

# THE TREATMENT OF "HOME OWNERSHIP" IN THE CPI\*

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This paper explores the imputed service price approach to the pricing of the services of consumer-owned-and-used durables in the construction of the consumer price index, using the services of owner-occupied housing as an illustration. A theoretical framework for analyzing this question is first developed. Certain practical problems are then discussed. The conceptual difficulty of constructing an appropriate rate of return on the basis of available data on interest rates and house prices, in the context of inflation, is explored. Two arguments are advanced that statistical agencies ought not to follow the imputed service price approach in pricing the services of owner-occupied dwellings and other consumer durables. On the one hand, nominal interest rates will, in any short period, reflect monetary policy and not any change in the money "rental" of owner-occupied houses. Second, movements in nominal interest rates will also reflect changes in the money price of pure consumption goods, as well as changes in the money price of houses. The argument is extended to other consumer durables and, in the limiting case, to monetary balances, and it is concluded that in all but trivial cases the application of the service price approach leads to price movements of little or no meaning.

## I. INTRODUCTION

The conceptual basis of the Consumer Price Index has numerous points of disputation which force continual re-examination of its theoretical foundations. The point of disputation I examine in this paper is the proposed "user cost" or service price treatment, in the conceptual basis and construction of the CPI, of the phenomenon that "consumers" purchase in the market place durable commodities or goods whose stream of services are firstly not all consumed at the time of purchase, and secondly are not themselves purchased in the market place. Specifically, I deal with the question of the pricing of "home-ownership" in the CPI.

It is immediately apparent that the problem is a general one in the sense that my analysis extends to the treatment of "car-ownership", other consumer durables and pantry-stocks. To the extent that it is possible to determine the service flows, the analysis should extend in the limit to the pricing of such service flows as those of "real cash balances" held by consumers. The questions to which I seek answers are: To what extent can the services of "consumer durables" be

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adequately “priced”, and to what extent and how should such “prices” be included in a Consumer Price Index?

## II. THE PRELIMINARY THEORETICAL FRAMEWORK

I begin by assuming all prices are generated in a competitive price system and consider the case of a person who rents a house, combines its services with materials and then rents what I call dwelling services to a lessee. Within the context of a self-contained period of time, the lessor may be deemed to have chosen the best technique (with the stars)

$$P_O Q^* - P_M M^* - H_K K^* \geq P_O Q - P_M M - H_K K$$

where, at the set of given prices he faces ( $P_O$ , the price of dwelling services;  $P_M$ , the price of materials;<sup>1</sup> and  $H_K$ , the rental he must pay for the use of one house for the period) *no* other technique open to him would be more profitable. Immediately, one has

$$P_O \Delta Q - P_M \Delta M - H_K \Delta K \geq 0$$

where  $\Delta Q \equiv Q^* - Q$ , etc., or

$$\left\{ P_O \frac{\Delta Q}{\Delta K} - P_M \frac{\Delta M}{\Delta K} \right\}_{\Delta K > 0} \geq H_K \geq \left\{ P_O \frac{\Delta Q}{\Delta K} - P_M \frac{\Delta M}{\Delta K} \right\}_{\Delta K < 0}$$

where the terms in brackets *may* be called the value of the net marginal product of the service of the house in the production of dwelling services.<sup>2</sup>

More generally, if one considers two time periods and imagines the lessor purchasing houses “today” and promising to take delivery of materials “tomorrow” and selling promises to deliver dwelling services and houses “tomorrow”, the lessor will choose that technique such that

$$-P_{K_0} K_0^* + \hat{P}_{Q_1} Q_1^* - \hat{P}_{M_1} M_1^* + \hat{P}_{K_1} K_1^* \geq -P_{K_0} K_0 + \hat{P}_{Q_1} Q_1 - \hat{P}_{M_1} M_1 + \hat{P}_{K_1} K_1$$

or

$$-P_{K_0} \Delta K_0 + \hat{P}_{Q_1} \Delta Q_1 - \hat{P}_{M_1} \Delta M_1 + \hat{P}_{K_1} \Delta K \geq 0$$

where  $P_{K_0}$  is the price of a house “today” and  $\hat{P}_{Q_1}$ ,  $\hat{P}_{M_1}$  and  $\hat{P}_{K_1}$  are the present-value prices “today” of promises to take or make deliveries of dwelling

<sup>1</sup>The lessor would as well consider the opportunity cost of his own service as an input in the production of dwelling services. For simplicity at this stage the value of the lessor’s own service is ignored.

<sup>2</sup>If the techniques were such that  $\Delta M = 0$ , then one has

$$P_O \frac{\Delta Q}{\Delta K}_{\Delta K > 0} \geq H_K \geq P_O \frac{\Delta Q}{\Delta K}_{\Delta K < 0}$$

and if the techniques were differentiable, a condition of maximum profits is simply the well known:

$$P_O \frac{\partial Q}{\partial K} = H_K$$

See, for example, C. J. Bliss, *Capital Theory and the Distribution of Income* (Amsterdam: North Holland, 1975.)

services, materials and houses “tomorrow”. The present-value prices are simply defined such that, for example,  $\tilde{P}_{M_1} = P_{M_0}(1+r_{1M})^{-1}$ , the present-value price of a promise to take or make delivery of materials “tomorrow”, equals the price of materials “today” divided by  $(1+r_{1M})$ , one plus the one period own-gross-rate-of-interest on materials. Hence, the inequality may be expressed as

$$-P_{K_0} \Delta K_0 + P_{Q_0}(1+r_{1Q})^{-1} \Delta Q_1 - P_{M_0}(1+r_{1M})^{-1} \Delta M_1 + P_{K_0}(1+r_{1K})^{-1} \Delta K_1 \geq 0$$

Since the “same” house is being considered, the inequality can be expressed as

$$P_{Q_0}(1+r_{1Q})^{-1} \Delta Q_1 - P_{M_0}(1+r_{1M})^{-1} \Delta M_1 + \{P_{K_0}(1+r_{1K})^{-1} - P_{K_0}\} \Delta K \geq 0$$

and, if all own-gross-rates-of-interest are the same, it can be expressed as

$$P_{Q_0} \Delta Q_1 - P_{M_0} \Delta M_1 - r_1 P_{K_0} \Delta K \geq 0$$

or

$$\left\{ P_{Q_0} \frac{\Delta Q_1}{\Delta K} - P_{M_0} \frac{\Delta M_1}{\Delta K} \right\}_{\Delta K > 0} \geq r_1 P_{K_0} \geq \left\{ P_{Q_0} \frac{\Delta Q_1}{\Delta K} - P_{M_0} \frac{\Delta M_1}{\Delta K} \right\}_{\Delta K < 0}$$

If “today” and “tomorrow” in this account are discretely perceived as the lessor purchasing the house at the beginning of a period and selling a promise to deliver the house at the end of the period (and let that period be “today”) then one could write the relationship as

$$\left\{ P_Q \frac{\Delta Q}{\Delta K} - P_M \frac{\Delta M}{\Delta K} \right\}_{\Delta K > 0} \geq r P_K \geq \left\{ P_Q \frac{\Delta Q}{\Delta K} - P_M \frac{\Delta M}{\Delta K} \right\}_{\Delta K < 0}$$

What was formerly described as the gross rental for the services of the house,  $H_K$ , will be definitionally the same as the one-period own-gross-rate-of-interest multiplied by the price of the house,  $rP_K$ .

In general, forward markets for dwelling services, materials and houses do not exist<sup>3</sup> and the choice of technique undertaken by the lessor may be examined another way. Suppose, then, the lessor contemplates purchasing a house “today”, to produce dwelling services (with the aid of material inputs) “tomorrow” and selling the house “tomorrow” at prices he expects to rule “tomorrow”. He could also contemplate purchasing a bond “today” with the amount of money he ties up in the house and selling the bond “tomorrow” at a price he expects to prevail “tomorrow”. The technique chosen then must satisfy

$$\begin{aligned} & (-P_{K_0} K_0^* + \tilde{P}_{Q_1} Q_1^* - \tilde{P}_{M_1} M_1^* + \tilde{P}_{K_1} K_1^*) \\ & - \left( -P_{B_0} \frac{P_{K_0} K_0^*}{P_{B_0}} + i_1 P_{B_0} \frac{P_{K_0} K_0^*}{P_{B_0}} + \tilde{P}_{B_1} \frac{P_{K_0} K_0^*}{P_{B_0}} \right) \\ & \geq (-P_{K_0} K_0 + \tilde{P}_{Q_1} Q_1 - \tilde{P}_{M_1} M_1 + \tilde{P}_{K_1} K_1) \\ & - \left( -P_{B_0} \frac{P_{K_0} K_0}{P_{B_0}} + i_1 P_{B_0} \frac{P_{K_0} K_0}{P_{B_0}} + \tilde{P}_{B_1} \frac{P_{K_0} K_0}{P_{B_0}} \right) \end{aligned}$$

<sup>3</sup>Particular examples exist, of course, such as long-term rental contracts, etc.

where  $\tilde{P}_{O_1}$ ,  $\tilde{P}_{M_1}$ ,  $\tilde{P}_{K_1}$ , and  $\tilde{P}_{B_1}$  are the prices of dwelling services, materials, "houses" and "bonds" expected to prevail "tomorrow",  $P_{K_0}K_0^*/P_{B_0}$  is the number of the "bonds" the lessor could buy with the purchasing power tied up in purchasing houses for the best technique and  $i_1$ , is the one period coupon rate on the "bond". Simplification (on the assumption that the "same" bond and house are being considered) yields the inequality

$$P_{O_0}(1+p_O) \Delta Q_1 - P_{M_0}(1+p_M) \Delta M_1 - \{(1+i+p_B) - (1+p_K)\}P_{K_0} \Delta K \geq 0$$

where  $p_O$ ,  $p_M$ ,  $p_K$  and  $p_B$  are the lessor's expected rate of change in the price of dwelling services, materials, the "house" and the "bond". Care must be taken with respect to the expected rate of change in the prices of the "house" and the "bond". The lessor could be deemed to purchase a house of age  $T$  and then sell a house of age  $T+1$ . He could expect the price of all houses of every age to remain constant but because the house he contemplates selling would be one period older its selling price would (normally) be lower than its buying price or he could expect his house to be subject to some rate of "depreciation by evaporation"<sup>4</sup> so that on this account, the expected rate of change in the price of the house would be negative. He could also expect the price of all houses (in his case the price of a house of age  $T+1$ ) to be changing. Thus  $(1+p_K)$  shall be written as  $(1+p'_K + p''_K)$  where  $p'_K$  (negative) captures the first influence and  $p''_K$  (positive, zero or negative) captures the second.<sup>5</sup>

To compare with the earlier results, if the lessor's expectations were that all prices would be unchanged, then the inequality can be simply expressed as:

$$P_{O_0} \Delta Q_1 - P_{M_0} \Delta M_1 - \{i - p'_K\}P_{K_0} \Delta K \geq 0$$

or, taking account of  $p'_K < 0$  where  $-p'_K = \delta$ , as

$$P_{O_0} \Delta Q_1 - P_{M_0} \Delta M_1 - \{i + \delta\}P_{K_0} \Delta K \geq 0$$

If, as before "today" and "tomorrow" were perceived discreetly as relating to one period, the inequality could be written as

$$\left\{ P_O \frac{\Delta Q}{\Delta K} - P_M \frac{\Delta M}{\Delta K} \right\}_{\Delta K > 0} \geq (i + \delta)P_K \geq \left\{ P_O \frac{\Delta Q}{\Delta K} - P_M \frac{\Delta M}{\Delta K} \right\}_{\Delta K < 0}$$

where the gross rental on the house equal to the own-gross-rate-of-interest on the house multiplied by the price of the house is seen to be equal to the sum of the coupon rate on the "bond" and the rate of "depreciation by evaporation" on the house multiplied by the price of the house.

Many problems associated with the above analysis must, in this study, be left untouched. First, the exercise does not determine the scale of investment, bond or

<sup>4</sup>All kinds of assumptions about depreciation may be made (see T. K. Rymes, *On Concepts of Capital and Technical Change* (Cambridge: Cambridge University Press, 1971), Chap. 4). It is assumed here for simplicity that a stock of similar houses evaporates or decays at an annual rate,  $\delta$ , so that the expected rate of decline in the price of the house, other things being equal, is  $\delta$ .

<sup>5</sup>Similarly, the expected change in the price of "the" bond could be decomposed into two parts: one showing its expected price movement as it approaches maturity and second, the expected price movements of bonds of similar maturities.

mortgage financing for the lessor – it merely determines the technique chosen.<sup>6</sup> Second, the exercise does not determine the proportion of houses and bonds (or mortgage liabilities) held by the lessor. This can be seen by assuming that at the prices faced by the lessor, the starred technique is such that

$$P_{O_0}(1+p_O)Q^* - P_{M_0}(1+p_M)M^* - \{(1+i+p_B) - (1+p'_K)\}P_{K_0}K^*$$

may be greater, equal to, or less than zero in which case it would seem that the lessor would be entirely in houses, would be indifferent between holding houses and bonds or would be entirely in bonds. On this point, either analysis including transaction costs in houses and bonds in the specification of the “best” technique and/or an analysis including variances in the expected rates of change of prices and/or an analysis dealing with the strength of belief in the less than confidently held expectations and the desired composition of “balance sheets” would be necessary to determine the particular composition of assets and liabilities which a lessor would hold as the best (i.e. highest present value) technique. Third, there is nothing as yet in the analysis which provides an explanation as to why the lessor can act either as a pure intermediary (renting a house) and/or as a pure trader (buying a house and combining its service and his own with material inputs and selling the resulting dwelling service to the lessee). Fourth, the assumption that the lessor has a one-period horizon is clearly restrictive.

For the purpose of this paper, however, the simple inequality for the one period case

$$P_{O_0}(1+p_O)\Delta Q_1 - P_{M_0}(1+p_M)\Delta M_1 \geq [(1+i+p_B) - (1+p'_K + p''_K)]P_{K_0}\Delta K$$

could be open to the following interpretation. If all prices (bonds excluded) were expected confidently to remain unchanged, as compared with a situation in which they were expected confidently to rise at the same rate, then for comparison purposes one would have

$$P_{O_0}\Delta Q_1 - P_{M_0}\Delta M_1 \geq [i - p'_K]P_{K_0}\Delta K \quad (\text{prices constant})$$

$$P_{O_0}\Delta Q_1 - P_{M_0}\Delta M_1 \geq [i - p - p'_K]P_{K_0}\Delta K \quad (\text{all prices rising at rate } p)$$

and it would appear that, *ceteris paribus*, the lessor would choose more-house intensive techniques—i.e., would hold relatively more houses and fewer bonds (or, in general, more houses, fewer bonds and less money balances, or more houses and more mortgage and loan financing when one re-introduces the holding of a complex of assets and liabilities associated with the lessor’s provision of dwelling services). Rewriting the inequality another way,

$$P_{O_0}\Delta Q_1 - P_{M_0}\Delta M_1 \geq [(1+i-p) - (1+p'_K + p''_K - p)]P_{K_0}\Delta K$$

<sup>6</sup>This is the standard problem of the indeterminacy of the desired stock of capital and the level of investment of the competitive firm. Desperate ad hoc expedients abound in the literature. Friedman falls back on “fixed entrepreneurship” but honestly admits how unsatisfactory is the “solution” (cf. M. Friedman, *Price Theory*, Chicago: Aldine, 1976), pp. 105–6; Mussa assumes the firm has a fixed initial stock of capital (for new firms?) which yields the desired stock of capital and an internal cost of adjustment mechanism which is, in reality, a simple general equilibrium solution to determine a finite rate of investment for the firm (cf. M. Mussa, *A Study in Macroeconomics* (Amsterdam, North-Holland, 1976), Chap. 2) while Brechling lets go the assumption of a constant return to scale technology (cf. F. Brechling, *Investment and Employment Decisions* (Manchester: Manchester University Press, 1975)).

one observes that the lessor expects to receive a nominal capital gain,  $p'_K P_{K_0}$ , from the holding of a house for one period, in “real” terms (a concept of some meaning in this instance since all prices pertinent to the lessor are confidently expected to rise at the same rate), while no “real” capital gain is experienced on houses since, by assumption,  $(p'_K - p)P_{K_0}$  is equal to zero, a “real” capital loss is expected from bond (and money) holdings. Of course, if the level of interest rates were altered in a way to offset exactly the expected rate of change of prices, then  $i - p'_K = i^* - p - p'_K$  (with  $i^* = i + p$ ) so that the lessor while indifferent perhaps between houses and bonds would not be indifferent between houses and (say) money—assuming that money holdings are not provided with nominal rates of return designed to offset the confidently expected general inflation. The same considerations would hold for the two period case. In the case where inflation is general (i.e., where relative prices are expected to remain unchanged) but it is not fully reflected in the nominal rate of interest on bonds, then, in a comparison of the two situations

$$\left\{ \frac{P_{Q_0}}{P_{K_0}} \frac{\Delta Q_1}{\Delta K} - \frac{P_{M_0}}{P_{K_0}} \frac{\Delta M_1}{\Delta K} \right\}_{P_{K_0} \Delta K > 0} \geq i - p'_K = i + \delta \geq \left\{ \frac{P_{Q_0}}{P_{K_0}} \frac{\Delta Q_1}{\Delta K} - \frac{P_{M_0}}{P_{K_0}} \frac{\Delta M_1}{\Delta K} \right\}_{P_{K_0} \Delta K < 0}$$

$$\left\{ \frac{P_{Q_0}}{P_{K_0}} \frac{\Delta Q_1}{\Delta K} - \frac{P_{M_0}}{P_{K_0}} \frac{\Delta M_1}{\Delta K} + p \right\}_{P_{K_0} \Delta K > 0} \geq i - p'_K = i + \delta \geq \left\{ \frac{P_{Q_0}}{P_{K_0}} \frac{\Delta Q_1}{\Delta K} - \frac{P_{M_0}}{P_{K_0}} \frac{\Delta M_1}{\Delta K} + p \right\}_{P_{K_0} \Delta K < 0}$$

one would argue that at the set of prices faced by the lessor in the first situation  $i - p'_K$  measures the nominal and real gross own-rate-of-interest on houses or the house value of the marginal product of houses or the house rental on houses while  $(i - p'_K)P_{K_0}$  measures the money value of the marginal product of houses or the gross money rental on houses. In the second situation  $i - p'_K$  measures the nominal gross own-rate-of-interest on houses, or the house value of the marginal product of houses or the own rental on houses plus the expected rate of nominal capital gain on houses while  $i - p'_K - p$  measures the real gross own-rate-of-interest on houses while  $(i - p'_K - p)P_{K_0}$  measures the gross money rental on houses.

If a set of prices, an interest rate and expectations prevailed such that  $i - p'_K > 0$  but  $i - p'_K - p < 0$  (i.e., the money rate of interest had not adjusted to the expected rate of general inflation), then, while the gross money rate of interest on houses was positive, one could argue that the real own gross rate of interest on houses and the gross money rental on houses was negative. While the concept of a negative own-rate-of-interest is acceptable (for it merely implies that the present value price of a house for delivery “tomorrow” stands above the price of a house for delivery “today”), I find the concept of a negative *gross* money rental difficult to understand. (There is no question that a *net* money rental can be negative, a case in which gross rental is less than the value of depreciation). A *negative gross* money rental implies however, that the lessor could merely adopt the best technique of *holding* the house through one period (not using its services to produce dwelling services), experience the one period carrying costs of the depreciation and then capture the expected nominal (not “real”) capital gains. That is, no lessor (if the range of techniques open to him includes the mere holding of the house) would choose that technique which would involve a negative gross money rental.

More generally, the lessor would expect relative prices to change and from the simple inequality

$$P_{Q_0}(1+p_Q)\Delta Q - P_{M_0}(1+p_M)\Delta M \geq [(i+p_B) - (p'_K + p''_K)]P_{K_0}\Delta K$$

one can always say that

$$\left\{ \frac{P_{Q_0}}{P_{K_0}}(1+p_Q)\frac{\Delta Q}{\Delta K} - \frac{P_{M_0}}{P_{K_0}}(1+p_M)\frac{\Delta M}{\Delta K} + p''_K \right\} \geq i + p_B - p'_K$$

the lessor will choose that technique which measures simultaneously real own-rates-on houses with real house rates on bonds or which measures simultaneously

$$\left\{ \frac{P_{Q_0}}{P_{K_0}}(1+p_Q)\frac{\Delta Q}{\Delta K} - \frac{P_{M_0}}{P_{K_0}}(1+p_M)\frac{\Delta M}{\Delta K} + p''_K \right\} + p'_K \geq i + p_B$$

money rates on houses with money rates on bonds, or

$$\left\{ \frac{P_{Q_0}}{P_{K_0}}\frac{\Delta Q}{\Delta K} - \frac{P_{M_0}}{P_{K_0}}(1+p_M - p_Q)\frac{\Delta M}{\Delta K} + p''_K \right\} + p'_K - p_Q \geq i + p_B - p_Q$$

which measures simultaneously the real dwelling service rate on houses with the net dwelling service rate on bonds and so forth. All of this is merely definitional and follows from what is meant by the choice of best technique. The point of importance is to note that in a world where relative prices are expected to diverge there is no unique real rate to be found. In the example, there are three:  $i - p''_K$ —the house rate,  $i - p_Q$ —the dwelling service rate and  $i - p_M$ —the materials rate and the difficulty which this gives rise to in this paper is that *money* rates of interest on bonds, loans, etc., will reflect the complex of real rates and different expected rates of change in the *money* prices of commodities and services and there is, as a consequence, no reason to expect a particular money rate to bear any close relationship to the actual or expected rate of change in the price of any particular producer or consumer durable.<sup>7</sup>

With the preliminary theoretical viewpoint in hand, I now turn to an examination of some of the problems involved in the construction<sup>8</sup> of price relatives for the home ownership component of the CPI.

### III. SOME PROBLEMS IN PRACTICE

How should the statistician price dwelling services? If all dwelling services are metered in the market price system, the problem is, of course, trivial. On the

<sup>7</sup>Certainly, the levels of different money rates are affected by considerations of risk or strengths of beliefs in expectations and (say) the level of mortgage rates will be different from the level of bank loans on which automobiles are the collateral but it is not clear that the movement of mortgage rates relative to automobile loan rates will necessarily bear any close relationship to the actual and expected movement of the relative prices of houses and automobiles, though they may bear some relationship to the actual and expected movement of the overall price level.

<sup>8</sup>In the larger study done for Statistics Canada, I deal with the difficult problems within the context of the service price approach, of the treatment of taxes, land as an input contributing to the flow of dwelling services, the measurement of the "price" of depreciation and quality change. For simplicity, I ignore such problems in this paper.

demand side (the Consumer Price Index side), one merely observes  $P_{Q_0}$  and  $P_{Q_1}$  and constructs the relative which appears as a component (with appropriate weights) in the CPI. On the supply side (say for an Industry Selling Price Index for the Real Estate Industry), the observations  $P_{Q_0}$  and  $P_{Q_1}$  are again entered as a price relative in a weighted component of the ISPI. The  $P_Q$ 's used in both indexes will be the same (abstracting from any sales taxes, etc.) as the prices of dwelling services. To move closer to the problem of this paper, suppose one wished to construct an input Industry Purchasing Price Index which would match the output ISPI and the CPI. Concentrating again on the exemplary lessor, one would employ his *ex post* accounts

$$P_Q Q = P_M M + \left( -\frac{\Delta P_K}{P_K} \right) P_K K + R P_K K$$

where  $-\Delta P_K/P_K$  is the *ex post* rate of depreciation on the house and  $R$ , the calculated *ex post* rate of return, is derived by dividing the net returns to capital (calculated by using current replacement costs estimates of depreciation) by the current replacement cost net of the house. In Divisia index number form, one has

$$p_Q + q \equiv \alpha [p_M + m] + \beta [-p'_K + p''_K + k] + \gamma [r + p''_K + k]$$

where  $p_Q \equiv$  (as before)  $\dot{P}_Q/P_Q$ ,  $r \equiv \dot{R}/R$ , etc and  $\alpha$ ,  $\beta$  and  $\gamma$  are the weights used in the construction of the index (eg.  $\alpha \equiv P_M M/P_Q Q$ ). One can rewrite this expression as

$$q - [\alpha_M + (\beta + \gamma)k] \equiv [\alpha p_M + \beta (-p'_K + p''_K) + \gamma (r + p''_K)] - p_Q$$

and derive immediately the well-known result, where any increases in economic efficiency in the activity of providing dwelling services is occurring, an inputs IPPI (the term in brackets on the right side of the identity) will run ahead of an outputs ISPI.<sup>9</sup>

If consumers as lessors are deemed to be purchasing houses and leasing them to themselves in the provision of dwelling services for themselves, and *even if* one could get a proper imputed measure of the *ex post* net rate of return on the owner-occupied houses, one could not satisfactorily impute the price of dwelling services the consumers as lessors are producing for themselves. If one compares the price of dwelling services purchased by a consumer from a lessor in the market place with an inputs price index for dwelling services produced by the consumer owner-occupier the latter will tend to run ahead of the former in a technically progressive economy.

It is, of course, precisely the fact that the flow of dwelling services produced by consumer owner-occupiers are not priced in the market place which implies

<sup>9</sup>The left hand side of the Divisia index expression of the proportionate rate of change in economic efficiency is the framework in which standard estimates of "total factor productivity" are prepared. While I have demonstrated elsewhere (cf. T. K. Rymes *op. cit.* and my "The measurement of capital and total factor productivity in the context of the Cambridge theory of capital", *Review of Income and Wealth*, XVIII, March 1972, 79-108), the invalidity of such measures of "total factor productivity" (a demonstration now being accepted; cf., for example Charles R. Hulten, "Technical Change and the Reproducibility of Capital", *American Economic Review*, LXV, 1975, 956-965), for this paper one notes that such measures, in terms of rates of change of outputs and inputs, are identical to those which are expressed in terms of rate of change of input and output prices.

that no *ex post* rate of return to owner-occupied houses, calculated in the outlined manner for tenant-occupied houses, can be calculated. The service price approach implies that an adequate estimate of the desired *ex post* rate of return can be constructed. Before dealing with this central problem, one must first ask: why bother?

An argument could be developed to the effect that market prices actually paid for dwelling services purchased by tenant-occupiers could be imputed to owner-occupiers or alternatively, *ex post* service prices for houses actually recorded in the accounts of lessors selling dwelling services in the market could be imputed to the houses of owner-occupiers. In short, where “adequate” markets in the rentals of the services of “consumer durables” exist, why not use the resulting market prices and impute them to the products or services deemed to be produced by or to the direct services of consumer-owned and-used durables.<sup>10</sup> In short, in the CPI only market rents price relatives would be recorded but the weights would be enhanced to include not only rentals on (in the special case discussed in this study) tenant-occupied housing but imputed rentals on owner-occupied housing as well. There are two objections at least to this suggested procedure: first, it would appear that owner-occupied housing is sufficiently different from tenant-occupied housing so as to render the sample of tenant-occupied rentals unrepresentative of the “true” rentals on owner-occupied housing; second, the procedure would imply that the relative prices of the services of owner-and-tenant occupied houses remained constant.<sup>11</sup> Hence, the resulting price measures of the services associated with tenant-occupied and owner-occupied houses could not be used in any study of relative price elasticities of the demand for market and non-market evaluated services of consumer durables. Differences in the demand for owner-occupied and tenant-occupied houses would then have to be explained by variables other than differences in the relative prices of the dwelling services. We are then led to abandon any attempt to impute a dwelling service price, are driven back that is from an output ISPI index to an input IPPI index and come to the central problem:

How then to “price” the services of owner-occupied houses? The calculation of the *ex post* net rate of return to tenant-occupied houses entails that all nominal capital gains are excluded from such a construction. How would such an *ex post* construct be expected to relate to the expected rates of return set out in the preliminary theoretical framework? A number of illustrative cases will be examined.

(i) During the current period, the price of houses rose and no other changes occurred. The *ex post* net rate of return to houses would be lower whereas if the activity were evaluated at a prevailing money rate of interest, it might well be shown as operating at a loss.

There is, in the example, no reason in general to expect the *ex post* real rate on the house plus the *ex post* proportionate rate of increase in the price of the house,

<sup>10</sup>This is the standard argument associated with imputations in the national accounts. For a plea for much wider imputation, see M. S. Denny and J. A. Sawyer, “Revising the National Accounts”, *Canadian Journal of Economics*, IX, November 1976, 720–732.

<sup>11</sup>At the aggregate level, of course, the index of owner-occupied imputed rentals might well move differently from the index of market rentals—but that would merely imply that the individual market rental price relatives were being put together with different weights in the two cases.

that is, the *ex post* money rate of return on the house, to stand in a predictable relationship to any particular nominal rate or composite of nominal rates. As a consequence, any particular nominal rate (say a mortgage rate) less the *ex post* proportionate rate of increase in the price of the house—the house rate of interest on the mortgage—might stand well below the *ex post* net real rate recorded for the house, even experiencing negative levels. Any such real rate when multiplied by the current replacement or market price of the house would show a money rental or money service price of the house different from the actual or *ex post* money rental—again, possibly at negative levels. The basic problem again illustrated by the example is that there are, in fact, being recorded a number of real rates—a characteristic of a non semi-stationary economy.<sup>12</sup>

Many such examples could be provided. The important point in any attempt to measure *ex post* the service price of owner-occupied housing is that no *ex post* real rate of return is available. If one should measure it by

$$(i - p'_K - p''_K)P_K$$

then, in price relative form,

$$\frac{(i_1 - p'_{K_1} - p''_{K_1})P_{K_1}}{(i_0 - p'_{K_0} - p''_{K_0})P_{K_0}}$$

the relative of the imputed money gross service price or rental on the houses of owner-occupiers will depend crucially on the relationships observed between *ex post* nominal interest rates and *ex post* proportionate rates of change in the money price of houses *not only between time periods but in each time period as well*. *Ex post* or observed relationships in any time period need not, of course, be the same as the expected relationships set out in the preliminary theoretical framework held by any or all transactors in that time period—though one would expect that the *ex post* relationships would have some bearing upon those anticipated or expected. The *ex post* nominal rates need not reflect the proportionate rates of change in prices being experienced by any particular consumer durable. As a consequence, if it were the case that the services of similar durables were simultaneously both priced and not priced in the market place, the observed money and real rate to such durables would not necessarily be the same as those imputed by the “user cost” or service price method. Another example may be imagined in which no such difficulties arise.

(ii) Suppose that *all* prices were rising at the same rate in the current period and that all nominal rates of interest had adjusted to reflect that fact—the standard case of much literature where anticipated events are identical to actual events. In this special case, the real rate of return on houses would be unchanged, all price relatives, would stand in the same relationship, the *ex post* net money rate of return on houses would equal (adjusted for the confidence with which expectations are held) the current nominal interest rate. As a consequence of these special assumptions,  $(i_1 - p''_{K_1})P_{K_1}$  would, of course, provide an exact measure of the current money value of the net rental or net service price while

<sup>12</sup>A non semi-stationary economy is one in which relative quantities and relative prices are changing. cf. C. F. Bliss, *op. cit.*

$(i_1 - p'_{K_1} - p''_{K_1})P_{K_1}$  would measure the current money value of the gross rental or gross service price of all durables, rented in the market place or not. Where all prices are expected to change at the same rate relative prices are not changing and a single (or unchanging structure of real rates of interest) real rate of interest prevails.<sup>13</sup> If one constructed for owner-occupiers a relative of gross service prices on houses equal to

$$\frac{(i_1 - p'_{K_1} - p''_{K_1})P_{K_1}}{(i_0 - p'_{K_0} - p''_{K_0})P_{K_0}}$$

a defensible measure of the movement over time in the imputed gross rental on owner-occupied houses would be in hand. Such a case seems to be so special, however, as to rule it out of serious consideration.

(iii) As another example to illuminate the problem, suppose that in the current period the monetary authorities so operated on the supply of money in a once-over fashion as to raise all nominal interest rates. The actions of the authorities on the prices of goods were not anticipated and do not have any effects on such prices in the current period. Imputed real rates to owner-occupied houses would stand at a higher level and therefore imputed money rentals, gross (or net) service prices to owner-occupied houses would be similarly shown to be a higher level. That is, one would have

$$\frac{(i_1 - p'_{K_1} - p''_{K_1})P_{K_1}}{(i_0 - p'_{K_0} - p''_{K_0})P_{K_0}}$$

where only  $i_1 > i_0$  with all other prices and rates of change of prices recorded as being unchanged. While one would expect that such actions by monetary authorities would normally result in a fall in prices (and by assumption, such declines in prices are assumed to follow with a lag), the imputation of money service prices or rentals to owner-occupied houses with the use of nominal interest rates would, *ceteris paribus*, indicate that such prices have risen—i.e., that component of the CPI dealing with imputed rentals would illustrate a rise.

A review of these examples in the context of the effects on a hypothetical CPI of the procedure of “pricing” the services of owner-occupied houses (and, of course, the argument generalizes to all consumer durables not rented in the market place) by means of adjusting *ex post* nominal interest rates on (say) mortgages for the *ex post* proportionate rate of change in the price of houses all multiplied by the current price of houses according to the formula

$$(i - p'_K - p''_K)P_K$$

is instructive.

The second case, we have seen, is trivial.<sup>14</sup>

<sup>13</sup>Some authors, in dealing with such a case, assert that “the” real rate of interest will tend to be equal to the real rate of growth of the economy (cf. M. Friedman, *A Theoretical Framework for Monetary Analysis* (New York: Columbia University Press for the NBER, 1971), 377. Such an assertion entails semi-stationary price and quantity systems. Outside of such special cases, however, such assertions do not hold, indeed, have no meaning.

<sup>14</sup>Indeed, since all prices would be rising at the same rate, the problem of constructing a CPI would be immediately trivial.

The third case, as already indicated, illustrates the fact that the imputation of the gross (or net) service price approach to the pricing of owner-occupied houses makes the CPI especially sensitive to changes in nominal interest rates and to the extent that such interest rates are, at least in a short-period context, sensitive to the actions of the monetary authorities, would seem to lead to movements (again in a short period sense) in the hypothetical CPI which are counter-intuitive. That is, a rise in interest rates, *ceteris paribus*, would lead to a rise in (at least the components under discussion) measured prices at a time when most economists would argue that prices would, *ceteris paribus*, begin to fall and *vice versa*.<sup>15</sup>

Notice what is being contrasted. From the theoretical or *ex ante* viewpoint, the opportunity cost of the purchasing power tied up directly in the form of the provision of house services and indirectly in the provision of dwelling services has risen given the recorded rise in money interest rates.<sup>16</sup> Yet the use of *ex ante* concepts, drawn from theory, would in this case lead to movements of *ex post* price relatives and price indexes which would not depict the actual movement of market prices.

The first case from the opportunity cost viewpoint would, I think, be interpreted in the following way. If, during the current period the price of houses was expected to rise, all other prices remaining constant, from the point of view of an owner of a house, the expectation of both nominal and real capital gain would lead to the adoption of techniques in which the money value of the services of the house (in providing dwelling services)—the  $P_Q(\Delta Q/\Delta K) - P_M(\Delta M/\Delta K) \geq (i - p'_K - p\%_K)P_K$  or the money value of “the marginal product” of the house in the conceptual discussion—would be reduced. Of course, at a more general equilibrium level of discussion, such a state of expectations would undoubtedly generate a much higher current price of houses. Indeed, if the market for houses and dwelling services were such that no supply responses were possible, one would argue that the current price of houses would adjust upward to preserve immediately equality between the expected money rate of return on houses with the expected nominal rate on bonds. At the partial level of analysis with respect to the individual owner of houses, however, the conceptual discussion would suggest that a nominal rate (or complex of nominal rates) less the *ex post* proportionate rate of change in the price of houses in any period all multiplied by the average current price of houses would be the current *ex post* measure of the money rental

<sup>15</sup>I conjecture that because under the suggested imputation the CPI would, *ceteris paribus*, rise, (if only briefly)—i.e., the price of home ownership would be shown as higher—increased weight would be added to arguments which suggest that contractionary monetary policy which results in (even temporarily) higher money interest rates is inflationary.

<sup>16</sup>In the example, it was suggested that all money interest rates would rise as a consequence of the actions of the monetary authorities. Some rates would rise more than others if account were taken of the long term expectations—indeed, if the long term expectations were such that individuals expected prices to fall as a consequence of the actions of the monetary authorities it might even be the case that some money rates of interest would fall.

Of course, rates on *existing* bonds, loans, mortgages, etc., would not necessarily move unless the bonds or loans were demand instruments or unless the mortgages were (so to speak) instantaneously variable term mortgages just as money rental payments by tenant occupiers would also not necessarily move if the rental contracts were not for an instantaneously variable term. The opportunity cost or *ex ante* approach would, however, concentrate on the rates associated with new bonds, mortgages, etc., on the argument that one is concerned with the current period opportunity cost of the purchasing power or money involved.

on the services of the house and, therefore, would be the appropriate “price” observations entering the relatives used in the construction of the owner-occupied housing component of the CPI. The argument here, if I understand it correctly, is that such a measure correctly “prices” the gross (or net) services of the house to the owner-occupier and that if a CPI is interpreted as an index of the *money* income a typical or representative consumer ought to have in order to preserve, in the face of changing prices, his level of utility or “real income” then, in a situation in which, *ceteris paribus*, the money price of houses (and, by analogy, of all consumer durables) is rising, the CPI—at least that component dealing with houses (or all consumer durables)—would be shown as exhibiting downward movements. It would correctly, it is argued, reflect the fact that the money opportunity cost to the representative consumer of preserving an unchanged level of utility (when it is the services of the durables which are entered directly or indirectly as arguments of the utility function) have, in fact, fallen *ex post* and that failure to make this adjustment, based on the opportunity cost approach, would incorrectly leave the CPI as reflecting capital gains (realized or not) made by consumer on his holdings of consumer durables.<sup>17</sup> A similar argument (with all the signs reversed) holds for a situation in which, *ceteris paribus*, the price of consumer durables is falling. In that case, though the stock price of durables is falling, it would be possible for the imputed gross (or net) money rental on consumer durables to be rising and a CPI, so adjusted, would, it is argued, correctly reflect the rising opportunity cost of “renting one’s house to oneself” and that failure to make the adjustment, based on the opportunity cost approach, would leave the CPI as reflecting capital losses (realized or not) made by the consumer on his holdings of consumer durables.

In dealing with the case of capital gains, it was earlier pointed out that it is conceivable that the *ex post* proportionate rate of change in the price of houses in relation to the *ex post* nominal rate of interest could generate an *ex post* negative real house rate of interest and therefore a negative imputed money service price (gross or net) of the house. It was argued that, even from the conceptual viewpoint, no house owner would continue to use that technique entailing the provision of dwelling services but would rather adopt the technique of merely holding the house for the expected capital gain.<sup>18</sup> Of course, at the general equilibrium level of analysis, one would predict in such cases that the stock price of houses and market money rentals would be adjusting upwards. The prospect of such negative imputed money rentals is not a remote one and it is clearly the case that the price of houses in Canada has risen during certain periods at a rate

<sup>17</sup>There are any number of sources of this argument. See, for example, R. M. A. Loynes, *An Examination of the Consumer Price Index and Implicit GNE Price Index as Measures of Recent Price Change in the Canadian Economy* (Ottawa: Prices and Incomes Commission, 1972) and many working papers by Muth, Gillingham *et al.* in the U.S.A.

<sup>18</sup>This assumes that the capital gain would exceed the sum of the nominal rate and the “depreciation” rate on the house—the latter being regarded as the carrying cost of the house. In fact, it is probably the case that the depreciation rate on unused houses would be less than the depreciation rate on houses providing dwelling services so that the switch in techniques discussed captures as well the reduction in carrying costs (i.e., the marginal user cost of Keynes) so that the switch in techniques would, *ceteris paribus*, occur before  $i - p'_K - p''_K$  equalled zero since the “depreciation” rate involved in merely holding the house would be below  $p'_K$ .

exceeding any nominal rate on mortgages, bonds or any chosen complex of nominal rates of interest.<sup>19</sup>

Even if one excludes from consideration such extreme cases as imputed negative money rentals when the price of houses is recorded as rising at rates above nominal interest rates and rapidly rising positive money rentals when the price of houses is recorded as falling fairly rapidly, it remains the case that the interpretation to be placed on the imputed measures is not clear. The problem arises, I believe, because the economy is monetized, so that movements in nominal rates of interest will reflect, in an imperfect way, divergences in expectations of the price movements of what may be called pure consumption goods (i.e., the real rate in terms of pure consumption goods together with expected rates of change in the money prices of pure consumption goods are only part of the determinants of money interest rates). As a consequence, in the calculation of a CPI using the imputed gross (or net) service price approach, should the *ex post* rates of change in the price of durables exceed (be less than) the *ex post* rates of change in the price of pure consumption goods even if nominal rates of interest had adjusted to reflect the latter, the suggested imputed service price approach would thus ensure that the movement in the relatives constructed by the computed service price approach could be similar to the movement in the price of the pure consumption goods.

<sup>19</sup>In one of the seminars at which I aired these views, it was objected that this is an empirical, not a conceptual, problem. Practically, such results are considered as extreme but it is clear that any attempt to average observations involved (such as (say) an average of a number of periods of observations regarding money rates and *ex post* proportionate rate of change of house prices) so as to eliminate such "extreme" observations merely involves the implicit retreat to the second example outlined above where nominal rates were adjusted perfectly to proportionate rates of changes of prices—a state of affairs in which it was argued no difficulties were involved. Short of this case, however, there remains, in my judgment, no satisfactory theory telling us how *particular* nominal rates should adjust to *ex post* proportionate rates of change in the money price of *particular* durables—such as houses.

In one application of the imputed service price approach, it was found that the service price index when compared to the published Statistics Canada "Homeownership" Index yielded the following:

	"Homeownership"	Imputed Dwelling Service Price
1961	100.0	100.0
1962	102.8	109.2
1963	105.9	91.2
1964	110.4	75.6
1965	115.0	69.5
1966	120.1	51.0
1967	126.9	92.8
1968	136.1	86.8
1969	148.3	93.7
1970	161.3	170.4
1971	174.3	141.2
1972	188.3	117.9
1973	207.0	77.7
1974	227.1	-3.5
1975	250.2	4.2
1976	284.7	114.6

Source: S. McFadyen and R. Hobart, "An alternative measurement of housing costs and the Consumer Price Index", *Canadian Journal of Economics* XI, Feb. 1978, 105-111. Table 1. No satisfactory explanation of the movements of the service price index (including negative levels) is offered by the authors save for a reference to the distinction between *ex ante* and *ex post* considerations.

In conclusion, the use of actual nominal interest rates less the *ex post* proportionate rate of change in the price of durables builds into the CPI the effects that such nominal interest rates reflect, *ceteris paribus*, the movements in the price of pure consumption goods. Should relative prices of durable and pure consumption goods diverge, the gross (or net) imputed service price approach to the "pricing" of the services of owner-occupied houses causes that portion of the CPI dealing with such services to reflect movements in the price of pure consumption goods with the imputed service price approach not measuring the "true" imputed rental at all.

Taking the two arguments into account, first, that nominal interest rates will, in any short period, reflect the relative scarcity of money induced by the monetary authorities and should not, as in the imputed service price approach, be taken as reflecting necessarily any change in the money "rental" imputed to owner-occupied houses (and consumer durables of all kinds) and that nominal interest rates, in any short period context, will reflect also changes in the money price of pure consumption goods and not necessarily changes in the money price of houses and consumer durables thereby imparting movements to the imputed money rentals on the services of houses and other consumer durables which are of most questionable meaning leads, in my opinion, to the argument that statistical agencies ought not to follow the imputed service price approach outlined above in pricing the services of owner-occupied houses and other consumer durables.

#### IV. ADDITIONAL THEORETICAL CONSIDERATIONS

I have suggested that the service price approach could be applied to all durables purchased by consumers, that the analysis could be extended to price the services of "real" money balances held by consumers yet that it is the monetization of the economy which is at the heart of the difficulty which I see confronting the imputed service price approach to the pricing of the services of consumer durables in the CPI.

When dealing with owner-occupied houses, it would appear reasonable to use a, or a complex of, nominal mortgage rates in the service price approach. When a number of other consumer owned and used durables (e.g., automobiles, household appliances, "leisure"-activity goods such as snowmobiles and water craft, pantry stocks, etc.) are considered it would appear equally reasonable to use the complex of nominal rates associated with bank loans and consumer credit. Yet even in the case of houses it will be obvious that there will exist a substantial number of types of houses (e.g., classified by age) whose price movements need not be the same. A fortiori, it would appear that the number of consumer durables in general to be priced will be greater than the feasible number of nominal rates which could be used in the service price approach. Even if one considers the case of matching houses of different vintages with mortgages of different term structures and when estimating the relevant nominal mortgage rate account being taken of the *ex post* rate of change in the market value (if such markets exist) of existing mortgages,<sup>20</sup> it will be obvious that there will be many different types of

<sup>20</sup>It will be recalled in the preliminary theoretical framework that account was taken of the expected rate of change in the price of "the" bond.

new owner-occupied houses financed by a much smaller number of types of new mortgages—if indeed their purchases be financed by mortgages. As a consequence, in general, for different durables, while the nominal rates used in the service price approach will be the same, the own-rates will not. That is, there is, of course, no reason to expect  $(i - p'_K - p''_K)_I$  to equal  $(i - p'_K - p''_K)_{II}$ . Thus, the imputed gross money rental on the first type of durable will be falling relative to that for the second type of durable if, *ex post*, the price of the first is rising relative to the second. Advocates of the service price approach to the pricing in a CPI of consumer owned and used durables would argue that in the first case the imputed money outlay necessary to procure the services of the first durable would be falling relative to that necessary to procure the services of the second. Consumers are enjoying relatively greater capital gains on the first durable and adjustment for such capital gains via the service price approach results in a correct measure of the movement of the imputed gross rental on the two different durables. Yet it is clear that the reason why such a result is occurring is that the common nominal rate being used reflects, at any moment of time, the expected and the actual rate of change of prices in general and not necessarily the expected and actual rates of change in the prices of those particular durables being financed by the type of bank loan or consumer finance paper whose particular nominal rate (or complex of rates) is being used in the service price imputation approach.<sup>21</sup>

It will be argued that this is a mere aggregation problem. It is, in my opinion, the heart of the problem and the core of the argument against the imputed service price approach. In temporary equilibrium economics, there will not be a unique one period real rate, nor unique one period money rates, nor a unique term structure of real or money rates.<sup>22</sup> The immediate consequence is that, in the service price approach, the use of a particular nominal rate and the observed rate of change of prices of a particular durable in the  $(i - p'_K - p''_K)$  formula results in an own rate of merely mechanical and of no or little economic significance. If the price of one durable were rising and another falling and the nominal rate in question remained unchanged, reflecting expectations and actualities with respect to the rate of change of prices of final goods in general, the use of the service price approach would result in a fall in the imputed gross money rental on the first and a rise in the second durable—the two opposite price movements offsetting each other when inserted into an overall CPI. What application of the formula generated in this case, however, is not a meaningful movement in the respective own-rates and imputed gross money rentals but merely the fact that the nominal rate in question reflects expectations and outcomes with respect to the rate of change of prices in general.

A durable such as a house is said to be a less “liquid” asset than say a mortgage or a bond, and they in turn are said to be less “liquid” than “money”.

<sup>21</sup>A rise in the price of houses and residential land compared with automobiles may be associated with a rise in nominal mortgage rates as compared with those on consumer bank loans but there is no reason to expect the divergence in the rates of change of prices to be matched by corresponding movements in the nominal rates associated with mortgages and bank loans. A rise in the price of refrigerators as compared to furniture will not be reflected in different rates on consumer finance paper used to finance the acquisition of the different durables by consumer owner-users.

<sup>22</sup>C. J. Bliss, *op. cit.*, Chap. 14. Bliss states that (p. 329) “. . . in principle the term structure might be anything one cared to imagine”.

What is meant by such assertions? One may improve the measures of the imputed gross money rentals on owner-occupied houses by means of the service price approach through the incorporation of transactions costs to reflect the "liquidity" of the durable. Hence, in the one period rate of return calculation outlined in the preliminary theoretical framework, one might incorporate brokerage fees, transfer taxes and the like in attempting to impute a gross money rental sufficient to offset the illiquidity of the durable as metered by such costs. Thus in the formula

$$(i - p'_K - p''_K - p''^*_K)P_K$$

$P_K$  would reflect the "buy" price of the house,  $p''^*_K$  would reflect, *ceteris paribus*, the difference between the "buy" and "sell" prices of the house, reflecting transaction costs. For example, where the "buy" price of a representative house remained unchanged but the "sell" price of the same house was ten per cent lower owing to the "search" costs embedded in brokerage fees, etc.,  $p''_K$  would be  $-0.1$  and, *ceteris paribus*, the imputed gross rental would stand ten per cent higher than if transaction costs were ignored. If the nominal rate in question were a mortgage rate and the degree of illiquidity of mortgages were similarly captured the formula would become

$$(i + p^*_B - p'_K - p''_K - p''^*_K)P_K$$

where  $p^*_B < 0$  would capture the difference, *ceteris paribus*, in the "buy-sell" prices of mortgages. When relative transactions costs were lower on mortgages than on houses reflecting the differences in the "liquidity" of the assets (so that  $|p''^*_K - p^*_B| > 0$ ) it would still be the case that the imputed gross money rental on houses would stand above that calculated where transaction costs were ignored.

But the explicit incorporation of "transactions costs" as explicit measures of the relative "illiquidity" of various consumer owned and used durables (and in the nominal rates being used) does not resolve the fundamental difficulty confronting the imputed service price approach.

Consider now the imputed service rental being earned by households on "real" money balances. To treat real money balances as arguments in utility or production functions is more of a confession of ignorance than an analytical advance.<sup>23</sup> But what precisely, if real money balances held by consumers are to be treated akin to consumer durables, is the service flow being rendered by the possession of money balances? If it is assumed that the possession of "real" money balances renders help along with houses to the consumer *only* in the provision of dwelling services then, in the continuous case, one has

$$\frac{P_{O_0}}{P_{K_0}} \frac{\partial Q}{\partial K} = i - p_O - p'_K - (p''_K - p_O)$$

for the dwelling services rate on houses and

$$\frac{\partial Q}{\partial M/P_O} = \frac{i - p_O}{P_O}$$

<sup>23</sup> As an example of the analytical confusion which results, see H. G. Johnson, "Inside Money, Outside Money, Income Wealth and Welfare in Monetary Theory", *Journal of Money, Credit and Banking*, I, February 1969, 30-45.

for the dwelling services rate on a unit of “real” money balances. Again, the imputed gross rental on a house would be

$$P_{Q_0} \frac{\partial Q}{\partial K} = [i - p_Q - p'_K - (p''_K - p_Q)] P_{K_0}$$

and on a unit of nominal money balances would be

$$P_{Q_0} \frac{\partial Q}{\partial M/P_Q} = i - p_Q$$

Assuming again that the nominal rate in question,  $i$ , is a mortgage rate and letting starred values represent transaction costs as a measure of the “liquidity” of the assets, the expressions may be written as

$$P_{Q_0} \frac{\partial Q}{\partial K} = [i + p_B^* - p_Q - p'_K - (p''_K + p_K^{**} - p_Q)] P_{K_0}$$

and

$$P_{Q_0} \frac{\partial Q}{\partial M/P_Q} = i + p_B^* - p_Q$$

Thus, if  $|p_K^{**} - p_B^*| > 0$  and  $p_B^* < 0$  represents houses as less liquid than mortgages less liquid than money, the value of the marginal product of houses would be higher and that of money lower than in the case where transaction costs are ignored. That is, taking the liquidity of the assets into account, the representative consumer would be using techniques less house and more money intensive than would otherwise be the case.

Yet it is essentially meaningless to assert that “real” money balances render service to the representative consumer only in the provision of dwelling services. Ignoring the problem of aggregation involved I shall write<sup>24</sup>

$$P_0 \frac{\partial x}{\partial M/P} = i - p$$

where  $P$  is the general price level,  $p$  its proportionate rate of change and  $\partial x / (\partial M/P)$  the marginal product of “real” money balances in general.

Consider now a case where the general price level is unchanged, so that  $p$  is zero and nominal rates of interest remain unchanged because all suppliers of finance are confident that nominal and real rates of interest are the same when the real rate is expressed in terms of the aggregate basket of goods referenced by the conception of the general price level. Suppose, for whatever reason, the price of houses begins to rise. Given the manner in which the imputed gross service price of the durable is constructed, the proportionate rate of change in that service price will be, of course, less than the rate of increase in the price of houses. And *vice versa*, if the price of houses begins to fall. It now is abundantly clear that, what the imputed service price approach to the “pricing” of the services of consumer

<sup>24</sup>The treatment outlined for transactions costs is for simplicity subsumed in the discussion which follows.

durables is in fact recording is merely the effects of the set of expectations and actualities which generate movements in nominal rates. In the example, nominal rates and hence an imputed service price on money as a consumers durable are remaining unchanged because, and here is the aggregation point, while some prices may be rising or falling, overall prices are remaining unchanged. Thus, when the imputed service price for durables rising or falling in price is calculated, the constancy of the nominal rates automatically pulls the imputed service price towards the movement of overall prices.

The same argument can be repeated if overall prices are rising (falling) at some rate and nominal rates are higher (lower) in an offsetting manner, but the price of the durable in question is rising (falling) more (less) than the overall price level. The imputed service price approach automatically pulls the movement of the rate of change of the price of the services of the durables into line with the movement of overall prices.

Yet the problem still lies at a deeper level. From the formula

$$P_0 \frac{\partial x}{\partial M/P} = i - p$$

it would appear that the service price approach can be carried over to money balances held by consumers as well. If consumers hold bank savings deposits it would appear meaningful to incorporate a bank deposit nominal rate in the calculations.<sup>25</sup> For bank current deposits and for circulating currency, however, a rate must be imputed for what is implied in the imputed service approach is that such money balances, even after transaction costs are incorporated, have a non-pecuniary liquidity yield rate exceeding that of interest-bearing bank deposits and in turn exceeding that of mortgages and finally exceeding that non-pecuniary liquidity yield rate of consumer durables such as owner-occupied houses. Yet it is precisely such non-pecuniary liquidity yields which in principle are not subject to quantification and measurement in the implicit service prices approach. Clearly, however, the non-pecuniary liquidity yields on consumer durables must be included in any measurement of the service price of the durables. Thus, in the imputed service price of owner-occupied houses, for example, it is precisely the non-pecuniary liquidity yield of houses (however low) which cannot be priced.

In the formula

$$P_0 \frac{\partial x}{\partial M/P} = i - p$$

let  $\bar{R} = P_0 \partial x / (\partial M/P)$ , the rate of transformation (substitution) between goods in general "today" and goods in general "tomorrow". Ignoring  $p$ , for monies bearing no interest, there must be a non-pecuniary liquidity yield for consumers to hold such monies (i.e.  $\bar{R} = l_{M_1}$  where  $l_{M_1}$  is the non-pecuniary yield rate on non-interest bearing monies).

<sup>25</sup>It is understood that  $p_B^*$  would, in this case, incorporate such brokerage fees as the service charges banks levy on deposits, etc. Thus, if  $i_M$  is a mortgage rate,  $i_D$  is a deposit rate then  $i_M - i_D > 0$  implies that  $|p_M^* - p_D^*| > 0$ .

For interest-bearing monies  $(M_2, \dots, M_n)$ , where  $i_{M_2} < R$ , then  $l_{M_1} > l_{M_2} > 0$  such that  $\bar{R} = l_{M_1} = i_{M_2} + l_{M_2} = \dots = i_{M_n} + l_{M_n}$ . The same calculations can, of course, be extended to include non-pecuniary liquidity yields rates (beyond that captured by the differing transaction costs) on all assets held by consumers, including consumer durables of all kinds.

While of course one can argue that the liquidity yield on houses, pantry stocks, will be low, the basic problem as has been shown is that such yields cannot be quantified yet must be considered as part of the service flow of the durables.<sup>26</sup>

## V. CONCLUSION

In this paper, I have discussed the problem of pricing consumer owned and used durables in a CPI. Owner-occupied houses have served as an illustration. I have shown that application of the service price approach—in all but trivial cases—leads to price movement of little or no meaning, which reflect primarily the movements of nominal rates and the expectations and actualities which determine such nominal rates and in a monetary economy biases the movements of the service prices of the durables towards movements of “the general price level” and, finally cannot—as illustrated when the service price approach is extended to “real money balances” held by consumers—price the non-pecuniary liquidity yields on consumer durables which must be considered as part of the service flow of the durables.

For my larger study for Statistics Canada, I have also outlined objections in principle to the construction of imputed market prices for activities which are chosen to be carried on outside the price system and have set out an alternative National Accounting framework in which price indexes for consumers can be set up on a current, capital, financial transaction and balance sheet accounts basis—an alternative framework better grounded in economic theory. In this paper, however, I have limited my remarks solely to difficulties confronting the imputed service price approach—difficulties so severe, in my judgment, as to suggest that statistical agencies ought *not* to incorporate the imputed service price approach to the pricing of the services of consumer owned-and-used durables in the CPI.

<sup>26</sup>The problem of pricing the services of “real” money balances held by consumers is, of course, part of the problem of the banking imputation in the National Accounts. Yet, it has not been sufficiently realized, given the general ubiquitousness of the financial intermediation activity in monetary economies, just how general the problem is in the construction of price and quantity indexes—as this section of the paper indicates.