, $y^n-(y^n/c^n)$, allows the household to reach I^n. The demand for housing has risen from x_h^o to x_h^n. Draw a line tangent to the new indifference curve (I^n) and parallel to the original budget line. Then the equivalent gain equals the vertical distance between these budget lines. Obviously this distance
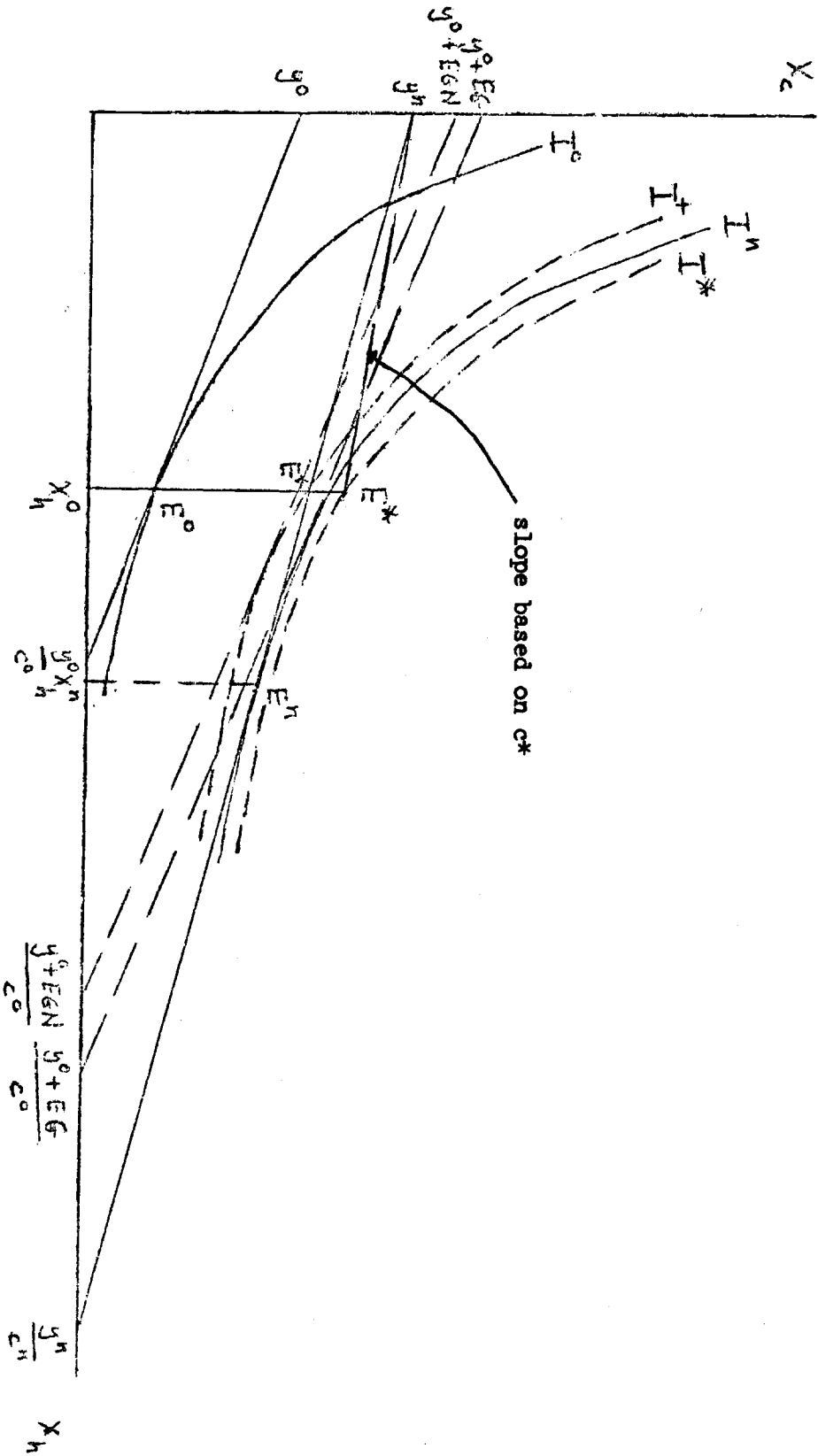
Figure 1: Calculation of Equivalent Gains

equals $y^n - y^o$ if the vertical distance is due entirely to a change in income.

The above analysis implicitly assumed that the household was financing the house with a one period loan or, equivalently, with a fully variable rate mortgage. Thus the real user cost fell to

$$c^n = \frac{p_h^A}{p_c} (r^n - \pi^n + \delta).$$

Alternatively, suppose that the house was financed entirely (for simplicity) by a nonassumable, long-term, fixed-rate mortgage. In this case, the effective user cost facing the household that does not move is

$$c^* = \frac{p_h^A}{p_c} (r^o - \pi^n + \delta) = c^n - \frac{p_h^A}{p_c} (r^n - r^*),$$

where $r^* = r^o$. Thus, this household is able to attain point E^* in Figure 1 that puts it on indifference curve I^* which, in this case, gives greater utility than I^n. That is, the household maximizes its utility by maintaining its existing housing (and low rate financing). Of course, the combination of inflation and normal amortization erodes the value of the low rate mortgage over time. Thus r^* will rise toward r^n, c^* will fall toward c^n, and E^* declines to E^+. When E^* falls below the I^n curve, the utility associated with maintaining x_h at x_h^o is less than that obtainable by shifting to E^n and increasing housing demand to x_h^n. At this point the household will move.

Because $r*$, $c*$, and $E*$ are not time invarient, it is convenient to divide the maximization calculation into two parts. In the first we consider the gross gain from moving (the gain before accounting for the cost of foregoing the existing mortgage). In terms of Figure 1, this is the gain generated by shifting from point E^+ to point E^n. (The gain from E^o to E^+ is achieved without moving.) In the second part we consider the costs from moving, i.e., the shift from $E*$ to E^+. When the gain exceeds the cost, the move will be made.

The Gross Equivalent Gain from Moving

The gross equivalent gain from moving (EGM) is defined as the difference between the total equivalent gain (EG) and the equivalent gain from not moving (EGN).[1] In terms of Figure 1, EGN is obtained by drawing a budget line tangent to the indifference curve (I^+) going through E^+ and parallel to the original budget line y^o-y^o/c^o. The difference between this line and the original line is EGN. For the purpose of measuring the EGN, let (y^e, c^e) be the solution to the following two demand equations

$$x_h^o = x_h^d(y^e, c^e) \tag{6}$$

$$x_o^+ = x_o^d(y^e, c^e) \tag{7}$$

where, from the budget constraint,
$$x_o^+ = y^n - c^n x_h^o \tag{8}$$

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[1] This assumes that the household's income is independent of whether or not it moves. Often achievement of income gains effectively requires changing one's location.

is the quantity of the other commodity consumed if the household does not move (is at point E^+). The solution values, y^e and c^e, are the equilibrium values that would lead the household to choose E^+ on I^+. Consequently, we can identify the utility of E^+ with the indirect utility measured at (y^e, c^e). That is, EGN is but the solution to:

$$v(y^o + \text{EGN}, c^o) = v(y^e, c^e). \tag{9}$$

In the analysis below, v will be assumed to take the following form: [2]

$$\log v = y^{1-\gamma} - \alpha c^{1-\beta}. \tag{10}$$

Applying Roy's Identity to equation (10), it can be shown that the demand functions for the two goods are given by

$$x_h = -\frac{\partial \log v/\partial c}{\partial \log v/\partial y} = A \frac{y^\gamma}{c^\beta} \tag{11}$$

$$x_o = y - cx_h, \tag{12}$$

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[2] Included as special cases of the above functional form are
$\log v = \log y - \alpha c^{1-\beta}$ $(\gamma \to 1)$ and $\log v = y^{1-\gamma} - \alpha \log c$ $(\beta \to 1)$.

where A is a parameter dependent upon α, γ and β, and
the latter, are, respectively, the elasticities of housing demand with
respect to real income and the real user cost of housing. When the
elasticities are unity, $A = \alpha$ is the proportion of household income spent
on housing services.

The equivalent gain between the two budget positions (y^o, c^o) and
(y^n, c^n) can now be explicitly solved from

$$(y^o + EG)^{1-\gamma} - \alpha c^{o^{1-\beta}} = y^{n^{1-\gamma}} - \alpha c^{n^{1-\beta}}$$

as

$$EG = \{y^{n^{1-\gamma}} - \alpha(c^{n^{1-\beta}} - c^{o^{1-\beta}})\}^{\frac{1}{1-\gamma}} - y^o. \qquad (13)$$

Replacing (y^n, c^n) with (y^e, c^e), the equivalent gain with no moving is

$$EGN = \{y^{e^{1-\gamma}} - \alpha(c^{e^{1-\beta}} - c^{o^{1-\beta}})\}^{\frac{1}{1-\gamma}} - y^o, \qquad (14)$$

where (y^e, c^e) can be obtained by substituting (11) and (12) into (6) and
(7), respectively, i.e., by solving[3]

$$x^o_h = A\frac{y^{e^\nu}}{c^{e^\beta}} \qquad (6')$$

$$x^+_o = y^e - c^e x^o_n. \qquad (7')$$

[3]For $\gamma = 1$, (13) and (14) can be written as

$$EG = y^n \exp\{\alpha(c^{o^{1-\alpha}} - c^{n^{1-\alpha}})\} - y^o$$

$$EGN = y^e \exp\{\alpha(c^{o^{1-\beta}} - c^{e^{1-\beta}})\} - y^o.$$

The Adjustment Costs

The costs associated with moving this period, rather than next, include the present (as opposed to later) payment of a realtor's fee, as well as the low-interest mortgage that the household has to give up. Assume that the real realtor's fee (F) is equal to a fraction g of the real value of housing,

$$F = g(1-d)^t x_h^o (p_h^A/p_c),$$

where d is the rate at which the real housing services from the house depreciate. By not postponing the sale of the existing house by one period, one foregoes the real interest saving associated with postponement of the realtor's fee. The foregone after-tax saving is

$$CF = [(1-\theta)i-\pi]g(1-d)^t x_h^o (p_h^A/p_c), \tag{15}$$

where θ is the marginal tax rate of the household and i is the interest rate.[4]

There is also the cost associated with exchanging the old mortgage for a new one. Assume that the house was initially financed with a fixed-rate, T-year mortgage with a loan-to-value ratio of v^o. Then the one-period real cost of relinquishing the existing mortgage is equal to

$$CM = (1-\theta)(i-i^o)\left[\frac{(1+i^o)^T - (1+i^o)^t}{(1+i^o)^T - 1}\right]v^o \frac{p_h^{A^o}}{p_c} x_h^o, \tag{16}$$

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[4]It is assumed that no change in p_h^A/p_c is expected to occur between the two periods.

where i is the current mortgage interest rate, i^o is the interest rate on the existing mortgage, and t is the number of years since the mortgage was originated.[5] (The ratio in brackets is the fraction of the initial loan that is still outstanding.)

The total one-period cost of moving is now equal to

$$COST = CF + CM. \tag{17}$$

Optimality dictates that the household should postpone the move at least until EGM > COST. Because the cost of giving up the mortgage falls in real terms over time (p_c rises and the mortgage is amortized -- t increases) and the gain does not, the household should move as soon as EGM > COST.

An Illustrative Example

In the following section we report estimates as to when different classes of households (defined by their particular marginal tax brackets and future growth in real permanent disposable income), who bought houses in particular years, would have maximized utility by moving. In this section we provide an example in order to illustrate the precise method of calculation. We also indicate some assumptions and data sources underlying the calculations.

[5]Equation (16) is not symmetric with respect to $i \gtrless i^o$. When $i < i^o$, households can refinance (reap a gain) without selling the house. Thus, we constrain CM to be nonnegative.

The income and price elasticities of housing demand are assumed to be plus and minus 0.75 respectively ($v = \beta = 0.75$). These are consistent with Polinsky and Elwood (1979), as well as other studies. The constant A is set such that the size of the house purchased in the fourth quarter of 1965 (1965:4) by a household in the 30% marginal tax bracket with real permanent disposable income equal to the average real disposable income per household in the economy was equal to the per-household housing stock in that year. The latter number is $13,866 and average disposable income per household was $10,975. (These and all dollar numbers reported below are 1972 dollars.) The real user cost of owner-occupied housing for households in the 30% tax bracket in 1965:4 was 5.77% (Hendershott and Shilling, 1981). This determines A to be 0.2707, and thus

$$x_h = .2707(y/c)^{.75}. \tag{11'}$$

The household is assumed to have purchased this house in 1965:4 and have financed it with a 75% loan-to-value, 25 year, 5.83% mortgage. The household's real permanent disposable income is posited to have risen by 1.5 percent per year.[6] Given the observed movement in the home mortgage rate and the measured change in the household's

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[6]This is one percent less than the $2\frac{1}{2}$ percent average growth rate in real disposable income per household in the U.S. observed between 1965 and 1979. We have chosen this lower rate for two reasons. First, the growth in permanent income will be less than the growth in current income to the extent that the former was anticipated. Second, some part of the growth was achievable only by households changing work location, and we are not modeling households that moved in order to achieve extraordinary income growth.

real user cost, this household would not have moved until 1975:1. We provide illustrative calculations for 1974:4 and 1975:1 below.

In 1974:4, the household's real income was \$12,558, the mortgage rate was 9.78% and the real user cost had fallen by 2.6 percentage points to 3.19%. Using equation (11'), x_h^n was \$23,927, a full \$10,000 above x_h^o. The total equivalent gain, from (13'), would have been \$2,078 per annum, of which \$1,612 was due to the rise in income and \$465 to the reduction in real user cost. Without moving, the household would have to take the consumption bundle of x_h^o = \$13,866 (the 1965:4 housing) and x_o^+ = \$12,116, \$12,558-.0319(\$13,866). Making use of (6') and (7'), we can translate this consumption into an equivalent budget position of y^e = \$13,068 and c^e = 6.87%. From equation (14'), we then calculate EGN to be \$1,932. Finally, EGM = EG-EGN is \$146.

From equation (16), the real per annum cost of relinquishing the existing mortgage is \$285. and the foregone interest saving on the realtor's fee is \$4 from equation (15). Thus the total one-period cost from moving is \$289. Because this exceeds the one period gain, this household should have remained in its existing residence.

The combination of a decline in the real after-tax user cost of capital from 4.27% to 3.25% and in the mortgage rate from 9.78% to 9.27% both increased the gross gain and lowered the cost of moving. (During the same period the household's disposal income rose slightly to \$12,605.) Repeating the above calculations with these new values, we obtain the total equivalent gain between the 1965:4 and 1975:1 budget positions to be \$2,459. The gain without moving is equal to \$2,134 leaving a \$325 gain from moving. The fall in the nominal mortgage rate

reduced the total one-period cost of moving to $245. Thus a net one-period gain of $79 could be achieved, and the household should have moved.

II. The Timing of Moves by Households

The above analysis is employed in this section to determine when households that purchased houses in the fourth quarters of the years 1959 to 1972 would have moved in order to upgrade (increase) their housing. As noted above, a move will occur when the gross equivalent gain from moving, which follows from the choice of a more satisfying consumption bundle, exceeds the costs of giving up a below-market mortgage and paying realtors' fees sooner. The optimal period to hold an existing house depends on a host of variables from the rate of growth in real income and housing income and price elasticities to the tax rate of the household and the type of financing obtained. We begin by considering our standard household -- that with the same characteristics and financing described in the illustrative example. We then examine the sensitivity of the holding period decision to the income and price elasticities, the rate of growth in real income, and the tax rate. Finally, we contrast the decisions that would be reached with fixed and variable rate mortgage financing.

The Standard Household

Table 1 contains the results for the basic case. The important parameter values are listed in the Table and are the same as those employed in the illustrative example. Columns (1) and (2) indicate

Table 1: The Timing and Quantity of Housing Purchases with Fixed Rate Mortgages [a]

Quarter House Bought	Real Value Of Original House [b]	Quarter Moved To New House	Real Value Of New House [b]	Original Real User Cost [c]	New Real User Cost [c]	Original Mortgage Rate [c]	New Mortgage Rate [c]	Cost of Giving Up Mortgage [b]
59:4	12.9148	66:2	16.5851	.0656	.0518	.0625	.0613	0
60:4	13.1012	66:2	17.0533	.0678	.0518	.0626	.0613	0
61:4	13.2336	66:2	17.0898	.0681	.0518	.0613	.0613	.0104
62:4	13.4064	68:1	19.4057	.0666	.0440	.0593	.0666	.0512
63:4	13.6129	71:2	22.1973	.0657	.0383	.0583	.0749	.1178
64:4	13.7444	75:1	35.2380	.0617	.0205	.0583	.0927	.2456
65:4	13.8662	75:1	33.4297	.0577	.0205	.0583	.0927	.2481
66:4	13.9361	75:1	32.3120	.0556	.0205	.0657	.0927	.1965
67:4	13.9243	75:1	29.2595	.0495	.0205	.0649	.0927	.2022
68:4	13.9279	75:2	26.0186	.0430	.0206	.0722	.0906	.1342
69:4	13.9213	75:1	25.6477	.0428	.0205	.0817	.0927	.0803
70:4	13.8290	73:1 [d]	17.2475	.0527	.0406	.0844	.0756	0
71:4	13.8481	75:1	24.9026	.0427	.0205	.0780	.0927	.1038
72:4	13.9508	77:4	28.3213	.0384	.0161	.0764	.0906	.1038

a/ Underlying parameters are $\gamma = \theta = 0.75$, $\theta = 0.3$, $g = 0.07$, $d = 0.0025$, $v^o = 0.75$, $T = 25$, and the growth rate in real disposable income is 0.015 per year.

b/ Thousands of 1972 dollars.

c/ Fraction per year.

d/ The period between moves was constrained to be greater than two years.

the year (fourth quarter) and quantity of housing this household is assumed
to have purchased. Columns (3) and (4) list the optimal quarter for the
household to move and the new quantity of housing purchased. As can be
seen, households that bought in the 1959-61 period moved in 1966; those
that bought in 1962-63 moved in the 1967-73 period; and those that bought
in 1964-72 generally moved in the 1975-77 period. An exception is the
move only nine quarters after the purchase in 1970:4. This is due to a
sharp decline in the real user cost as can be seen in columns (5) and (6).
The nearly continuous decline in the real user cost throughout the 1963-77
interval provided a strong impetus for one to upgrade housing, as did the
assumed rise in real income. On the other hand, the sharp rise in the
mortgage rate between 1965 and 1974 [see columns (7) and (8)] generated
capital gains. Column (9) reports the annual cost, in 1972 after-tax
dollars, of giving up the mortgage in the quarter that the household is
calculated to have moved. Households that purchased
originally in 1964-67 and moved in 1975 gave up 197 to 248 of these dollars.
That is, in spite of the decline in the real user cost and rise in real
income, these gains prevented households that purchased in late 1964 and
early 1965 from moving for 10 years.

Possibly the clearest way to illustrate the impact of capital gains
on mortgages on the timing of the upgrading of housing is the following.
During the entire 8 year period 1967-74, only households (with our
characteristics) that bought in 2 earlier years (mid 1962 to mid 1964)
upgraded their housing. In contrast, in 1975 alone,
households that had bought in the full 8 year period (mid 1964 to mid 1972)

moved up. It is thus not surprising that the sharpest percentage increase in the 1966-79 period in the average quality of new houses sold occurred during the mid 1975 to mid 1977 period.[7]

Sensitivity Analysis

Increasing the assumed growth rate in real income has two effects on the timing of moves. With income rising at 2.5 percent per year, households purchasing in the 1962-64 period should have moved 2 to 4 years earlier (1966-71 rather than 1968-75). Further, households buying in 1966 and 1969 moved in 1973 rather than waiting until 1975. Lowering the growth rate to 0.5 percent has a larger impact in the opposite direction. Most strikingly, those who purchased as early as 1962 do not move until 1975. Also, those purchasing in 1967 and 1968 now do not move until late 1977, rather than early 1975.

Increasing the assumed income elasticity has an effect similar to raising the income growth rate. Lowering the assumed price elasticity from -0.75 to -0.5 has a similar impact to lowering the income growth rate. Most importantly, households who purchased in 1967-68 do not move until late 1977.

For households in lower tax brackets, the decline in the real user cost, and thus the incentive to upgrade housing, is reduced. Lowering the assumed tax rate thus has the same directional impact as lowering the price elasticity. When the tax rate is assumed to be 0.15 and all the

[7]The increase in the ratio of the average price of a new house sold to the price of a constant quality (1974) house rose by 7 percent between 1975:3 and 1977:2. The ratio of the value of subsidized 1-4 family starts to the value of total 1-4 family starts was 0.05 in both quarters. [The sharp increase in this measure of quality that occurred between 1971 and 1973 can be attributed to a decline in subsidized starts; see Hendershott (1980).]

original parameter values are maintained ($v = \beta = 0.75$ and real income grows at 1.5 percent per year), the immobility is striking. Except for the sharp downward blip in the user cost in 1971 and 1972, which causes a move after only two years, no household purchasing after 1963 moves by 1979. And those purchasing in 1961-63 do not move until 1975-77.

Owing to both bracket creep and growth in real income, one would expect the tax rate relevant to our hypothetical household to rise over time, expecially in the late 1970s. This exacerbates the decline in the user cost and lowers the after-tax cost of giving up the mortgage, both of which increase the speed at which households will upgrade their housing. In reality, the tax bracket of a typical household purchasing housing in the early and middle 1960s was probably in the neighborhood of 0.20 and likely rose to 0.30 by the 1975-77 period. The moving pattern of such households would probably not be much different than that depicted in Table 1.

Variable Rate Mortgages

In the following analysis we assume that all housing purchased during the 1959-72 period was financed with variable rate mortgages (VRMs). The rate on these mortgages is assumed to equal the observed yield on new issue fixed-rate mortgages (FRMs). As a result, there would not have been any capital gains on existing mortgages, and we would expect that households would have upgraded their housing more frequently in response to rising incomes and a declining real rental price of housing.

Table 2 presents the same type of data reported in Table 1 except that the mortgage rates and capital gain (zero) are not listed. Comparing the two tables, households that purchased in the 1959-61 period would not

Table 2:   The Timing and Quantity of Housing Purchases
With Variable Rate Mortgages[a]

Quarter House Bought	Real Value Of Original House	Quarter Moved to New House	Real Value Of New House	Original Real User Cost	New Real User Cost
59:4	12.9148	66:2	16.5851	.0656	.0518
60:4	13.1012	66:2	17.0533	.0678	.0518
61:4	13.2336	66:2	17.0898	.0681	.0518
62:4	13.4064	66:2	16.8359	.0666	.0518
63:4	13.6129	66:2	16.7328	.0657	.0518
64:4	13.7444	67:4	16.7694	.0617	.0495
65:4	13.8662	68.1[b]	17.4270	.0577	.0440
66:4	13.9361	69:1[b]	18.6834	.0556	.0389
67:4	13.9243	71:2	17.5548	.0495	.0383
68:4	13.9279	71:2	15.6235	.0430	.0383
69:4	13.9213	73:3	17.8499	.0428	.0325
70:4	13.8290	73:1[b]	17.2475	.0527	.0406
71:4	13.8481	74:4	17.8237	.0427	.0319
72:4	13.9508	75:1[b]	22.9090	.0384	.0205

[a] For the underlying parameter values and measurement of variables, see
Table 1 and the text.

[b] The period between moves was constrained to be greater than two years.

have been affected by the type of mortgage instrument because mortgage

rates fell in the first half of the 1960s. With either a FRM or VRM,

the move occurs in 1966:2. However, strikingly different behavior would

have occurred for purchasers during the 1963-69 period. With FRMs,

buyers in these years would have held their houses for 8 years, on average.

With VRMs, the holding period never exceeds $3\frac{1}{2}$ years, and the average

holding period is only $2\frac{1}{2}$ years. This heightened mobility can be illustrated

in another way. With FRMs, households that purchased in 1964:4 and 1966:4

did not upgrade their housing until 1975:1. With VRMs, the households

that purchased in 1964:4 would have upgraded for the third time in 1974:4

having moved in 1967:4 and again in 1971:2. The household that purchased

in 1966:4 would have moved in 1969:1 and again in 1974:4.

III. Efficiency Losses from Fixed-Rate Mortgages

By definition, households always maximize their utility. Even when
they are not choosing the optimal combination of housing and nonhousing
goods given their income and the "equilibrium" rental price of housing,
maintaining their mortgage capital gain allows them to achieve the greatest
utility (reach the highest indifference curve in Figure 1). Unfortunately,
maintaining this gain is tantamount to enforcing a capital loss on
mortgage lenders or, equivalently, on other households. The mortgage
capital gain does not provide any net utility or gain to society. On
the other hand, the suboptimal consumption pattern of households with'
gains is an efficiency loss that is not matched by a gain elsewhere.
Thus any "reform" that would reduce mortgage gains and thus suboptimal
consumption patterns would provide a net gain to society. The use of
variable rate mortgages is one such reform. What follows is an attempt
to obtain a rough estimate of the cost of the regulatory prohibition
against variable rate mortgages during the 1966-79 period.

A Methodology for Measuring the Loss

The loss due to the use of nonassumable, long-term, fixed-rate mortgages
is the difference between the equivalent gain with a variable-rate
mortgage (EGV) and with a fixed-rate mortgage (EGF), the gain being
a measure of the suboptimality of consumption. The cummulative loss
for the entire economy during the 1966-79 period is then

$$\text{LOSS} = \sum_{j} \sum_{i=1966}^{1979} (\text{EGF}-\text{EGV})_{ij} H_j \,, \tag{18}$$

where H_j is the number of households in the jth category.[8] To simplify

matters greatly, we assume that one-fifth of all homeowners in 1965:4

had purchased houses during the fourth quarter of 1961, another fifth

during the fourth quarter of 1962, etcetera through the fourth quarter

of 1965. Given that there were roughly 35 million homeowners, this

amounts to 7 million purchases per year. We assume further that 1 million

additional households purchased in the fourth quarters of 1966 through

1972. Finally, all households are assumed to correspond to our standard

one ($\tau = 0.3$, $\gamma = \beta = 0.75$ and income grows at 1.5 percent per year).

Thus, there are only 12 household classes ($j = 12$).

Calculation of the losses from fixed and variable rate mortgages is

illustrated in Figure 3 which is based on Figure 2. The latter indicates

the consumption patterns between 1966 and 1979 of a household buying in

1965:4 under three different assumptions: (a) no transactions costs

(neither a brokerage fee nor mortgage capital gain), (b) no mortgage

capital gain (a brokerage fee, but use of a variable-rate mortgage),

and (c) use of fixed-rate mortgage (both brokerage fee and mortgage capital

gain). The jagged line is the optimal consumption pattern and reflects

every twist and turn in the real user cost or rental price of housing.

The household effectively moves every quarter. The solid line, which

jumps discreetly in 1968 and 1975 to reflect moves at those times, is

based upon variable-rate financing. The hatched line is based upon fixed-

rate financing and indicates only one move, in 1975. The move in 1968

with the VRM shifts the household to the optimal consumption line at

that point and generally keeps the household closer to this line throughout

the 1968-74 period. Thus the loss with a VRM is generally less than with

[8] A more precise calculation would compound the gains prior to 1972 and discount those after 1972. Given the low real after-tax interest rates existing in the 1970s and the compounding of gains prior to 1972, introduction of this precision is unlikely to affect the results significantly.

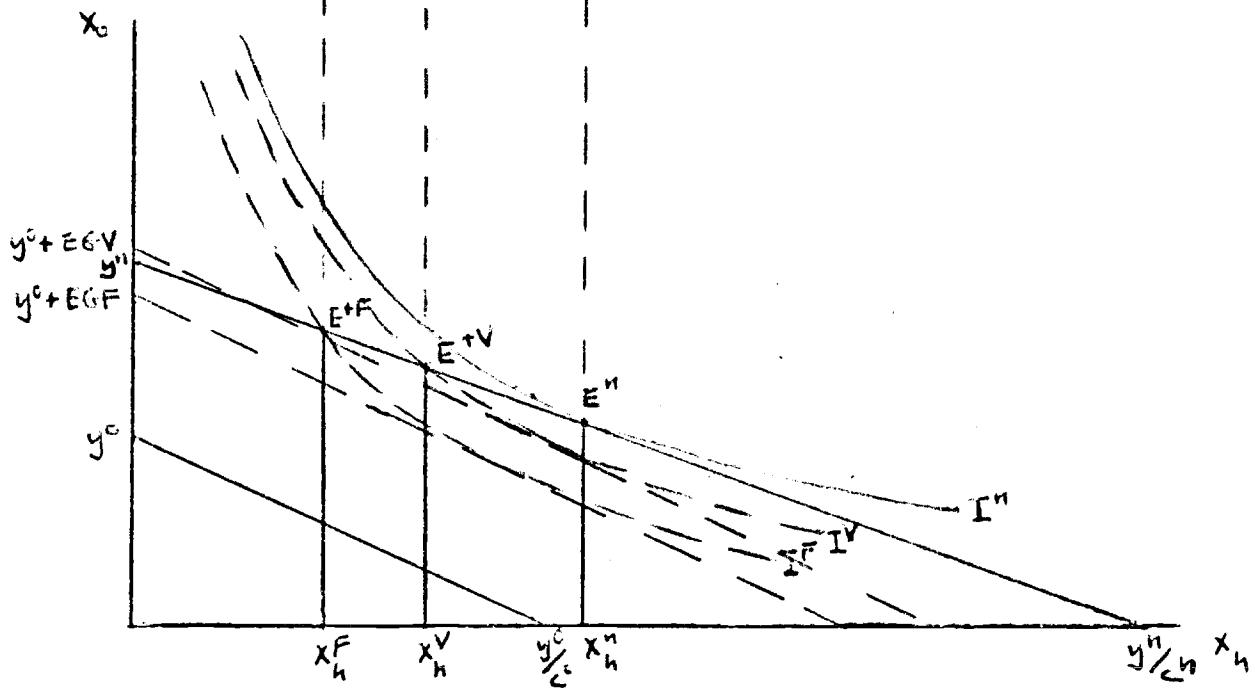Figure 2: Alternative Housing Consumption
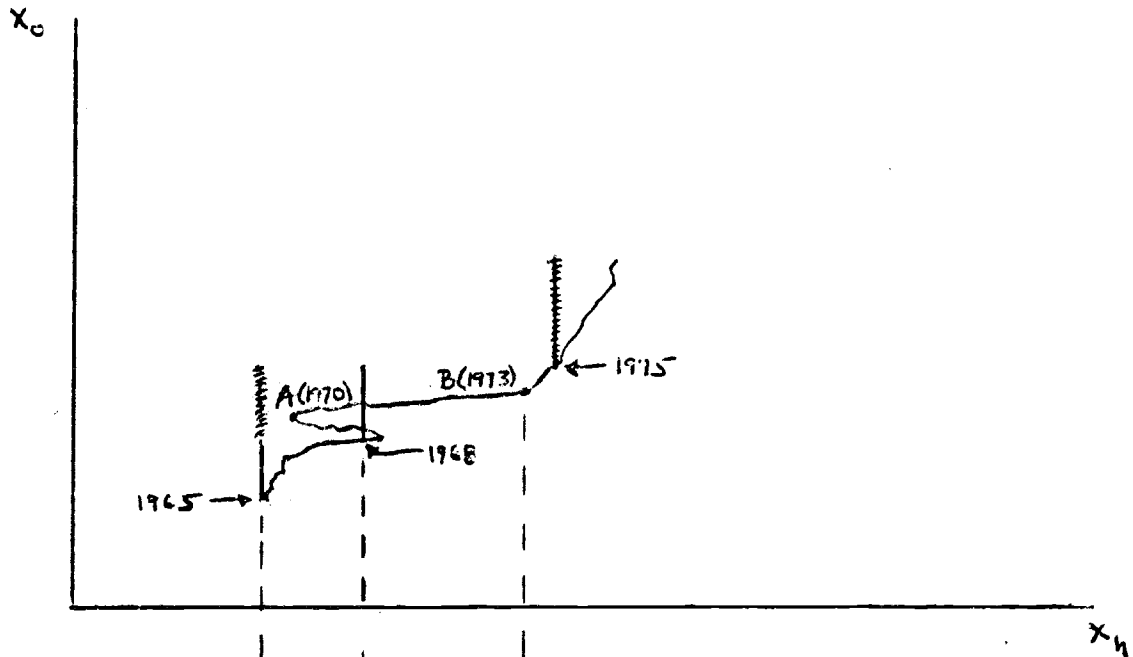Paths Over Time

Figure 3: Calculation of Equivalent Gains for
1973 with Fixed and Variable Rate Mortgages

a FRM. Note, however, that if the real user cost rose after the move in 1968, optimal consumption of housing could decline so that the loss with a FRM would be less than with a VRM. This is the case at point A.

Figure 3 illustrates the calculations of the equivalent gains with fixed and variable rate mortgages for the more typical point B in, say, 1973. I^n is the indifference curve reached by households choosing the optimal consumption bundle based upon (y^n, c^n). Housing consumption would be x_h^n. Because of the transactions costs associated with moving, households originally purchasing in 1965:4 choose less housing in 1973, x_h^V or x_h^F, depending upon variable (V) or fixed (F) rate mortgage financing. Indifference curves I^V and I^F are drawn through points E^{+V} and E^{+F}, respectively, which denote the consumption bundles associated with variable and fixed rate mortgages (ignoring the capital gain on the latter). The equivalent gains are calculated, as before, by drawing budget lines tangent to these indifference curves and parallel to the original budget line, $y^o - y^o/c^o$. The precise calculation for EGV, to illustrate, is made by solving equations (6') and (7') for y^{eV} and c^{eV}, after replacing the left-hand side variables with x_h^V and x_o^{+V}, and then using equation (14) where EGN becomes EGV.

Some Estimates

Table 3 contains estimates of the loss per household [column (2)] initially purchasing in different years [column (1)] and the total loss for each class household [column (4)], which is the product of columns (3) and (4). The cummulative loss for the 1966-79 period is 18.52 billion 1972 dollars. Over 18 billion of this accrues during the period 1967-77. That is, for this 11 year period the loss is 1 2/3 billion dollars per year.

Table 3: Efficiency Loss Owing to Fixed Rate Mortgages

(1)	(2)	(3)	(4)
Quarter of Initial Purchase	Loss Per Million Households[a]	Millions of Households in Class	Total Loss of Households in Class[b]
61:4	0.35	7	2.45
62:4	0.51	7	3.57
63:4	0.50	7	3.50
64:4	0.68	7	4.76
65:4	0.49	7	3.43
66:4	0.35	1	0.35
67:4	0.18	1	0.18
68:4	0.11	1	0.11
69:4	0.05	1	0.05
70:4	0.04	1	0.04
71:4	0.05	1	0.05
72:4	0.03	1	0.03
Total Efficiency Loss			18.52 66-79
			18.16 67-77

[a]Thousands of 1972 Dollars.

[b]Billions of 1972 Dollars.

This analysis overstates the direct welfare loss due to FRMs for a number of reasons. First, fewer household moves generate a resource saving. This includes both direct moving expenses and the substantial search costs reflected in realtor fees. Second, probably a fifth of the value of house sales in the 1961-65 period was financed by assumable, FHA-VA mortgages.[9] Third, many households move for reasons other than normal income growth and changes in relative prices. For example, one might move to achieve extraordinary income growth or to be closer to (further from) one's family. When such moves occur, the optimal consumption bundle will be selected, in general reducing the measured loss from FRMs. On the other hand, there are some unmeasured indirect costs of FRMs. Because of capital gains on mortgages, some households will forego or postpone moves that would increase the aggregate welfare of society; labor mobility and productivity are reduced. On net, our measure of the cost of FRMs could overstate the true value by as much as a multiple of two.

General Equilibrium Considerations

The above is a partial equilibrium analysis of welfare loss insofar as only one distortion of increased inflation on consumer choice is considered. Another well-known distortion is the favored tax treatment of

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[9]Between 1961 and 1965, 23 percent of loan originations on 1- to 4-family houses were FHA-VA financed (Mortgage Loan Gross Flows, U.S. Department of HUD, 1968, Table 25). Because loan-to-value ratios are higher for FHA-VA than conventionally financed houses, the share of housing that was FHA-VA financed is lower than 23 percent.

owner-occupied housing vis-a-vis business capital; in fact, this treatment
is the source of the decline in the real rental price of owner-occupied
housing noted above. Thus, the "distortion" in consumption in the 1967-76
period owing to capital gains on fixed-rate mortgages is partially an
offset to the distortion generated by fundamental biases in tax law.[10]

The efficiency loss due to FRMs has also been calculated for the
case where the real user cost of housing was frozen at the value existing
when the original house purchase occurred. That is, suboptimal consumption
(too little housing) exists in this calculation only because households
do not allocate any of their increased real income to housing. Our
estimate of the efficiency loss in this case is only $2\frac{1}{4}$ billion for the
1967-77 period. Thus seven-eights of the earlier calculated distortion
due to FRMs actually generated positive welfare because it acted as an
offset to another distortion in the system.

In an earlier paper, we calculated the annual economy wide efficiency
loss owing to the favorable tax treatment of owner-occupied housing to be
1 3/4 billion (1972 dollars) in 1964-65 and 6 billion in 1976-77
[Hendershott and Hu (1980)]. Thus the increase between the middle 1960s
and 1970s was just over 4 billion. If one assumes that the loss increased
linearly between these dates, then the annual incremental (above the
1964-65 value of 1 3/4 billion) loss from overinvestment in housing in

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[10]The authorization of variable rate mortgages by the Federal Home Loan Bank
Board in 1979 and the obviously desperate need of most mortgage lenders
to achieve a better balance between the effective maturities of their
assets and liabilities suggests that very few nonassumable, long-term
fixed-rate mortgages will be originated in the United States in the 1980s.
As a result, if inflation should accelerate in the late 1980s or 1990s,
mortgage capital gains will not exist to offset the inducement to greater
housing investment.

the decade from the middle 1960s to the middle 1970s was just over

$2 billion. This is not much greater than our $1 2/3 billion estimate

of the loss due to underinvestment in housing owing to nonassumable long-term,

fixed-rate mortgages. In addition, the two alternative mechanisms proposed

for the sluggishness of housing activity in this decade -- the sharp increase

in the ratio of mortgage payments to income and credit rationing (see the

introduction to this paper) -- could also have been operating. It seems

safe to conclude that the net efficiency loss during the 1966-75 period

triggered by the acceleration in inflation and the favored tax treatment

of owner-occupied housing was relatively minor.

Unfortunately, the 1976-79 housing boom certainly changed matters.

Annual single-family starts averaged 1.41 million, up from 1.15 million

in the previous four years and roughly 1.0 million in the two four year

periods prior to that. Moreover, the average quality of these starts

jumped by nearly 10 percent relative to previous years (see footnote

7), and the real price of a constant quality house increased by 21 percent

between the third quarters of 1975 and 1979.[11] By 1979, the efficiency

loss from overinvestment in owner-occupied housing was likely substantial.[12]

[11]The real price is defined as the ratio of the price of the constant (1974)
quality house to the CPI net of the shelter component. With the latter
indexed to unity in 1967 (when the constant quality price equalled $24.8
thousand), the real price rose from $26.8 thousand in 1975:3 to $32.5
thousand in 1979:3. (By 1980:4, the real price had declined by 3 percent.)

[12]This overinvestment seems certain to be reduced over time owing to the
economic policies of the Reagan administration (high real interest rates
and reduced taxation of returns on assets other than owner-occupied housing).

V. Conclusion

This paper attempts to explain the surprising absence of a surge in housing demand in the 1967-74 period. The absence is a surprise because the real user costs or rental prices for owner-occupied housing appear to have fallen sharply in this period (by 2 to 3 percentage points -- or 25 to 50 percent -- between 1964-65 and 1973-74, depending on the households marginal tax bracket). Our explanation of the absence of a housing boom follows from the fact that most housebuyers in the 1950s and 1960s financed their purchases with nonassumable, long-term, fixed-rate mortgages. The sharp increase in the nominal mortgage rate from under 6 to well over 9 percent during this period created substantial mortgage capital gains for these buyers; however, given the nonassumability of their mortgages, the gains could only be reaped if the households maintained their existing houses (continued low rate financing while their houses inflated rapidly in value). To the extent that households chose to reap these gains, housing demand failed to rise in response to both the decline in the real rental price and increases in real income. For these households, the housing-income ratio actually fell.

The paper contains three sections. The first provides a methodology for calculating the benefits and costs associated with moving and for determining when households who purchased houses in specific years would have moved. During the 1967-78 period, households are viewed as weighing the benefits of retaining existing low-rate mortgages (and of postponing the payment of realtors fees) against the costs of a progressively more "suboptimal" consumption bundle (too little housing given its falling

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