COWLES FOUNDATION FOR RESEARCH IN ECONOMICS

AT YALE UNIVERSITY

Post Office Box 208281
New Haven, Connecticut 06520–8281

COWLES FOUNDATION DISCUSSION PAPER NO. 1179

Designing Indexed Units of Account

by

Robert J. Shiller

May 1998

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Abstract

An indexed unit of account is a unit of measurement defined using an index such as a consumer price index so that prices, wages or deferred payments defined in terms of these units will automatically adjust to changing economic conditions. Evidence on money illusion and sticky prices, and evidence from countries (notably Chile) that have created indexed units of account, suggests that creating such indexed units is an important policy option for governments in countries with unstable prices or incomes.

Choices for governments designing indexed units of account are discussed. Governments may choose to encourage the use of the units only for large long-deferred non-wage payments, or they may choose to go to the opposite extreme of encouraging the use of the units for defining all prices, wages and payments. A general equilibrium model is given that shows the dynamics of prices when all prices are expressed in the units. Governments may choose to link units to a consumer price index or to a *per capita* income index, and there may be advantages to creating both kinds of units simultaneously. Downward rigidity of real wages might be reduced if wages are denominated in base-income-indexed units of account, where base income is defined so that the growth rate in money value of the unit is biased down relative to actual *per capita* income growth. Examples of the units for United States are displayed and discussed.

Keywords: Indexation, escalator clause, cost of living allowance (COLA), monetized indexed units of account, base income, money illusion, sticky prices, fairness, unidad de fomento, Chile

*The author is indebted to Michael Bordo, David Hale, Robert Hall, Michael Krause, Gil Mehrez, Felipe Morandé, Andrew Powell, James Tobin and Salvador Valdés–Prieto for helpful comments and discussions.

The general public appears to have sufficient difficulty with indexation, with tying payments to indexes such as the consumer price index, that they will do so only in rare or extreme situations. Even in times of moderate to high inflation, most people will not purchase inflation-indexed debt, will not borrow with an indexed mortgage, will not agree to indexed alimony or child support payments and will not push hard for indexed rent or wage contracts. Prices of many items and wages tend to stay fixed in money terms for periods measured in months and even years, and this stickiness can cause unfortunate wealth redistributions in times of economic change. The stickiness is also, by many accounts, a factor that tends to increase the amplitude of business fluctuations.

The reasons for public resistance to indexation are varied (see Shiller 1997, and related work by Shafir Diamond and Tversky 1997). The problems appear to include that the public is not fully attentive to the potential uncertainty in future inflation, is not attentive to the income redistributions caused by unexpected inflation, that the public suffers mathematics anxiety in the use of mathematical formulas (indexation rules) in contracts, and that at some level the public habitually thinks in terms of units of money, as if these were the final measure of value.

The impact of these problems can be reduced if the government (or some other public agency) defines indexed units of account for use by the public in place of money, and if the public learns the habit of using these new units of measurement. In its most widely used form, as with the unidad de fomento (UF) in Chile today, an indexed unit of account is defined by a lagged interpolated consumer price index that is published daily. If a payment of x UFs is to be made, the payment is made in money in the amount of x times the lagged interpolated consumer price index for that day. Thus, defining a payment in terms of the units automatically indexes the payment to inflation. While the same result could be achieved merely by specifying an indexation formula in the contract for the payment, we have noted that the public will generally not do so.

The world outside Latin America has taken little notice of these indexed units of account, and there appear to be no scholarly articles that are devoted to understanding these units. Despite this lack of interest in them, it should be recognized that the indexed units of account are potentially very important. The widespread acceptance of the units of account in Chile is apparently an important reason why Chile's is the most fully-indexed economy in the world.

I will discuss here some options that the designers of the units have. Creators of indexed units of account will have to confront the question: which prices and deferred payments should ideally be expressed in the units and which not? One answer to this question, the Chilean answer, is that the units ought to be used only for substantial deferred payments excluding wages. Another possible answer is that one might want to encourage the use of the units for *all* prices, thereby "monetizing" the units, turning them into money in a sense, even though

they are not the medium of exchange. A model illustrating the workings of monetized indexed units of account is presented below.

Designers of indexed units of account will have also to decide which kind of index to tie them to. They may want to have a unit tied to the consumer price index as in Chile, or, alternatively, to a *per capita* income index, and they also may want to create both kinds of indexed units of account. Moreover, indexed units of account for use in defining rates of compensation may be tied to an index of "base income," so that the growth of the money value of the units is biased downward relative to the growth of *per capita* income. Then, when wages and salaries are expressed in the units, psychological resistance to real income cuts may be less of a problem.

I will illustrate both a consumer-price-index-linked unit of account and a base-income-linked unit of account with US data, and discuss how these will behave over time and over short-run business fluctuations.

The Chilean Experience with the Unidad de Fomento

The Chilean unidad de fomento was established in 1967, and its use became widespread in Chile in the early 1980s. The peso value of the UF, a daily interpolated lagged consumer price index, is published in Chilean newspapers every day, and the UF is upheld by the government and by the legal system as a unit of account for transactions. If one defines a payment in UFs, one must then execute the payment in pesos according to the value shown in the newspaper on the day the payment is made. People in Chile today will quote the price of houses for sale and of apartments for rent in UFs, and they specify mortgage payments, tax payments, and even child support and alimony payments in UFs. However, wages and prices of everyday items are still not defined in UFs.

The UF appears to be viewed in Chile as if it were a kind of money, although there are no UF coins or notes. Advertisements in newspapers feature UF-denominated prices prominently, without translating them into pesos. As further evidence that the UF is treated as if it were a kind of money, note also that prices denominated in UFs appear to have taken on some of the stickiness that we observe in prices denominated in money. UF prices in Chile tend to end in the numeral 9 much more often than the numeral 1.[1] This tendency suggests

[1]I checked whether this tendency is operative with the UF in Chile by counting the numbers of UF condominium prices by last digit (excluding trailing zeros) quoted in display advertisements (the larger advertisements, often including a photograph of an apartment building or graphic art) in the *Propriedades* (properties) section of the Sunday August 10, 1997 edition of the Santiago newspaper *El Mercurio*. There were 26 UF prices ending in 9, 16 in 8, 11 in 7, 9 in 6, 16 in 5, 4 in 4, 10 in 3, 8 in 2, and 6 in 1.

that people are conscious of the threshold when a price is increased so that the leading digit is changed, and this itself suggests some UF price stickiness. Research on money illusion (Shafir *et al.*, 1997), suggests there may be stickiness in prices in terms of whatever unit they are defined in.

It is often said that it would be better if the government could somehow guarantee that the real purchasing power of the money will remain constant, therefore obviating the need for the indexed unit of account. But no government has any way to guarantee that purchasing power will remain constant.

Four countries (Colombia, Ecuador, Mexico and Uruguay) have followed Chile's lead in establishing indexed units of account.[2] In the Uruguayan case the index is of wages, not consumer prices.

Should All Prices Be Quoted in Indexed Units of Account?

Which prices should be quoted in the indexed units of account? Jevons (1875) gave one possible answer; without mentioning the possibility of indexed units of account, he advocated automatic indexation of all contracts over three months' duration. On the assumption that inflation uncertainty over future time intervals of less than three months is likely to be inconsequential, one might defend this simple rule for its simplicity. A conservative principle of tinkering with the economy as little as possible might also lead us to something like Jevon's prescription.

In a sense Chile has adopted approximately Jevons' prescription, since UFs are used primarily for longer-term commitments. Most bank deposits in Chile have been 30-day peso deposits and 90-day UF deposits. But Chile has not adopted Jevons' advice with respect to wages, which are still denominated in pesos. Experience with labor negotiations has suggested to some observers that labor becomes more unyielding in terms of real wages if wages are indexed, and that the result can be that indexation promotes inflation. This consideration perhaps suggests that wages should not be defined in terms of indexed units of account. Below I will argue that this alleged inflationary bias might be reduced by defining a biased indexed unit of account for wage indexation.

As an alternative to these conservative views on dealing with indexation, it is important to recognize that there are arguments leading us the other way, towards tying *all* prices, wages, and payments to indexed units of account. There is no clear advantage to tying any payments to money, with its inherent uncertainty. There is no reason to complicate the

[2]In Brazil, the Unidade Real de Valor (URV) was a sort of indexed unit of account. In Venezuela, apartment rents are often expressed in units of "salarios minimos," the minimum wage.

decisions that the public has to make by keeping alive both the tradition of prices quoted in money and the option of prices quoted in terms of indexed units of account.

Even in the pricing of everyday items, there is some, albeit usually small, advantage to defining payments in indexed units of account. If, for example, one buys a television and returns it for a refund in two months, receiving the initial money value back, one may suffer a loss of a percent or more in situations with moderate inflation, and this would not happen if the price were set in indexed units of account. While, in examples like this one, the advantage to setting prices in terms of indexed units of account may be small, there seems to be no offsetting advantage to using money sometimes that would justify making the public have to deal with two kinds of prices, money prices for everyday items and indexed unit of account prices for deferred payments. Using the indexed units of account for all prices, wages, and payments establishes the presumption and habit that indexing will always be used, just as stopping at a red light even when there is no traffic coming in the cross street preserves the proper habit.

Monetized Indexed Units of Account

We could drive a system of indexed units of account to its extreme in which the indexed unit completely replaces money for price, wage, and other payment definition. People could carry debit cards that allow access to their account which is defined in terms of money. The individual need have no other encounters with money. When a purchase is made, the price can be rung up in terms of these units, and the computer can automatically translate the units price into a money price and debit that persons' account.

Credit cards and checking accounts might also allow payments to be specified in terms of the units. Then it is possible that money itself might eventually virtually disappear as a unit of account. Even the last strongholds of coin usage, the vending machines and newspaper stands, could be incorporated into an indexed unit of account debit card system with today's technology. We may say then that the units would be monetized, in the sense that the public may come to regard them almost as if they are money, since all transactions take place in these units, and they never see money. I use the term "monetized" even though the units are still not true money, as there is still a money that is the true medium of exchange.

Irving Fisher (1913) proposed that a new hand-to-hand currency, the compensated dollar, be created whose gold content was constantly adjusted so that its real buying power was constant. His proposal would in effect go even further than what I call here monetization, and maintain the indexed units of account as the medium of exchange as well as unit of account. His proposal received a great deal of public attention for some years, but was eventually mostly forgotten after it became clear that the chances that it would be implemented in any

country at all were very slim. It would appear that governments are less likely to accept his proposal, since the first step to implement it, the step of changing the currency itself, seems more radical than the first step of merely announcing an optional new unit of measurement, and, today, since there are no examples of actual use in any country of the compensated dollar. The use of indexed units of account for some prices at least is not such a radical idea, as is proven by the proliferation of these units already, and the creation of the indexed units of account for some uses might eventually lead to their monetization. Moreover, as regards Fisher's plan, there are some doubts that it could succeed, and today, in the age of computers and electronic communications, there is little need for his indexed hand-to-hand currency. For further discussion of his idea, see Shiller (1998).

Monetizing indexed units of account would represent a basic change to our economy, and, virtually eliminating money as we know it in pricing, could alter the dynamics of the economy in fundamental ways. Let us consider an example illustrating the operation of such a system of units.

The Workings of Monetized Indexed Units of Account

The idea of indexing all prices seems circular to some people. If all prices, other than the money price of the indexed unit of account itself, are indexed, they ask, then how can the government find out what is the money price of the indexed unit of account? What determines the change in value of the unit of account from month to month? The answer to this question has to do with a lag in the definition of the unit, so that the system is not simultaneous. The lag, given that some rigidity in prices defined in terms of the units is to be expected, also introduces potentially complicated dynamics to prices.

Let us consider a case where a unit of price (UP), based on the consumer price index, is used, and consider how a monetized indexed unit of account could then be defined. Let us for this example disregard the daily interpolation of monthly indices, and consider transactions at discrete intervals, so that the value of the unit of price is just the consumer price index lagged one period. The period might be a month, as it is today for consumer price index announcements. Someday the period might be less than a month, if the importance of the units is sufficient to warrant the extra data collection effort.

Even though all prices are in this example specified in terms of the indexed unit of account itself, the money value of the index can always be specified. Since all prices specified in terms of the indexed units of account are translatable immediately into money values based on the known value of the consumer price index last period, the ordinary consumer price index for dollar prices can always be computed. (This is the reason why it is possible to compute consumer price indices even today in countries using indexed units of account for some

prices.) If UP_t is the dollar value of the monetized indexed unit of account at time t and if $P_{UP,i,t}$ is the price of the ith good in terms of UPs at time t, then the consumer price index with base period at $t = base$ is at time t:

$$CPI_t = \frac{\sum_{i=1}^{n} a_i P_{UP,i,t} UP_t}{\sum_{i=1}^{n} a_i P_{UP,i,\text{base}} UP_{\text{base}}} = UP_{t+1} \qquad \textbf{(1)}$$

where a_i, $i = 1, ..., n$ are the weights in the market basket for each of the n goods, and $CPI_{\text{base}} = UP_{\text{base}+1} = 1$ by construction. All information on the right hand side is observable at time t, even if all prices are specified in terms of the indexed units of account.

If UP prices are relatively sticky, and are to remain relatively constant in the presence of aggregate inflation, one wonders how the dollar value of the indexed unit of account will change, defined as it is in terms of the UP prices. The answer is that the UP prices will not all remain constant during a transition period to the different dollar price level.

Let us consider a simple general equilibrium model of Blanchard and Fischer (1989), based on a monopolistic competition equilibrium theory of Blanchard and Kiyotaki (1987) and drawing on Dixit and Stiglitz (1977). The formal model in its simplest form has 2 producers, each producing a unique consumption good, and each of whom is also a consumer. The utility of the i-th producer–consumer, $i = 1,2$, depends positively on the consumption of both goods, positively on real money balances held, and negatively on the output of the i-th good. Since the utility is assumed to be CES in consumption, it yields simple log-linear demand and pricing equations. In accordance with their model we must also replace equation (1) with a loglinear indexation formula, and using lower case p for logs, taking both a_i equal to 1/2 and choosing a simple normalization this gives us, for the log dollar value up_t at time t of the unit of price:

$$up_t = \tfrac{1}{2} p_{1,t-1} + \tfrac{1}{2} p_{2,t-1} = \tfrac{1}{2}(p_{up,1,t-1} + up_{t-1}) + \tfrac{1}{2}(p_{up,2,t-1} + up_{t-1}). \qquad \textbf{(2)}$$

We begin here with the Blanchard–Fischer (1989, p. 391, eq. 14) derived equation for the utility-maximizing log price $p_{i,t}$, $i = 1,2$, of the i-th producer– consumer at time t, given the log price of the other producer–consumer, and given the log money supply m_t:

$$p_{1,t} = bp_{2,t} + (1 - b)m_t \quad \textbf{(3)}$$

$$p_{2,t} = bp_{1,t} + (1 - b)m_t . \quad \textbf{(4)}$$

Here, the parameter b is determined by utility function parameters, $0 < b < 1$. Each producer sets a price that responds positively to the competitor's price, and positively to the demand-shift variable, the money supply. Solving the two equations (3) and (4) for $p_{1,t}$ and $p_{2,t}$, we see that when both producers are profit maximizing, that is when prices are not sticky, both log prices equal m_t. Therefore, money shocks are neutral when prices are not sticky. For example, starting from an equilibrium with $m_0 = 0$ and both log prices equal to zero, a doubling of the money supply in time 1, changing m_1 to ln(2), immediately produces, when prices are not sticky, a doubling of all prices, and the relative prices are unchanged.

Blanchard and Fischer use a modification of this model to explore price dynamics under the assumption that $p_{1,t}$ is set for odd t by producer 1 and $p_{2,t}$ is set for even t by producer 2, so that half of prices are sticky, predetermined, in each period. For our purposes, concerned as we are with the lag built into equations (1) and (2), it will be easier just to assume that the price set by producer 2 is infinitely sticky, and remains forever at its initial value, determined either in money units or indexed units of account depending on which was used to define price. The assumption of fixed price for producer 2 is an extreme form of the assumption that the lag imposed by the stickiness in some prices is much longer than the lag built into equations (1) and (2), the lag in the reporting of the consumer price index. We will have to assume, of course, when considering sticky prices, that the price that is sticky in terms of indexed units of account is stuck at its nonsticky-price equilibrium value if we hope to see a system that converges on the nonsticky-price equilibrium.[3]

If, again starting from an equilibrium with m_t and both prices equal to zero, producer 2 sets a price that is sticky in money terms, setting $p_{2,t} = 0$ for all t, and producer 1 still behaves in an optimal, nonsticky way, then, from the model, $p_{1,t} = (1 - b)m_t$. If the money supply were to double between periods 0 and 1 as above, neither price would double, and in fact even the nonsticky price would less than double. Money is not neutral, and in the Blanchard–Fischer model positive money shocks would then would stimulate the real economy, stimulate them forever in this extreme case of perfect price stickiness for producer 2.

If producer 2 determines the UP price instead of the money price, setting $P_{UP,2,t} = 1$ for all

[3]Ideally, we should consider a model in which neither price is completely sticky, so that even the relatively sticky price adjusts eventually toward an optimum value. However, the dynamics of such models appear to be sufficiently complicated as to obscure the simple point I wish to make here.

t, thereby in effect setting $p_{2,t} = up_t$, then money will, in contrast to the above, be neutral in the long run. Again let us suppose that initially m_0 and both log prices equal zero, as would be the equilibrium if the m_t had always been zero for $t \leq 0$, and that the money stock will now change. With a now-sticky UP price for producer 2, equations (2) and (3) give us the two equation system:

$$up_t = \tfrac{1}{2}p_{1,t-1} + \tfrac{1}{2}up_{t-1} \quad \textbf{(5)}$$

$$p_{1,t} = b\,up_t + (1 - b)m_t \quad \textbf{(6)}$$

Solving for up_t, we find:

$$up_t = (1 - \rho)\sum_{k=0}^{\infty} \rho^k m_{t-k-1} \quad \textbf{(7)}$$

where $\rho = (1 + b)/2$, $1/2 < \rho < 1$, and $p_{1,t}$ is given by:

$$p_{1,t} = b(1 - \rho)\sum_{k=0}^{\infty} \rho^k m_{t-k-1} + (1 - b)m_t \quad \textbf{(8)}$$

It follows that the price set in terms of units of price for producer 1 is:

$$p_{UP,1,t} = (1 - b)\sum_{k=0}^{\infty} \rho^k \Delta m_{t-k} \quad \textbf{(9)}$$

where $\Delta m_t \equiv m_t - m_{t-1}$. Note now that a sort of overshooting in the UP price of the producer whose UP prices are not sticky enforces a move to a new equilibrium with higher up_t but both UP prices back again to their original values ($p_{up,i,t} = 0$). If the money supply is suddenly doubled (m_1 is increased from 0 to ln(2) as above and held there forever) then $p_{1,1}$ rises as much as it would in the case considered above where producer 1's price were sticky in money terms, that is, price less than doubles initially. Output is stimulated in the first period by exactly the amount in the case where the money price $p_{2,t}$ was sticky, but now gradually, $p_{1,t}$, $t > 1$, rises further, so that price eventually is doubled. In contrast, the UP (log) price $p_{UP,1,t}$, rises initially, and then declines exponentially back to its initial value. Eventually, both log UP prices are at their original values of zero and, because of the increase in up_t, money prices have doubled. Eventually, and in contrast to the sticky money supply example, output falls back to its original non-sticky-price value.

This transition to new equilibrium did not keep relative prices constant on the way to the new equilibrium, but it is not possible to achieve that if some prices are sticky. If b is not too large, the transition shown will produce nearly correct prices again within a few periods (months) of the change of the money supply. The presence of indexed units of account has functioned as a sort of automatic stabilizer, blunting the impact of sticky prices.

Note that the use of indexed units of account for all prices was not inflationary in this model; it did not produce a higher equilibrium price level up_t than in our nonsticky price level model. It was not inflationary since agents set the profit maximizing price, and this price is ultimately related to the money supply. Of course, inflationary outcomes might still be produced if we attached to the model a price-destabilizing monetary authority reaction function determining the money supply. We might also conceivably produce inflationary outcomes by adding some assumptions of irrational market psychology to the model. But there appears to be nothing intrinsic to defining all prices in terms of the units of account that is inflationary.

The dynamics of variants of models like the above could be the subject of further research, as they are potentially complicated. However, our incomplete understanding of such dynamics is not sufficiently worrisome that we should necessarily avoid monetized indexed units of account at this time. After all, with monetized indexed units of account, whatever happens to the price level, all contracts will be indexed. The risk of inflation amounts only to a risk of an increase in the usual welfare triangle costs of inflation, of the inconvenience of maintaining smaller money balances. The welfare triangle risks appear to be a small part of the cost of inflation, see Fischer and Modigliani (1978).

Alternative Indexes for Indexed Units of Account

It was noted above that the indexed unit of account in Chile is tied to a consumer price index while the indexed unit of account in use in Uruguay (there called the unidad reajustable, UR) is tied to a wage index. The Uruguayan UR is used both for social security payments and for government indexed bond payments, but is not as widely used as is the unidad de fomento in Chile. Even prior to the introduction of the UF in Chile, there was established there also an indexed unit of account also called the Unidad Reajustable (UR), introduced in 1960, that depended both on wages and prices. Although the Chilean UR was apparently not very successful, it is worth noting that after the introduction of the UF in 1967 Chile had two indexed units of account simultaneously, one tied to a consumer price index and one tied in part to a wage index. Apparently, constructors of indexed units of account have not found it easy and obvious to settle on a definition of the index.

A reason for defining a consumer-price-index-linked unit of account is that it seems

natural that prices of many items should remain relatively constant relative to an overall market basket, even when real incomes shift. If the prices expressed in the units are relatively constant through time, then people will find it easier to remember prices and do comparison shopping.

But, as has been discovered in Latin American countries where the consumer-price-indexed units of account are used, there may be problems if all contracts are denominated in consumer-price-indexed units of account. It is probably not ideal to keep the real value of social security payments or of salaries of employees fixed when aggregate incomes are changing (see Bohn, 1997; Shiller, 1998). Moreover, there were problems in using consumer-price-indexed units of account when individuals must make streams of payments in terms of the indexed units of account, contracts such as mortgages and alimony payments. People are sometimes caught in a difficult situation if the consumer price index rises more than incomes. Thus, it may be preferable to tie units of account to some index that is responsive to incomes. Many times, when there are payments to be made through time, the payments are best thought of as schemes of sharing income. While moral hazard reasons may prevent defining contracts in terms of a contractor's own income, it is certainly better in these cases to tie payments to aggregate income measures rather than to the consumer price index.

A measure of labor income, rather than total income, might have been used in defining the base income. But the use of labor income might have more destabilizing feedback effects on the level of wages if all wages are defined in the wage-indexed unit. If all wages were tied to a wage-indexed unit of account, that responded to aggregate wage levels with a lag, then, so long as wages in the units remained constant, the wage level would be determined entirely in terms of its own past values as defined by the formula for the indexed unit of account. Under these assumptions, if, when the system was established, there were an increase in wages, then this wage increase would be perpetuated forever. Of course, there is no reason to think that wages as measured by the indexed units of account need stay constant over long intervals of time, but still it seems perhaps undesirable to build in such a feedback loop. In contrast, if the units are defined in terms of total income, rather than labor income, then there is no feedback so long as changes in the labor share of income do not affect total income.[4]

[4]Conceptually superior indices, that are based on repeated measures of individuals' incomes through time, could be envisioned (see Shiller and Schneider, 1996).

Multiple Indexed Units of Account

The advantages of both kinds of indexed units of account, the consumer price index units and the income units, seem possibly strong enough that governments should try to create both.[5] If both are available, then it is reasonable to suppose that people will exercise simple common-sense judgment as to which to use in each situation.

Further indexed units of account might also be created, to allow the better sharing of risks across individuals. For example, there might be low- middle- and high income units, or occupational-income indexed units of account, or indexed units of account reflecting larger world-income aggregates. In the European Union, the rigidities imposed by the common currency, the Euro, might be reduced if individual countries define their own units in terms of country-specific consumer price indices and country-specific income indices.

When designing indexed units of account initially, it may be advantageous to a set of alternative units initially. Public acceptance of more than one indexed unit of account might not be significantly harder to achieve than public acceptance of only one, if all are defined initially and if the nature of their definition and publication suggests that they are equal possibilities for use in setting prices, wages or payments. Of course, there is not yet any example of the public's widely adopting more than one indexed unit of account at a time, and it is possibly too much to ask to expect them to acquire the habit of using more than one.

Biasing Income-Indexed Units of Account Downward Through Time

Income-indexed units of account that are tied to *per capita* income without adjustment will tend to show, in an advancing economy, a gradual uptrend through time in real buying power. There is a serious question whether we want to define units used for wage and salary indexation to show this uptrend in real buying power. I will argue that there are reasons to think that designers of the units of income should define the units of income in terms what is called here base income, whose growth rate is less than that of *per capita* income. The reasons for using base income rather than *per capita* income is to suggest a less ambitious standard or comparison for wage and salary definition.

The most important contract that people regularly make is the contract to sell their own labor, the contract that determines their own non-property income. It is thus extremely

[5]That there are advantages to both price indexing and wage indexing was apparently recognized by the US Treasury in 1996 when it proposed the first US indexed bonds; both the consumer price index and the employment cost index were mentioned as possible bases for the indexation, and public discussion was sought on which to choose.

important to determine the optimal units in which to write such contracts. This is true whether or not the labor contract is explicit, as with collective bargaining contracts, or implicit, as just an informal agreement between an employer and employee. In either case, the real wages paid through time are likely to be affected by the indexed unit of account if such an account is established and its use encouraged.

Usually, these labor income contracts are contracts between individuals, the employees, and larger institutions. The psychological stance of individuals who sell labor, rather than of institutions who buy labor, is of great importance. Organizations are less likely to be influenced by emotional issues with the contracts than are the individuals.

It is extremely important to individuals' sense of self esteem and sense of fair play that their labor contracts can be viewed as recognizing their achievements, and part of a sense of a continuing sense of achievement is a sense that one is improving through time. It is thus important that people perceive their incomes as growing through time in terms of the units of measurement for incomes.

Psychologists have long noted that self-esteem tends to come from comparing oneself with others. William James (1890) argued that one's very sense of personal identity seems to be defined by comparison with others: the self is a "social self." The comparisons people make of themselves with others was studied by Hyman (1942), by interviewing people and asking them about these comparisons. While he found a great deal of individual variation across people in terms of the salience of such comparisons (some people resisted his questions, denying that they compared themselves with others), the great majority had a lot to say about how and with whom they compare themselves. He was struck that very few compared themselves with society as a whole, and he coined the term "reference group" for the group of people that people choose to compare themselves with. The choice of reference group (or reference individuals) seems to be somewhat arbitrary, but he concluded that:

> The reference individuals in many cases are chosen by virtue of similarity to the subject, proximity to him in life situation or as the result of objective facts which facilitate such comparison (p. 27).

Reference individuals are often chosen, Hyman found, as "aspiration points," as ideals that one sets for oneself. Thus, for example, a professor of psychology compares himself with Pavlov or Helmholtz, while a nurse compares herself with a very competent nurse where she works.

Festinger (1942), studying the determination of aspiration levels, defined an important principle that people tend to raise their aspiration levels (and thus change their reference individuals) if they perform better and lower them if they perform less well. (For further discussion, see Suls, 1977.) But, in many cases comparisons and aspiration levels must still

be determined stably by convenience and salience. One cannot compare oneself with others that one has no information about, as Hyman pointed out. Thus, the standards of comparison may tend to stay fixed if the information with which to make other comparisons is not readily available. This is why it is reasonable to suppose that units of measurement may themselves influence the mode of comparison.

People appear to be very influenced by the change in their money wage, it being so visible and tangible to them, and often in relative disregard of the change in their real wage. Kahneman, Knetsch and Thaler (1986) documented that feelings of the fairness of wage changes are affected by the appearance of the change in money units even when the change in real wages is held constant. They posed to their subjects the following scenario:

> A company is making a small profit. It is located in a community experiencing a recession with substantial unemployment but no inflation. There are many workers anxious to work at the company. The company decides to decrease wages and salaries 7% this year.

Only 38% of respondents thought that the company's behavior was acceptable, 62% thought it was unfair. They posed to another group of subjects the same scenario with the following changes:

> ...with substantial unemployment and inflation of 12%....The company decides to increase salaries only 5% this year.

Now, 78% thought that the companies behavior was acceptable, only 22% thought it was unfair, even though the scenario was the same in real terms (Kahneman, Knetsch and Thaler, 1986, p. 731; see also Shafir, Diamond and Tversky, 1997).

The money illusion documented by these researchers will likely extend to a similar illusion in terms of any newer units in which income is measured, unit illusion. It is thus important that people should see their income increasing through time in these units.

Will the people on incomes that do not increase in terms of units of income eventually conclude that the disguising of the real income decline is in a sense a deliberate illusion, and thus lose the psychological benefit of the less ambitious standard of comparison of the base income units? I think probably not, at least not fully. Surely, if both units of income and units of price are in use, these people will note that their incomes translated into the units of price are declining. But noticing this is hardly different from noticing that incomes may not be keeping up with inflation today, and we have seen that people do not appear to react to the implied declines in real incomes as much as they do to nominal income cuts. Even those workers who fully understand that their real wage is declining may appreciate not seeing "in-your-face" documentation of the decline on their pay stubs.

Akerlof, Dickens and Perry (1996) have shown that people rarely if ever experience nominal wage decreases within the same job. Apparently because of an irrational fixation on income as measured in dollars, people feel that a wage decrease measured in dollars is a terrible affront, an insult, see Bewley (1997). Such wage decreases are thus largely confined to disciplinary situations, situations in which the manager wishes to make a strong, aggressive or angry point to some workers, or to situations in which the company is in serious risk of bankruptcy and can ask the workers' understanding. On the other hand, workers seem to accept almost without notice declines in real wages caused by wage increases failing to keep up with inflation.

If people cannot be given pay cuts within a job, then employers' natural alternative, when they are no longer so productive, is to terminate them. A possibly important reason why retirement age cutoffs have been imposed in the past has been that it is difficult to cut the nominal pay of older workers. In this time of lower inflation in most countries of the world, when money illusion offers less help in disguising real wage decreases, the problem that has caused earlier forced retirement may be more severe.

Friedman (1997) has argued from historical evidence that when populations of people do not perceive their incomes as growing through time, that morale problems have profound problems for nations' political atmosphere. When incomes are not perceived as growing, political movements that are intolerant or scapegoating of minorities become prevalent. While defining units of account so that the incomes appear to be growing is likely to have only a minor impact on such perceptions, the problems Friedman alludes to are so important that they must stand as another reason to create the biased units.

It is important that the units not be described to the public as biased units relative to *per capita* income, since we do not want to frame *per capita* income as the point of comparison. The units can instead be described as tied to base income which would be constructed so that its increases can be taken to represent, by some approximation, the basic level of income increases that an employee who is not reinvesting any of the income in further human capital can expect. The standard for such level could be set so that most people will receive fairly regular wage or salary increases relative to base income, just as people receive bonuses and benefits on top of their base salary.

How should we compute base income? Ideally we would define an objective way of measuring the income of people who are not investing in human capital for income growth. Failing that, we may just deliberately transform a *per capita* income series to produce base income. One gauge might be had by looking at the lifetime income profile of people. Most people's income follows a hump-shaped pattern over their life cycle, rising through time through middle age and gradually declining, relative to others, afterwards. The rising side of the hump might possibly be viewed as representing the improved performance of young people as they acquire

skills. At this stage of the life cycle, people are more likely to be investing in human capital. The rate of decline on the declining side of the hump might be taken as an indicator, at least in part, of the rate of real income decrease people can expect who do not make serious efforts to improve their human capital. The decline in income after middle age is found not only in occupations involving physical ability, but also in jobs whose exertions are primarily mental. While the notion of "serious effort" is vague, the rate of decline of the hump after middle age might be a concrete standard on which to base the definition of base income.

Carroll and Summers (1991), using data from the 1960 and 1972 Consumer Expenditure Surveys of the US Bureau of Labor Statistics, show, with cross-sectional data, that for most occupations lifetime real income peaks around the ages of 45 to 49, and then declines from about 1% to 2% a year after that, for a cumulative 15-year decline of about 15% to 25%. Because these results are obtained using cross-section age-income profiles at points of time, it would appear that if we tracked an individual through time, we might expect to find that individual real income grows 1% to 2% a year less fast between these ages than aggregate per capita real income, which has been about 2% a year historically. Thus, under these assumptions, many people may tend to see their real income grow well under 2% a year or not at all between these ages, but not to suffer a decline. Base income might be defined to have a slightly larger downward drift through time relative to *per capita* income, so that there is some latitude for employers to reduce wages further without actually announcing a cut in wages.

If wages and salaries are denominated directly in the units of base income, then the money value of these wages and salaries will tend to decline almost immediately in times of recession. Of course, units of measurement do not dictate outcomes, and employers might frustrate this implication of the units of income by defining labor contracts that prevent such sudden wage declines, even if incomes are otherwise defined in terms of base income. But it is plausible to suppose that the natural consequence of the adoption of the units of income for labor contracts would be that the money value of wages and salaries would decline temporarily in recessions.

If such wage and salary cuts are done as an automatic consequence of a system of indexed units of accounts, then it may seem much more acceptable to employees. This is particularly so since it will be known that the sudden cuts in real incomes are a consequence of the recession. Bewley concludes that wage cuts can at times be justified to employees if the justification is given in terms of "necessity, the long-term interest of those affected, or universal principles of justice" (Bewley, 1997, ch. 13, p. 22; see also Campbell and Kamlani, 1996.) Since the units of base income reflect shares in personal income *per capita*, there is an element of fairness in their definition that will encourage adoption of labor contracts in their terms.

Indexed Units of Account for the United States

Figure 1 shows the path of the dollar value of two indexed units of account for the United States through time, monthly from 1947 to 1997.[6] The dollar value of the unit of price UP is just a one-month-lagged CPI-U. The dollar value of the unit of (base) income UI is the one-month lagged per capita personal income, biased downward at the rate of 0.35% a month, or about 4.3% a year. The dollar value of the UP shows a simple, smooth path over this time period, but the dollar value of the UI shows short-run declines at times of recessions.

The real buying power of the UI, as shown in Figure 2, displays sharp declines at times of recessions. If wages and salaries are sticky in terms of units of income, then these declines in the real buying power of the UI might have been big enough at times of recession to have a significant impact on reducing unemployment. In this historical sample, employers who set salaries in terms of units of income would have been able to impose real wage declines in recessions often exceeding 5% to 10% in the span of a couple of years, without cutting wages in terms of the units. Of course, if *all* employers did this, then the *per capita* personal income would not be the same as it was historically. Further modeling would be necessary to assess the effects on incomes of the adoption of the units of account. As an example of what might be learned, note that from the simulation model of Akerlof, Dickens and Perry (1996) the adoption of the UI for wage and salary setting would result in the elimination of the long-run Phillips curve (see Akerlof, Dickens and Perry, 1996, pp. 22–36).

Are the nominal wage and salary declines during recessions that would be created by defining wages and salaries in terms of the UI optimal? We would have to agree on a model of the business cycle to answer this question. In any event, complicated definitions of the units of income may not be acceptable to the general public, or even comprehensible. There is a natural logic to tying wages and salaries to base income, and a natural appearance of fairness. The question is perhaps not whether this indexation scheme is optimal, but whether it is better than tying wages to money or setting incomes in terms of units of price.

The real UI shown in Figure 2 has a slow downward trend to it. By comparison with the lifetime income profile data described above, the downward bias of 4.3% a year imposed on the base income relative to *per capita* might appear to be excessive: with a real aggregate *per capita* income growth of about 2% a year, a person whose income stayed constant in terms of this unit would tend to see real income declining at over 2% a year. But we would expect most employers to give regular raises in terms of the unit of income. With the UI, many people would see raises in terms the real income units of about 2% a year, which would tend to result for them in real buying power that is approximately constant through time. Weaker

[6]The data are available on my web site **http://www.econ.yale.edu/~shiller/uf-usa4.html**

workers might see their income in terms of the real income units increase only 1% per year, which would mean that real incomes are actually falling, for something like a 15% real decline in 15 years. Some of the weakest workers, who get no pay increase in terms of the UI, could see their pay real salary decline by on the order of 30% in 15 years without suffering the humiliation of a decline in pay in terms of the units of income. Thus, the adoption of these units of base income for wage and salary setting would encourage considerable flexibility in the long-term trend in real incomes, reducing the effects of sticky wages.

Concluding Remarks

I have argued here that adopting some form of indexed units of account could have profound effects on the economy. It would tend to reduce random interpersonal real shocks currently caused by unanticipated inflation, reduce the need for layoffs or early retirements due to sticky wages, reduce the effects on the macroeconomy of sticky prices, and allow better sharing of income risks. The adoption of indexed units of account has been a successful movement in Latin America, and there is reason to suggest the adoption of such units in other countries. Perhaps this should be done with some of the changes discussed here: the adoption of multiple units, the biasing downward of the growth of the income units, and the monetization of these units so that their integration into the economy is complete.

The choices that must be made in designing the indexed units of account are fundamental and in some ways difficult. While the costs for governments to create indexed units of account appear to be extremely low relative to the potential benefits of doing so, it is important to work out all issues related to the indexed units of account before adopting them. The point of creating indexed units of account is to encourage better habits of price setting. Since we are dealing with difficult-to-change human habits, it is best to get the system right from the beginning and not to have to change it later.

This paper has not settled all the issues relevant to the design of indexed units of account, and more research would be helpful. Indeed, much of monetary theory needs to be reworked to consider all the impacts of the change that the extensive adoption of these units for definition of payments would entail.

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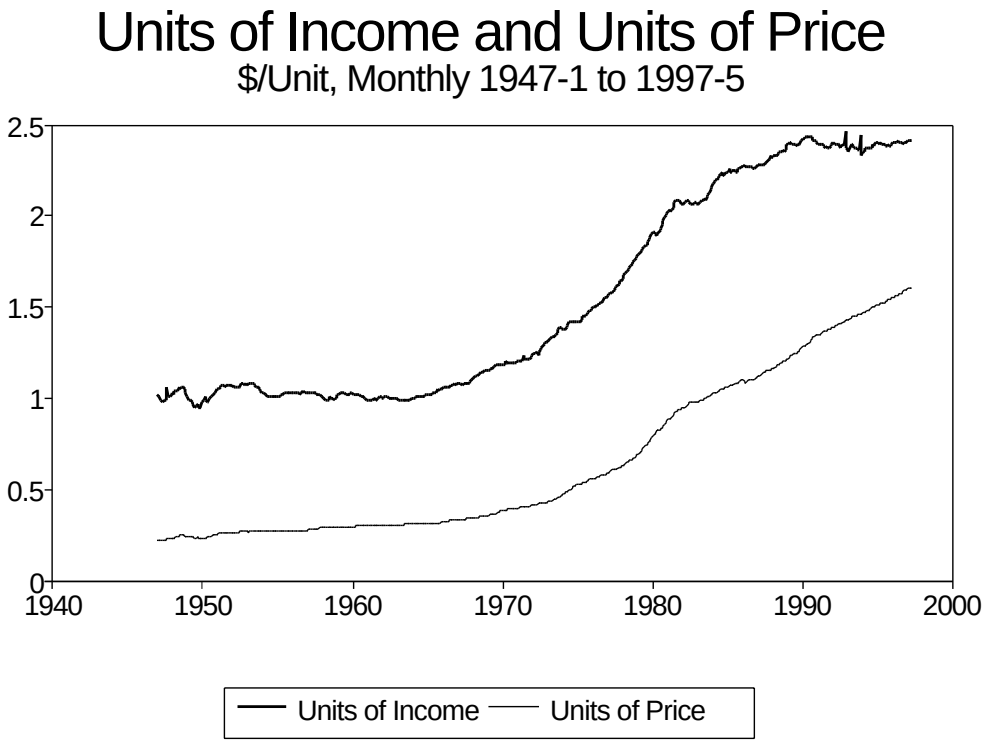

Figure 1. Dollar value of units of income and units of price in the United States.

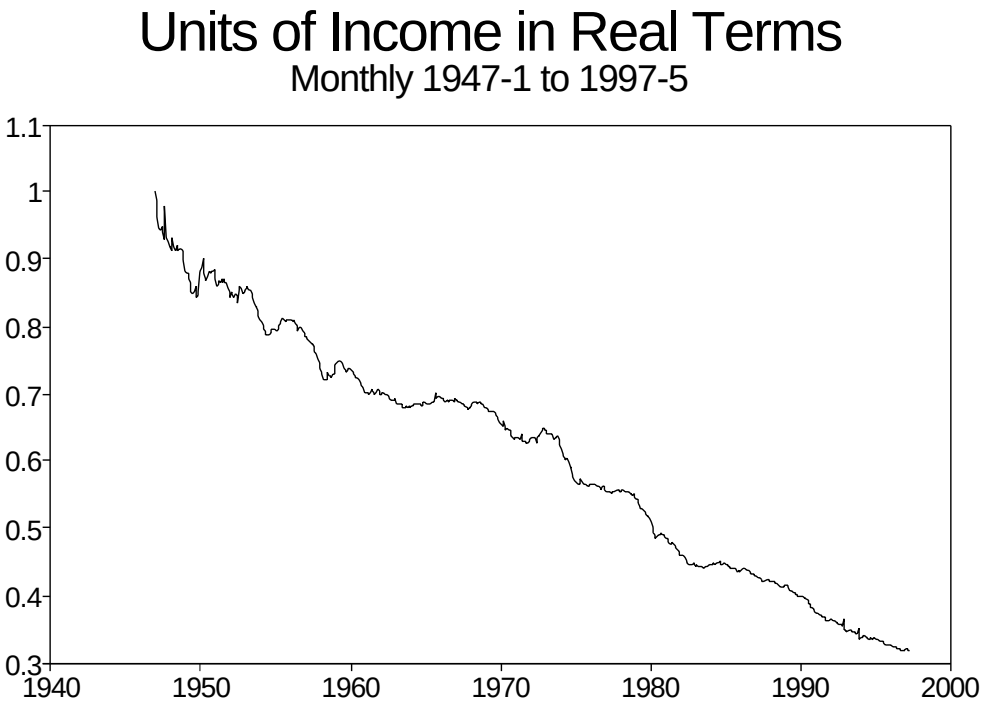

Figure 2. Real value of unit of income, the dollar value of the unit of income divided by the consumer price index, rescaled to 1.00 in 1947–1