Inflation, Housing Costs, and the Consumer Price Index

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This paper is an investigation into the measurement of the cost of housing. We focus first on setting up a theoretical foundation for properly measuring the cost of housing and then present some estimates of how these measures would have affected the movement of inflation in the 1970's, as measured by the Consumer Price Index (*CPI*). We argue that the *CPI* has been significantly affected by using an inappropriate measure of owner-occupied housing costs, with the rise in both housing costs and the *CPI* being overstated. Given the number of government programs and private contracts that are tied to the *CPI*, this result is of some significance.[1] The mismeasurement has also had an impact on the way inflation is commonly perceived, as is evidenced by misdirected concerns raised in the 1970's about housing "affordability."[2]

There are two reasons for our results. The first is the failure to allow for the tax treatment of owner-occupied housing, and the second is the failure to account for the (either implicit or explicit) capital gains coming from homeownership. The purpose of the theoretical section is to derive how these should be treated. We focus entirely on the "capital cost" part of housing costs, leaving "operating costs" unchanged; and we deal only with owner-occupied housing, leaving rental costs unchanged.

While the basic result of the theoretical section—that it is the after-tax real interest rate that matters in housing costs—is probably intuitively obvious, it is worth spending some time deriving it. This will enable us to address points that are not entirely obvious such as: 1) should we use actual (*ex post*) or expected inflation in our measure of the after-tax interest rate, and 2) given that tax breaks are not explicitly included in most of the *CPI*, how should we treat both the explicit deductibility of mortgage interest costs and the implicit deductibility of the opportunity cost on equity?

We have two approaches to measuring homeowner cost.[3] The first, which might be classified as "user cost," looks at household utility maximization. The measure of cost is the amount necessary to bribe a household to give up a unit of housing. In real terms this is measured by the marginal rate of substitution between housing and other goods. We derive an expression for this from utility maximization, and multiply it by the price of other goods to get the nominal cost. The second approach, which might be classified as "implicit rent," views homeowners as profit-maximizing landlords that rent to themselves. We then calculate, given the tax advantages that homeowners receive, the rent

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[1] Testimony by Lawrence deMilner at the Hearings of the Task Force on Inflation, on December 14, 1979, suggests that each one percentage point increase in the *CPI* leads to an automatic increase in federal expenditures of $1 billion to $2 billion.

[2] See Benjamin Frieden and Arthur Solomon, Craig Swan, and John Weicher for discussions of affordability.

[3] We take it for granted that the *CPI* is supposed to be a "cost of living" index, that is, an index of the minimum expenditure flow needed to support a standard level of welfare. This leads us to our marginal rate of substitution formulation, but it is not what the *CPI* is always described as. Alan Blinder discusses this, but he argues that the *CPI* is, in fact, overwhelmingly used as a cost of living index (for example, as a way of calculating real income), and we, along with Blinder, interpret it this way. We do not attempt to solve any of the potentially important index number problems associated with the *CPI*, keeping as close as possible to the *CPI*'s methodology.

that would prevail in a competitive market. Not surprisingly, the two approaches lead to the same result. We then discuss how this measure might differ from what a real landlord (with current landlord tax treatment) would charge. This is followed by estimates of the *CPI* using our measure of capital cost.

1. Theory

A. *User Cost*

Assume there are two goods, owner-occupied housing, h, and nondurable consumer goods, c, with purchase prices (omitting time subscripts) of p_h and p, respectively. The household can issue or buy bonds, whose real value (deflated by p) is given by b, at nominal interest rate i. It pays an income tax on labor income, whose real value is y, and on nominal interest received. It also deducts any interest payments. The tax rate is given by θ and is fixed. Capital gains on housing are untaxed, and we ignore operating costs of housing. Letting $q = p_h/p$, $Y =$ nominal income, $B =$ nominal value of bonds and letting time be indexed by t, the household's current budget constraint is given by

$$pc_t + ps_t + p_h x_t = (1-\theta)Y + (1-\theta)iB_t,$$

or, dividing both sides by p,

$$(1) \quad c_t + s_t + qx_t = (1-\theta)y + (1-\theta)ib_t,$$

where x_t and s_t are real gross housing purchases and real financial saving, respectively. They are defined by

$$(2) \quad h_{t+1} - h_t = x_t - dh_t,$$

$$(3) \quad b_{t+1} - b_t = s_t - \pi b_t,$$

where d is the rate at which houses depreciate and π is the expected inflation rate (i.e., the rate at which real bonds depreciate). For simplicity we assume q and i to be constant.

Households maximize a standard utility function of the form

$$U(c_0, c_1, \ldots c_n; h_0, h_1, \ldots h_n),$$

subject to constraints (1), (2), and (3) over n periods. We make the usual assumptions about U, and assume an interior solution.

Carrying out the optimization, it can be shown (see our earlier paper) that the first-order conditions imply that

$$(4) \quad [(1-\theta)i - \pi + d]q = U_h/U_c.$$

The right-hand side is simply the marginal rate of substitution of housing for consumer goods. The left-hand side is the ratio of $[(1-\theta)i - \pi + d]p_h$ to p, the price of consumer goods. We contend that

$$(5) \quad C = [(1-\theta)i - \pi + d]\, p_h$$

is an appropriate measure of housing cost on the grounds that it is a measure of the dollar value of the bribe necessary to get homeowners to give up one unit of housing.[4]

Note that (5) does not have any intertemporal substitution in it. In fact, it is easy to interpret $[(1-\theta)i - \pi + d]p_h$ as a "rental" price (as will be seen shortly), suggesting that the effect of a rise in interest rates on housing demand is not through intertemporal effects as much as through ordinary relative price changes. Intertemporal effects do matter, as is seen by noting that (5) cannot be solved for a housing demand curve. It can be solved for h as a function of housing costs, and c, but c is endogenous. Presumably it depends on income, wealth, etc.; and it is here that intertemporal aspects enter, but they are no more essential to housing than to, say, food.

B. *Implicit Rent*

An alternative way of looking for the appropriate index is to ask what a landlord with tax breaks similar to a homeowner's would charge in a competitive market. Such a landlord would wish to maximize the present value of the real cash flow from

[4]If we allow relative house prices to change, the change in q enters into (5), so that the relevant inflation rate in (5), when q is changing, is the expected rate of growth of house prices. (This is a first approximation, that requires that the periods be small; otherwise there is a term for the change in U_c and the periods do not all coincide.)

renting houses. The tax break occurs because interest expenses can be deducted, but there is no tax on rental income. Thus the landlord maximizes

$$(6) \qquad \sum_{t=0}^{n} (vh_t - qx_t) D^t$$

where $D = 1/(1+r)$,

R = nominal rent net of operating expenses,

$v = R/p$ (real rent),

$r = (1-\theta)i - \pi$, the real discount rate,

subject to

$$(2) \qquad h_{t+1} - h_t = x_t - dh_t.$$

Substituting (2) directly into (6) and setting the first derivative with respect to x_t equal to zero for each t, we end up with (omitting subscripts)

$$(7) \qquad v = (r+d)q$$

or

$$(8) \qquad R = [(1-\theta)i - \pi + d]\, p_h$$

For any arbitrary purchase price of housing and an arbitrary nominal rent, this equation will not hold; which is to say that in such cases the amount of rental housing demanded by landlords will be either zero or infinite. In equilibrium with a nonzero, finite amount of housing R and p_h must be such that (8) holds. Hence, it can be considered an equilibrium equation for the rent that competitive landlords would charge. It tells the same story as (5) above.

Therefore, whether we look at housing from the standpoint of a household expressing its preferences over time or a landlord renting the unit (to himself) we get the same index for capital costs.

This measure is not at all the same as that used in the *CPI*, which looks at both house price by itself and interest payments.[5] In fact, our measure can be expected to move in the opposite direction of the *CPI's* during times of expected inflation. Rewriting (5) or (8), our measure of nominal capital cost is given by

$$(5') \qquad C = [(1-\theta)(i-\pi) - \theta\pi + d]\, p_h.$$

Consider the term in brackets. The first term, $(1-\theta)(i-\pi)$, is proportional to the gross real rate. Suppose, for empirical rather than theoretical reasons, that this gross real rate is constant. Then a rise in the expected rate of inflation will lower the term in brackets (our net real rate), but it will raise nominal interest rates. Hence, depending on how house prices move, a period of inflation might involve the *CPI* measure rising and our measure falling.[6]

Our cost measure for homeowners is also not the same as that for real landlords, the difference being differing tax treatment. Given, as will be seen shortly, that our measure is difficult to compute exactly, it would be helpful to find out if a rent index (like the one published with the *CPI*) could be used as a proxy for homeowner cost that would incorporate our measure of capital cost.

We suspect, as our calculations in Section II suggest, that a rent index in a period of accelerating inflation will overstate changes in homeowner cost. For instance, landlords are more likely than homeowners to pay taxes on nominal capital gains, and their depreciation deduction is based on historic rather than replacement cost.[7] Both of these tend to raise real tax burdens as inflation increases. Furthermore, the period that we investigate, 1968–80, has seen several major changes in tax treatment of rental property. Calculations by Patric Hendershott and Sheng Hu take these changes into account and indicate that, since the 1960's, landlord's capital costs have risen steadily relative to a measure of homeowner capital cost similar to ours.

[5]The *CPI*'s index of interest payments can be approximated by an index of (ip_h).

[6]Note that this problem comes from the use of nominal interest rates and could occur even if tax considerations were unimportant.

[7]For an analysis of how this affects capital costs in some simple cases see Martin Feldstein, Jerry Green, and Eytan Sheshinski, and Van Order and Kevin Villani.

C. *Observations*

The above analysis leads to the following observations:

1) It is *expected* future inflation that matters, as that is what enters the hypothetical landlord's maximization calculations. Actual inflation is not directly relevant.

2) Homeowner tax advantages belong in the index. Again, in a hypothetical rental market with landlords receiving homeowner advantages, the tax advantage would show up in the rent index just as present tax treatment is reflected in the current rent index.

3) The nominal rate of interest *is not* used in the nominal cost of capital. The nominal cost of capital is the *real* rate (adjusted for taxes) times nominal price, and the real cost is the real rate times *real* price. Hence, the equation does not support the notion that high nominal interest rates have often had even once-and-for-all cost-push effects (since after-tax real rates have, with the important exception of 1980, probably fallen).

4) With transactions costs the holding period of the homeowner becomes relevant and π in (5) should be the average expected rate of house price inflation over that period (we take it to be five years).

5) As has been pointed out elsewhere (for example, Martin Feldstein, Jerry Green, and Eytan Sheshinski), tax treatment of nominal interest is quite important. Of particular significance is the taxation (and deductibility) of all of nominal interest. Given that, for reasons beyond the scope of this paper, gross rather than net real rates have been constant, this tax treatment insures that net real rates for homeowners will fall as inflation increases. This is the major factor in our results.

Some insight into the size of the subsidy due to inflation can be seen by looking at (5′). Assuming that the gross real rate is constant, inflation affects costs via π. If, for instance, $\theta = .25$ and $\pi = .10$, $\theta\pi$ is .025 per year. Since the first term of the equation $(1-\theta)(i-\pi)$ is on the order of magnitude of .025, this suggests that the subsidy due to inflation is currently on the order of 100 percent of real interest costs.

6) It is possible that a rent index is a suitable proxy for true homeowner costs. Given the necessity of estimating expected inflation in estimating the latter, this may be a useful compromise. Indeed the Bureau of Labor Statistics (*BLS*) has proposed substituting this for the homeowner index, if an appropriate sample can be obtained. It is, in fact, roughly what is done in the consumption deflator in the National Income Accounts.

The calculations in the next section suggest that while it is better than the current measure, rental measure has, until 1980, systematically overstated recent changes in capital costs brought on by accelerating inflation.

The above analysis is also subject to several caveats. The most obvious one is that capital markets are not perfect. One version of this problem is that borrowing (mortgage) rates and lending rates (opportunity cost on equity) are not equal. It can be shown, for instance, that if we add to the household optimization problem an equality constraint that fixes the loan-to-value ratio, then the appropriate i is the weighted average of the borrowing and lending rates. If the constraint is an inequality, the analysis is more complicated, but in the long run the appropriate rate will tend to be the lesser of the two. In any event, the movements in the difference between these rates does not appear to be a major factor in housing costs.[8]

There is also the possibility of constraints on total borrowing. The model above implicitly assumes that individuals can borrow large amounts in the early years of owning a house. In principle, there is no reason for this not to be the case since their wealth would be rising to cover the debt. Furthermore, the borrowing may simply take the form of drawing down initial wealth holdings or saving less than otherwise.

Nonetheless, solving the above problem may require more borrowing (for example, a downpayment) than capital markets actually allow consumers to borrow. If we simply add a constraint $b \geq \bar{b}$ to the household maximi-

[8]Our calculations assume that the opportunity cost on owner equity is the mortgage rate. There are reasons both for that to be too high and for it to be too low.

zation (where $\bar{b}$ is negative), it is straightforward to show that the new measure of capital cost is

$$(9) \qquad C=[(1-\theta)i-\pi+d+\propto]\,p_h,$$

where $\propto$ is the ratio of the shadow price of the new constraint to the marginal utility of c. Of course, if the constraint is not binding, $\propto$ is zero; but we have no reason to assume it to be zero, and if it is positive, we have no way of measuring it.

The term $\propto$ is similar to the well-known cash flow constraint (see James Kearl). If borrowing is required to take a form that does not allow negative amortization and if interest rates rise as inflation rises (for example, holding $i-\pi$ constant), then the effect of inflation on housing demand may be ambiguous. We ignore $\propto$, partly because we cannot measure it and partly because we are not sure how inflation affects it. That is, while inflation increases the cash flow burden on first-time buyers, it also causes equity to grow more rapidly, so that existing homeowners can "trade up" faster.

Another issue recently raised by Douglas Diamond concerns the role of the standard deduction. The θ used above is the representative homeowner's marginal tax rate. But the tax system is quite nonlinear. In particular, homeowners do not get a tax break on interest deduction between the standard deduction and the amount they deduct other than mortgage interest (and property taxes). Diamond computes estimates of capital costs adjusting for this. Since the standard deduction has been rising recently, the incentive to own rather than rent (especially for lower income groups with fewer other deductions) is diminished.[9]

To some extent, Diamond's measure is of average cost—since for the homeowner currently itemizing deductions the adjustment is all water under the bridge. Our measure is the relevant one, however, as an index of demand. From a "welfare" point of view, Diamond's measure may be appropriate. It is also useful in explaining tenure choice. It is clear from our measure of housing costs that inflation such as that of late should raise relative house prices. But Diamond's analysis suggests that homeownership (especially among low-income groups) need not change, existing homeowners bidding up prices with renters not changing their behavior as standard deductions increase.

For much the same reason, we do not take account of the fact that most owners pay past rather than current interest rates. We regard the fact that current rates are higher than those that some owners are paying as indicating windfall gains (due to the decrease in the value of mortgage liability), which should not be counted as part of current cost and which in the aggregate are balanced by lenders' capital losses.[10]

Finally, our measure applies to all durable goods, not just housing. Therefore, the "mistakes" in price measurement apply to a larger part of the *CPI* than just housing (for example, yachts, cars, solar energy equipment, etc.). Since housing probably has the smallest depreciation rate, it is the most significant source of error in measurement of cost. That is, as the depreciation rate increases (given that real interest rates remain small) the "true" measure of cost becomes roughly proportional to purchase price, so that purchase price measures of durable goods costs may be approximately correct for most durables, although the weights attached to them may be wrong. We do not take any account of uncertainty, either of expected capital gains or of the services provided by the housing.

II. Numbers

In this section, we present some estimates of the *CPI* using alternative measures of capital cost. Two of these replace the *CPI*'s measure of home purchase price and mortgage interest cost with our measure of capital cost, equation (5). The other substitutes the

[9] This does not apply to the implicit deduction for the opportunity cost on equity.

[10] This is taken into account in the Canadian version of the *CPI*. On this and some calculations similar to ours, see Stuart McFadyen and Robert Hobart. The *BLS* is experimenting in their user cost calculations with both an average interest rate and a current rate.

CPI rent index for the entire homeownership component.

Several problems arise when we attempt to restructure the *CPI* using our capital cost measure. The first involves measuring expected inflation in (5) and is discussed in Part A. The second involves reweighting the entire homeownership component to reflect the use of a capital cost measure which is significantly lower than the house price and mortgage interest cost measures it replaces. This is discussed in Part B. Part C presents actual estimates we obtained using our capital cost equation along with comparisons of how different homeowners have experienced significantly different levels of inflation depending on their marginal tax bracket.

A. *Expected Inflation*

The central problem in using the capital cost equation is the measurement of expected house price inflation. We have experimented with several approaches, including the use of nominal interest rates (see our earlier paper). Most of the approaches led to *CPI* revisions that were a good deal more drastic than the results presented here. Our "preferred" measure takes advantage of information about expected inflation contained in work by John Carlson.[11] We have from Carlson semiannual survey data on expected inflation; but the paper does not give expected house price inflation, and it only gives expectations up to one year (which is shorter than the period relevant for a typical homeowner).

To take advantage of the information about expected inflation we estimated an equation designed to explain expectation formation. We assumed that inflation expectations were formed by a simple distributed lag of past actual inflation. From 1963 to 1979:1 (using semiannual data) the estimate of this equation was

$$(10)\quad \pi = \underset{(2.4)}{-.32} + \underset{(8.7)}{.49}\bar{\pi}_{-1} + \underset{(1.2)}{.10}\bar{\pi}_{-2} - \underset{(0.3)}{.03}\bar{\pi}_{-3} + \underset{(2.1)}{.17}\bar{\pi}_{-4} + \underset{(0.4)}{.03}\bar{\pi}_{-5} + \underset{(0.2)}{.02}\bar{\pi}_{-6} + \underset{(0.3)}{.02}\bar{\pi}_{-7} + \underset{(2.5)}{.15}\bar{\pi}_{-8},$$

$$R^2 = .97; \qquad DW = 1.71.$$

where π is expected inflation as measured by Carlson and $\bar{\pi}_{-j}$ is actual inflation (as measured by the consumption deflator from the National Income Accounts) of j periods ago.

In choosing the equation we took into consideration both the plausibility of the results (i.e., we rejected equations that led to implausibly high or low values of π) and how well it fit. We were inclined not to use the *CPI* as a measure of past inflation rates since the thrust of our paper is that such use is wrong. It was also the case that using the consumption deflator gave a somewhat better fit. An eight-period lag had the best fit; although other lag lengths gave similar results.

We assumed that house price expectations were formed in the same way as prices generally, so that (10) could be used to forecast house prices by plugging house price data into it, using the same coefficients. We then obtained an expected rate for five years. This was done by using (10) every period to make forecasts for five years. The average of these forecasts is our estimate of π and is recorded in column (3) of Table 1. Column (4) gives our measure of the after-tax real rate of interest as derived from the bracketed term in equation (5), using the above measure of expected inflation plus a 1 percent depreciation rate (since depreciation is not included elsewhere in the index). Nominal rates are measured by the new home mortgage rate (col. (1), Table 1), and the marginal tax rate is set at 25 percent.[12] We then multiply the net real rate by house price to get our measure of capital costs.

For comparison purposes we also use an average of the past eight half-years' house price inflation as an estimate of expected

[11] The data in Carlson end in 1975. We have added three years of data, since calculated by Carlson.

[12] We have not tried to incorporate the increase in marginal tax rates over the period. This is largely because we do not know a good way to estimate state tax rates. Presumably, this means that our estimates, on this account, underestimate the *CPI* errors, and that people in different states have different housing costs.

TABLE 1—BASIC DATA[a]

	New Home Mortgage Rate (1)	Constant Quality House Price (2)	Expected Inflation (3)	Net After-Tax Real Rate (4)	*CPI* Rent Index (5)
1968	7.2	26,225 (5.4)	3.0	3.4	1.000 (2.4)
1969	8.1	28,300 (7.9)	4.3	2.8	1.032 (3.2)
1970	8.3	29,175 (3.1)	4.2	3.1	1.075 (4.1)
1971	7.7	30,725 (5.3)	3.6	3.2	1.125 (4.6)
1972	7.6	32,650 (6.3)	4.4	2.3	1.164 (3.5)
1973	8.2	35,750 (9.5)	5.1	2.1	1.214 (4.3)
1974	9.1	39,075 (9.3)	6.4	1.4	1.275 (5.0)
1975	9.0	42,825 (9.6)	7.3	0.4	1.341 (5.2)
1976	9.0	46,475 (8.5)	6.7	1.0	1,413 (5.4)
1977	9.1	52,375 (12.7)	8.0	−0.2	1.499 (6.0)
1978	9.8	59,600 (13.8)	8.8	−0.5	1.601 (6.9)
1979	11.2	68,075 (14.2)	10.3	−0.9	1.719 (7.3)
1980	13.2	74,900 (10.0)	9.8	1.1	1.871 (8.8)

Note: (1) Effective rate, combined lenders, led one quarter, *Source*: *Federal Home Loan Bank Board Journal*. (2) *Source*: *C-27 Construction Reports*, (3) Our estimate of expected inflation as derived from equation (10). (4) $(1-\theta)i-\pi+d$, where π = Col. (3), $\theta = .25$, i = Col. (1), $d = .01$. (5) *Source*: *CPI Detailed Report*.

[a]Percent changes in parenthesis.

inflation. We then take the expected five-year average, as before, to get an alternative measure of expected inflation and capital costs.

B. *Weights and Data*

Currently, the *CPI* homeownership index is the weighted average of indices of home purchase prices, mortgage interest costs, maintenance, taxes, and insurance. Housing is treated like other durable goods in the index. Only those who actually purchase housing during the period are counted, and they are assumed to pay the entire purchase price and half of the total mortgage interest payments at time of purchase. Hence, the measure is conceptually quite different from ours. The *CPI* index explicitly includes a house price index, and its index of mortgage cost, which moves like iP_h, leaves out the tax and appreciation effects. Our revised version of the *CPI* eliminates these two indices and replaces them with capital cost estimates from equation (5). We do not change the other parts of homeowner costs (maintenance, taxes, and insurance).

The home purchase price index in the *CPI* is calculated from FHA data, attempting to hold quality change constant. It is probably the case, both because of the ceiling on FHA mortgages and problems with the sample actually used that FHA data are not representative of house price movements. The *CPI*'s house price measure moves very differently from the Commerce Department's measure of a constant quality house though they ostensibly measure the same thing.[13] In our estimates we use the Commerce constant quality house price index and FHLBB conventional new home mortgage rate data.[14]

It is important to emphasize that the homeownership index counts house price twice, once explicitly in its index of house price and implicitly in the mortgage interest cost.[15] Our theory implies that the first index does not belong at all. Hence, the apparent downward bias in the *CPI* house price index is probably more than compensated for by

[13]For instance, the Commerce Department measure increased 86 percent from 1968 to 1980 while the *CPI* measure rose only 47 percent for the same base period. (However in 1980, the Commerce Department measure rose 10 percent while the *CPI* measure rose 14 percent.)

[14]The *CPI* uses FHLBB mortgage rate data adjusted for differences in loan characteristics. The indices of the two move very closely with no significant differences for our purposes.

[15]This "double indexes" the *CPI* measure of interest payments because it is the product of the nominal interest rate and the price of housing, both of which rise with inflation.

TABLE 2—DIFFERENT MEASURES OF THE CONSUMER PRICE INDEX[e]

	CPI[a]	*CPIR*[b]	*CPI4*[c]	*CPIA*[d]
1968	1.000 (4.2)	1.000 (3.7)	1.000 (n/a)	1.000 (n/a)
1969	1.054 (5.4)	1.044 (4.4)	1.037 (3.7)	1.035 (3.5)
1970	1.116 (5.9)	1.095 (4.9)	1.097 (5.8)	1.076 (4.0)
1971	1.164 (4.3)	1.143 (4.3)	1.149 (4.8)	1.132 (5.2)
1972	1.202 (3.3)	1.179 (3.1)	1.168 (1.7)	1.156 (2.1)
1973	1.277 (6.2)	1.252 (6.2)	1.239 (6.0)	1.231 (6.5)
1974	1.418 (11.0)	1.378 (10.1)	1.352 (9.1)	1.319 (7.2)
1975	1.548 (9.1)	1.492 (8.3)	1.439 (6.4)	1.388 (5.2)
1976	1.636 (5.7)	1.577 (5.7)	1.544 (7.3)	1.470 (5.9)
1977	1.743 (6.5)	1.677 (6.4)	1.599 (3.6)	1.537 (4.6)
1978	1.876 (7.6)	1.792 (6.8)	1.695 (6.0)	1.587 (4.5)
1979	2.087 (11.3)	1.963 (9.6)	1.837 (8.3)	1.728 (7.0)
1980	2.369 (13.5)	2.183 (11.2)	2.168 (17.6)	2.014 (17.1)

[a]The overall *CPI*, urban consumers. *Source*: *CPI Detailed Report*.

[b]*BLS* experimental measure, rental equivalence approach. *Source*: Same as fn. a.

[c]The *CPI* replacing home purchase and mortgage interest cost with our measure of after-tax real rate (col. (3), Table 1) multiplied by the constant quality house price.

[d]The *CPI* replacing home purchase and mortgage interest costs with a net after-tax capital cost measure using a past average of house price changes to predict expected inflation.

[e]Percent changes in parenthesis.

the double counting of nominal house prices which biases the index upward.

Since we argue that the *CPI*'s measure of capital cost is inappropriate because it double counts house price and leaves out taxes and appreciation, the capital cost measure we use must be reweighted to reflect its smaller share in consumer expenditures. The appropriate weight for our measure of capital cost is its share in 1968 (our base year) expenditures, which we do not know. The actual weights used in the *CPI* are, again, too high, and the present approach, which treats housing as purchased totally at the time of purchase, does not allow us to infer much from the weights actually used.[16]

We chose a simple expedient. The *CPI* treats the representative consumer as part owner and part renter, the relative weights of the two reflecting their expenditure share. This is not changed. We assumed that the weight for the (tenant) rent index was correct. In 1968 it was 5.2 percent. Also in 1968 in the National Income Accounts imputed rents were 2.4 times tenant rent. We then multiplied the *CPI* rent weight by 2.4 and assumed that to be the correct weight for total homeowner cost. From this we subtracted the weights for the maintenance, insurance, and taxes part of the index, which left 6.8 percent. We took this to be the weight for our measure of capital cost.[17] All other weights are adjusted so that the weights add up to 100 percent and relative weights remain constant.

[16]On the way the weights are chosen, see Blinder.

C. *CPI Estimates*

Table 2 calculates the overall *CPI* using various cost measures. Comparing the first column, the published *CPI*, with the others reveals a range of differences. The *CPI* containing our preferred measure of capital costs

[17]Since our calculations suggest that the imputed rent calculated in the National Income Accounts (which comes from market rents) is an overestimate of our cost, this weight may be too high. The *CPI* weight for its experimental user cost index, which is similar to our capital cost measure was 11.4 percent in December of 1977. The difference is presumably due to the absence of tax advantages in the *CPI*'s measure. Our *CPI* calculations do not appear to be sensitive to minor changes in weights. Earlier calculations setting capital cost weights at 10 percent (rather than 6.8 percent) led to similar results.

TABLE 3—THE CONSUMER PRICE INDEX: GIVEN DIFFERENT MARGINAL TAX BRACKETS[a,b]

	CPI4[c]	*CPI4*[d]	*CPI4*[e]
1968	1.000 (n/a)	1.000 (n/a)	1.000 (n/a)
1969	1.045 (4.5)	1.037 (3.7)	1.011 (1.1)
1970	1.103 (5.6)	1.097 (5.8)	1.075 (6.3)
1971	1.153 (4.5)	1.149 (4.8)	1.138 (5.9)
1972	1.179 (2.3)	1.168 (1.7)	1.133 (−0.4)
1973	1.256 (6.5)	1.239 (6.0)	1.184 (4.5)
1974	1.381 (10.0)	1.352 (9.1)	1.255 (6.0)
1975	1.482 (7.2)	1.439 (6.4)	1.300 (3.6)
1976	1.583 (6.9)	1.544 (7.3)	1.415 (8.8)
1977	1.660 (4.9)	1.599 (3.6)	1.399 (−1.1)
1978	1.776 (6.9)	1.695 (6.0)	1.435 (2.6)
1979	1.948 (9.7)	1.837 (8.3)	1.477 (2.9)
1980	2.262 (16.1)	2.168 (17.6)	1.832 (24.0)

[a]Derived from our preferred measure of the *CPI* (fn. c, Table 2).
[b]Percent changes in parenthesis.
[c]0 percent tax bracket.
[d]25 percent tax bracket.
[e]50 percent tax bracket.

(the third column, using the autoregressive forecast) suggests that prices have risen by less than is generally believed. Of the rise in the *CPI* since 1968 our index implies that about 15 percent is spurious. The calculations using a simple average of past price changes are more striking, suggesting that 26 percent of the rise was spurious. The second column replaces the *CPI*'s homeownership index with *BLS*'s experimental rental equivalence measure of homeownership. Though not a perfect proxy for homeowners' imputed rental costs, it suggests that about 15 percent of the increase in the CPI may be spurious.

Of particular interest is the role of 1980 in the index. Unlike most of the previous years, 1980 was characterized by a sharp rise in net real rates (see Table 1). Hence, we get a higher inflation rate than the *CPI*'s. The index using rents for homeowner cost rose by less than this, so that our preferred index almost catches up with the index using rent, after rising more slowly throughout the period. Apparently, rising interest rates due to monetary policy changes (which raise real rates) can have significant short-run inflationary effects, although rising interest rates caused by rising inflation (which does not raise real rates) do not.

The behavior over subperiods is of some interest. For instance, excluding 1980, our "preferred" index (*CPI4*) indicates that 23 percent of the inflation from 1968 to 1979 was spurious, the index using rents gives 11 percent and the one using an average of past prices, 34 percent. For the 1976–79 period, the numbers are 35, 14, and 44 percent, respectively.

Table 3 calculates the *CPI* by different tax bracket. This is done by using our autoregressive forecast (as in col. (3), Table 1) and changing θ to 0 or .5. As is suggested by equation (5), the results vary significantly by tax bracket. This suggests an unintended regressiveness in the tax system. At low inflation rates, the tax break to different bracket owners may be what was originally intended as fair. But as inflation increases, the difference in treatment becomes much larger.

We have used the same data elsewhere to estimate homeownership costs by combining our estimates of capital costs with *CPI* estimates of maintenance, insurance, and taxes. As one would suspect from the *CPI* numbers and our capital cost measure, the results are quite different from the *CPI*'s homeownership cost. For all estimates of θ, homeownership costs have risen by less than rents, except for the zero bracket, which is

roughly the same. For the 50 percent bracket, owners' nominal costs may well have been constant or even fallen since 1968. The calculations suggest rather strongly that the affordability problem has not been an issue for most homeowners during most of the period, and that if there is a problem it is a cash flow problem for first-time buyers, a problem that is probably best solved with more flexible mortgage instruments.[18] The numbers do suggest that 1980 was an exception and that concern about rising housing costs was not unreasonable.

IV. Conclusions

Standard price theory suggests that the appropriate measure of homeownership cost is significantly different from that used in the *CPI*. Our estimates suggest that something on the order of 15 to 25 percent of the price rise since 1968 as measured by the *CPI* could be spurious.

The tax system, by allowing implicit and explicit deductions of interest cost without taxing capital gains, has conferred large subsidies on owner-occupied housing. These subsidies have at recent high inflation rates been in the vicinity of 100 percent of real interest costs in some tax brackets. Not accounting for this has generated spurious measures of inflation.

An obvious question is what to do next with the *CPI*. Our numbers, because they are based on estimates of expected inflation and because the results are sensitive to these estimates, are probably not reliable enough to be taken seriously as an official alternative. The *BLS* has recently begun publishing alternative *CPI* measures, using different measures of housing cost (including in some cases adjustments for appreciation, but not for taxes)[19] and others (see Blinder) have offered some practical possibilities.

Finally, our numbers suggest that, because of differences in tax brackets, there has been a significant divergence of housing costs for different people over time. Whether or not this is equitable requires a thorough analysis of the overall effects of inflation. On efficiency grounds it seems suspect. While there may be some social reasons for wanting to subsidize housing, we doubt that the social benefits rise with the tax brackets of the individuals on whom the benefits are conferred.

[18]For instance since 1980, FHA has been insuring graduated payment mortgages which lower first year monthly payments by up to 25 percent without requiring an increased downpayment. Federally chartered savings and loans associations are also allowed to make conventional graduated loans, and there appears to be a market developing for shared appreciation loans, which trade lower interest payments for a share of capital gains.

[19]The problem of the *CPI* measure of housing costs has been discussed at length inside the *BLS*. In 1978, after various studies of alternative homeownership measures, proposals for reform were made by the staff, but these were rejected due to technical difficulties and protests from users.

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