

Indexing the Federal Tax System: A Cost-of-Living Approach

Robert Gillingham and John S. Greenlees

U.S. Department of the Treasury, Office of the Assistant Secretary for Economic Policy,
Washington, DC 20220

In this article, we analyze the indexation of federal taxes, using an approach based on cost-of-living measurement. We use our Tax and Price Index methodology and data base to study an indexed system historically, comparing indexation with the Consumer Price Index (CPI) to actual tax policy, a tax system with constant parameters, and an "exact" indexing scheme. We reach three main conclusions: (a) The sequence of tax reductions implemented between 1967 and 1985 have fallen short of mimicking indexation, (b) wealthier households would have benefited relatively more than lower-income households from indexation, and (c) CPI indexation would not have completely eliminated bracket creep.

KEY WORDS: Price indexation; Tax burden; Tax equity; Tax policy.

1. INTRODUCTION

The 1981 Economic Recovery Tax Act (ERTA) included rules for automatically adjusting the individual-income-tax system for inflation, effective in tax years starting in 1985. Previously, periodic amendments had offset the effects of inflation—the phenomenon commonly referred to as "bracket creep"—and incorporated other changes in policy. ERTA stipulated that certain nominal quantities in the Internal Revenue Code—personal exemptions, standard deductions (or zero bracket amounts), and bracket widths—be increased each year by the percentage change in the Consumer Price Index (CPI). The Tax Reform Act (TRA) of 1986 made certain specific changes for 1987 and 1988 but reaffirmed indexing for years beginning in 1989.

In this article, we examine the issue of tax indexation from a historical, household perspective. We specify and simulate four alternative tax-rate policies. The first three are straightforward—(a) the actual, observed system; (b) a system with constant parameters set at the 1973 historical values; and (c) a system like that of 1973 but with indexation to the CPI in other years. An indexation program—using the CPI or any other index—is a compromise between the desire to achieve a conceptual objective and the practical requirements for implementation. As we shall show, indexation with the CPI will not, in general, satisfy the objective specified in ERTA. To evaluate how CPI indexation might differ from a more rigorously defined scheme, our fourth alternative policy simulates criteria that, we believe, do satisfy the goals of ERTA. Our simulations compare the impacts of all four tax policies on individual household tax bills and cost-of-living indexes for the period 1967–1985.

The development of a Tax and Price Index (TPI) methodology and data base at the U.S. Bureau of Labor

Statistics makes this type of examination possible. The TPI is a more broadly defined CPI, useful for many purposes because of its inclusion of direct taxes—federal, state, and local income taxes, along with Social Security contributions—in the cost of living. In an earlier article (Gillingham and Greenlees 1987), we presented historical TPI series. Here we show how alternative, hypothetical tax structures would alter the TPI. We demonstrate that, on average, actual federal tax policy over the period 1967–1985—that is, rate reductions, exemption increases, credits, and so forth—raised tax burdens relative to those that would have prevailed under indexation. We also show how households with lower standards of living fared better under historical tax policy, whereas wealthier groups would have been substantially better off under indexation. Finally, we demonstrate that CPI indexation would have eliminated most, but not all, of the historical bracket creep.

2. THE TPI METHODOLOGY

The essential construct in our analysis is that of gross consumption cost. This is the total that we index in our TPI approximation to what Pollak (1989) called an income cost-of-living index. The traditional, or expenditure, cost-of-living index measures changes in the market expenditures necessary to achieve a given level of satisfaction. The U.S. CPI is a Laspeyres bound to an expenditure cost-of-living index, measuring the cost of a fixed market basket of goods and services. By contrast, an income cost-of-living index is essentially an index of the income, before taxes, that a consumer must receive to reach a given utility level. It incorporates into the cost of living direct taxes as well as the sales and other indirect taxes already included in the CPI. For many of the uses to which the CPI is put, such as wage

escalation and deflation of income, an income rather than an expenditure focus may be more reasonable. An income focus is also an appropriate measure for our present purposes—namely, the consideration of the impact of indexation and other tax policies on the cost of living.

To make these ideas more precise, consider two column vectors of goods, x and z . Vector x corresponds to the usual set of consumption goods but also includes real savings. Vector z represents other, nonconsumption goods for which current expenditures are incurred, such as employee business expenses, asset-management fees, and mortgage-interest payments. Let p_x and p_z be row price vectors corresponding to the two goods vectors, and let p refer to the combination of the two price vectors; that is, $p = (p_x, p_z)$.

We treat the purchase levels of z as conditioning variables in the function relating consumer utility to consumption of x , as given by $U = u(x; z)$. Following Gillingham and Greenlees (1987), this treatment abstracts from intertemporal aspects of utility maximization by focusing on preferences over x conditional on z and (implicitly) on all future consumption of market and nonmarket goods, as well as the current levels of nonmarket goods. Our treatment of real saving as a current-period good, following Pollak (1989) and Howe (1975), is a simplifying assumption. Although we take future consumption as given, we treat as a current choice variable the quantity of current consumption foregone to finance future consumption. In this treatment, the price of saving is therefore the price of current consumption and not, for instance, the interest rate. Given that the price of saving is an index of the prices of the other goods in x , however, the alternative treatment of real saving as an element of z would only change the weight of current consumption in the indexes we derive and would not change any of our qualitative results.

The level of direct taxes T is determined by the level of gross income Y , as well as by x and z , owing to the deductibility of certain expenditure categories:

$$T = t(Y, p, x, z). \quad (1)$$

Next, we define a function τ , which yields the tax burden implicitly associated with a given pattern of prices and purchase levels. It is obtained by solving

$$\tau(p, t, x, z) = t(p_x x + p_z z + \tau(p, t, x, z), p, x, z). \quad (2)$$

Put another way, τ is the amount of tax that would be paid on the minimum income sufficient both to pay that tax and to fund the specified purchases of x and z . Our fixed-weight index, which we will refer to as the TPI, is then defined as

$$\text{TPI}(p^c, p^r, t^c, t^r, x, z) = \frac{p_x^c x + t(p_x^c, t^c, x, z)}{p_x^r x + t(p_x^r, t^r, x, z)}, \quad (3)$$

where the superscripts c and r indicate price vectors and tax functions in comparison and reference situations, respectively. This TPI is a fixed-weight upper bound to a true income cost-of-living index, which holds constant the level of $U(x; z)$ rather than x itself.

Notice that the purchase levels of z are not included in the numerator or denominator of Equation (3). This is because our goal is to index the cost of consumption, when that cost includes direct taxes. We will use the term *gross consumption cost* to represent the sum of direct consumption expenditure $p_x x$ and taxes τ . We must recognize the presence of investment carrying costs and other nonconsumption expenditures to reflect accurately the tax structure. They should be excluded from the cost aggregate being indexed, however, to retain a consistency with received cost-of-living measurement theory. We do not wish changes in p_z to impact the TPI except insofar as they affect current tax liabilities. If, however, an element of x is mistakenly included in z —or vice versa—the error in the estimated index will be small unless expenditure on the good is very large or its relative price changes drastically.

Note also that, in contrast to a CPI, a TPI must be defined for a specific income source or mix of income sources. Since, for example, wage income and interest income are often taxed at different rates, the required before-tax income for a given consumption market basket depends on whether that income is received through wages or through interest. In our work, we confine our attention to what the tax code calls “earned income.” Therefore, our conclusions regarding the relative effects of alternative tax scenarios apply strictly only to individuals and families whose income is from wages and self-employment.

Finally, the TPI, like the CPI, is a conditional cost-of-living index; it measures the cost of market goods (including those sold by governments, such as postage stamps and bridge tolls) and, like the CPI, should be interpreted as conditional on all other factors affecting household utility. Those factors include, *inter alia*, such public goods as air quality, public safety, and national defense. In effect, we assume that the availability and quality of public goods does not vary over time, though we need not specify any particular levels. As Pollak (1989) noted, “under this assumption government goods and services can be absorbed into the parameters of the utility function” (p. 199). In this context, it is important to distinguish between measures of public goods, which affect utility directly and on which our indexes are conditional, and measures of government activity. When increases in taxes are used to increase the level of public goods—and not to cover the increased costs of attaining a given level—both the CPI and the TPI will overstate the increase in the unconditional cost of living.

The relationship between Social Security contributions and real Social Security wealth is a potential cause of such an overstatement. If taxpayers get a direct re-

turn for increases in their Social Security contributions in the form of increased real future benefits, this return should be treated as saving. We believe that the relationship between contributions and the value of benefits is sufficiently tenuous, however, to justify treating these contributions as a tax. [Treating Federal Insurance Contributions Act (FICA) contributions as saving would shift their base period weight into the saving component, which is indexed by the price of consumption goods in constructing the TPI. Since FICA contributions increased more rapidly than direct consumption costs during our sample period, this treatment would reduce the difference between the TPI and the CPI.]

In general, there is no reason to believe that the case in which increased taxes finance higher levels of public goods is more likely than that in which public-good levels (pollution, congestion, etc.) deteriorate. In the latter case, both conditional indexes understate changes in the unconditional cost of living. Furthermore, the CPI has the important disadvantage relative to the TPI that it is sensitive to the mix of taxes even in the absence of either a tax or public-good change. In any event, however, the purpose of this article is to compare tax components of the cost of living under alternative tax-schedule scenarios. For this purpose, the conditionality assumption does not play a critical role.

3. CHOICE OF INDEXATION FORMULA

The justification for tax-schedule indexation stems from the bracket creep induced by the interaction of inflation and a progressive rate structure. The choice of an appropriate inflation measure, however, requires that the purpose of indexation be more precisely specified. For example, if the goal were to maintain federal revenues as a proportion of national income, the correct indexation factor would logically be based on the rate of change in nominal incomes. If instead the goal were to hold constant the real purchasing power of federal revenues, the indexation factor would depend on changes in the relative prices of the goods and services purchased either directly or indirectly by the government. Congress's official justification for ERTA's indexing provisions stops short of providing a clear objective:

Indexing will prevent inflation from increasing that percentage [i.e., tax as a percentage of income] and thus will avoid the past pattern of inequitable, unlegislated tax increases and induced spending. (U.S. Congress 1981, p. 38, brackets added)

The preceding quotation asserts that, absent of changes in real income, indexation by the CPI will hold constant the ratio of federal tax revenues to income. We feel that this (mistaken) conclusion stems from an incomplete understanding of the interrelationships among three indexes—the CPI, the TPI, and the series used to index the tax system. As we shall demonstrate, historical indexation by the CPI would have failed to achieve the stated objective. Moreover, it is easy to see

that, except under the simplest of expenditure and tax structures, CPI indexation cannot maintain a specified federal tax share of constant-utility income.

To demonstrate a case in which CPI indexation will maintain the federal tax share, assume a simple system in which there are only two components of expenditure, consumption goods and federal taxes. In this case, CPI indexation amounts to adjusting the rate brackets by a global index of prices, and an individual whose income rises by that same index will continue to afford the same bundle of goods. The TPI thus equals the CPI. However, this convenient result requires the absence of, *inter alia*, (a) tax-deductible consumption items, such as medical care; (b) implicit income sources, such as owner-occupied housing, that are not subject to taxation; (c) expenditure categories, such as consumer interest, that are outside the scope of the CPI; and (d) tax components other than federal income tax that may not move proportionally to the CPI. In effect, a necessary condition for changes in the TPI to equal changes in the CPI is that all levels of the tax structure treat all expenditure items symmetrically. Otherwise, unless there is no relative price variation, the federal tax share will fluctuate.

Since there is no apparent conceptual rationale for indexation by the CPI, in this section we consider how one might frame a reasonable indexation rule. There are three obvious objectives which might be considered: (a) indexation that fixes the ratio of federal taxes to consumption costs—that is, that holds constant what we have called the “federal tax premium” (Gillingham and Greenlees 1987, p. 788); (b) indexation that fixes the ratio of federal taxes to total income—the objective put forward by Congress; or (c) indexation that fixes the ratio of federal taxes plus tax subsidies on deductible expenditures to total income. Assuming constant real income and either a single-level tax system or a multilevel system with coordinated indexation, the first two options are equivalent and result in the equality of the TPI and the CPI—although the system is *not* indexed by the CPI—but the third results in indexation by the TPI, which is not, in this case, equal to the CPI. Depending on one's view of tax subsidies, any of these options can be viewed as satisfying a reasonable objective. Indexation by the CPI, on the other hand, makes the ratio of federal income taxes to either income or consumption expenditure a seemingly arbitrary function of the relative movements of deductible and non-deductible expenditures.

To compare a more rigorous indexation scheme to the procedure enacted in ERTA, we implement the first of these alternative indexation rules—along with CPI indexation—in the simulations to be presented. Consequently, we compute an indexation factor such that federal taxes increase at the same rate as the CPI, and thus the federal tax burden is a constant percentage of before-tax consumption costs. For expositional purposes, we refer to this procedure as exact indexation,

although, as we have pointed out, it is only one of at least three exact rules. We discuss the alternative rules defined previously in the Appendix, which also presents a computational framework that can incorporate a wide variety of indexation objectives and discusses the implications of coordinating the indexation of all types of taxes.

In constructing the exact indexation factors, we assume that the federal rate brackets, the zero bracket amount, and the personal exemption would all be indexed. Using the sample of individual households to be described, we solved for the factors that held the ratio of *aggregate* federal taxes to *aggregate* consumption expenditures constant. It is important to recognize that exact indexation is not devoid of distributional effects. As with CPI indexation, any rule that uses an average index will not keep the ratio of federal taxes to consumption expenditures constant at the individual-taxpayer level. (Note also that, given the block rate structure of our tax system, a solution to the exact indexation problem at the individual-taxpayer level is not guaranteed.)

In Table 1, we contrast these exact factors for each sample year with percentage changes in our constructed measure of consumer prices (for simplicity we will refer to these as CPI indexation factors, although they were constructed as part of the TPI and differ slightly from the official CPI). In every year except 1982, the adjustments in the second column exceed the changes in the CPI. In particular, in 1973, 1974, 1979, and 1981, the difference is approximately two percentage points. These were all years of major increases in Social Security rates. For the entire 18-year period, exact indexation would amount to 241%, again compared to a 197% indexation based on the CPI.

Table 1. CPI and "Exact" Indexation Factors, 1968–1985

Year	Percentage adjustment	
	CPI indexation	"Exact" indexation
1968	3.6	4.8
1969	4.2	5.2
1970	4.7	4.8
1971	4.3	4.9
1972	3.0	3.9
1973	6.4	8.6
1974	10.5	12.5
1975	8.1	8.8
1976	5.8	6.2
1977	6.4	6.5
1978	7.0	7.4
1979	10.1	12.0
1980	11.5	12.2
1981	9.5	11.5
1982	5.9	5.8
1983	4.0	4.2
1984	4.2	4.6
1985	3.4	3.8
Annual average	6.2	7.1

4. INDEX SIMULATION

We carried out our analysis at the individual-household level, using a sample of 7,242 consumer units taken from the 1972–1973 Consumer Expenditure Survey. This survey fell within the time period of our analysis and formed the expenditure basis for the CPI from 1977–1986. (A later survey, with smaller sample sizes, was initiated in 1981 but was not incorporated into the CPI—and was not generally available—until 1987.) We computed tax liability at the individual-household level through iterative solution of Equation (2), with locational (for state and local taxes), demographic, expenditure, and saving data as determinants of the tax function. This microlevel focus, made necessary by the nonlinearity of the tax structure, is convenient for subsequent analysis, since it permits presentation of index series for subpopulations of interest. We consider three categories of direct tax—Social Security, state and local, and federal—in our analysis. Each had a unique pattern of development over our 1967–1985 study period.

The Social Security contributions rate has risen steadily and rapidly. In 1967, the rate for wage and salary workers was 4.4% of earnings below a ceiling of \$6,600. By 1985, the ceiling income had reached \$39,600, and the employee contributions rate was 7.05%. Self-employed individuals are subject to the same ceiling but contribute at a higher percentage rate, which rose from 6.4 in 1967 to 11.8 in 1985.

On average, state and local income taxes have also displayed rapid growth. This is primarily due to the introduction of income taxes by several large states in early years—Michigan in 1967, Illinois in 1969, Pennsylvania in 1971, and Ohio in 1972. More recently, several states have begun to index their rate schedules to some measure of inflation.

By contrast with the other categories, the federal system has been characterized by a series of decreases in nominal tax rates. For example, the standard deduction and the value of an exemption have been increased several times. A surcharge was introduced in 1968 and lifted two years later. Credits for low-income earners and for the elderly were instituted in 1975 and 1976, respectively. The first major rate reduction occurred, for single taxpayers, in 1971. At the same time, the maximum tax rate on earned income was reduced from 70% to 60%, it was further lowered to 50% in 1972. Later, general rate reductions occurred in 1979 and, under ERTA, in 1981, 1982, 1983, and 1984.

To place this pattern of federal tax changes in context, we simulated three hypothetical tax policies. Specifically, we simulated tax liabilities for 1967–1985 under a constant federal system identical to that of 1973 and the 1973 system indexed to two alternative inflation factors—the percentage change in the CPI and our exact indexation factor. [Sunley and Pechman (1976) also simulated CPI indexation for the 1960–1975 period using substantially different data and methodology.]

Table 2. Gross Consumption Cost Series, 1967–1985

Year	Tax policy (\$)				Direct cost
	Actual	Constant	CPI indexation	"Exact" indexation	
1967	10,540	10,282	10,604	10,953	8,702
1968	11,216	10,756	11,051	11,352	9,019
1969	11,893	11,322	11,576	11,832	9,400
1970	12,253	11,917	12,117	12,385	9,840
1971	12,703	12,556	12,701	12,923	10,267
1972	13,068	13,068	13,170	13,316	10,579
1973	14,164	14,164	14,164	14,164	11,253
1974	15,963	15,963	15,751	15,644	12,429
1975	17,288	17,499	17,074	16,917	13,440
1976	18,394	18,729	18,120	17,898	14,220
1977	19,722	20,160	19,317	19,048	15,133
1978	21,439	21,889	20,745	20,378	16,190
1979	23,812	24,730	23,020	22,446	17,833
1980	27,205	28,224	25,727	25,018	19,876
1981	30,587	31,836	28,455	27,403	21,771
1982	31,917	34,175	30,190	29,006	23,045
1983	32,751	36,028	31,553	30,164	23,965
1984	33,916	37,961	32,937	31,426	24,967
1985	35,134	39,671	34,160	32,482	25,806
Index level	333.3	385.8	322.1	296.6	296.6

We chose the year 1973 as our base year to correspond to the timing of our sample household-expenditure data. In that year, the value of a personal exemption was \$750. The standard deduction was equal to 15% of adjusted gross income, with a minimum of \$1,300 and a maximum of \$2,000. The rate schedules for single and joint filers contained 25 brackets each, with the marginal rates on earned income ranging from 14% to 50%. The Earned Income Credit and the Credit for the Elderly (Schedule R) are examples of programs that did not yet exist in 1973 and so are excluded from our hypothetical indexed tax system.

Tables 2 and 3 present the results of simulating four TPI's for 1967–1985. The first column in Table 2 is from Gillingham and Greenlees (1987) and reflects actual tax and price experience. We estimate that the gross consumption cost, including direct taxes, of a fixed (1972–1973) market basket rose 233.3%, from \$10,540 to \$35,134, in 18 years. This compares to the 196.6% rise in the cost of goods and services that, for comparison purposes, is presented in column 5. The 37-percentage-point difference (about .7% per year) is a result of state and federal bracket creep, as well as statutory tax-law changes. Social Security and state income tax were the smallest components of gross consumption cost but were by far the fastest growing, with average annual rates of growth of 12.1% and 12.7%, respectively (Gillingham and Greenlees 1987, table 3).

A cost series simulated under the assumption of constant 1973 federal-income-tax parameters throughout is shown in the second column. The costs under our two alternative indexed systems are displayed in the third and fourth columns. For these indexed calculations, we adjusted the exemptions, standard deductions, and

brackets in each tax year by the indexation factors for that year. For convenience and clarity, our simulations ignore any required lag between computation of an indexation factor and its use in the tax system. (In practice, there has been a significant lag. The indexation factor applied to tax year 1985 was the ratio of the average monthly level of the CPI for fiscal year 1984 to the corresponding average for fiscal year 1983.) We also assume no feedback between the tax system and the level of individual incomes. The dynamic impact of tax policy is beyond the scope of this article.

Table 3. Federal Tax Series, 1967–1985

Year	Tax policy (\$)			
	Actual	Constant	CPI indexation	"Exact" indexation
1967	1,404	1,155	1,467	1,540
1968	1,690	1,252	1,535	1,597
1969	1,912	1,370	1,613	1,664
1970	1,818	1,499	1,691	1,742
1971	1,773	1,634	1,772	1,817
1972	1,742	1,742	1,839	1,873
1973	1,992	1,992	1,992	1,992
1974	2,436	2,436	2,236	2,200
1975	2,634	2,831	2,431	2,379
1976	2,840	3,152	2,580	2,517
1977	3,132	3,539	2,749	2,679
1978	3,604	4,023	2,950	2,866
1979	4,042	4,894	3,298	3,157
1980	5,081	6,026	3,697	3,518
1981	6,102	7,258	4,113	3,854
1982	5,962	8,052	4,352	4,079
1983	5,635	8,661	4,533	4,242
1984	5,638	9,373	4,740	4,420
1985	5,813	9,997	4,918	4,568
Index level	414.0	865.5	335.2	296.6

Comparing the four alternative gross costs in 1985, we see that historical tax cuts have, to a large extent, yielded tax obligations in 1985 that approach those under our indexed systems. Although our estimated actual cost of \$35,134 is almost 3% above the cost under CPI indexation and more than 4% above the cost under exact indexation, it is more than 11% less than under the fixed 1973 structure. Over the entire study period, the annual rates of cost increase under actual, constant, and CPI and exact indexed policies are 6.9%, 7.8%, 6.7%, and 6.6%, respectively.

Table 3 displays the federal tax component of gross consumption cost for the same four simulations. The table highlights the greater volatility and divergence of the series in the years after 1978. Between 1978 and 1981, the indexed series rise less rapidly than the others, as indexation counteracts the bracket creep induced by the high goods-inflation rate. The actual tax series then declines after 1981, eliminating more than half of the dollar gap between it and the indexed series. Finally, notice the parallel movements of the actual and indexed series in 1984–1985 after CPI indexation was actually implemented.

Figure 1 displays actual and simulated federal tax premiums, with the tax premium defined as the ratio of tax liability to the direct consumption cost of a constant market basket of goods and services. By construction, the tax premium under exact indexation is constant at the actual 1973 level of 17.7%. The actual premium peaks at 20.3% in 1969, during the period of the Vietnam War surcharge, and again in 1980 at 28% prior to ERTA. In 1985, it stood at 22.5%. The simulated premium under CPI indexation exhibits slow, steady growth over the entire period from 16.9% to 19.1%.

Figure 2 shows how the relationship between a CPI-indexed system and actual tax policy varied with the consumption level—that is, the standard of living—of a household. The chart displays the ratio of CPI-indexed to actual federal taxes by quartiles of the distribution of 1985 direct-consumption cost. This chart demonstrates that the degree to which a household

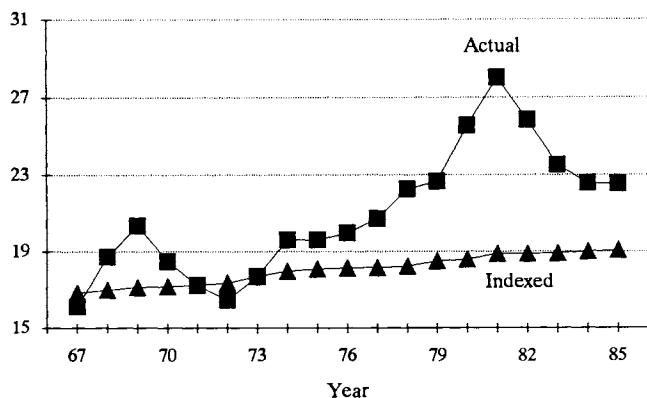


Figure 1. Federal Tax Premiums for All Taxpayers. Aggregate federal taxes for all taxpayers as a percentage of aggregate consumption expenditures are measured.

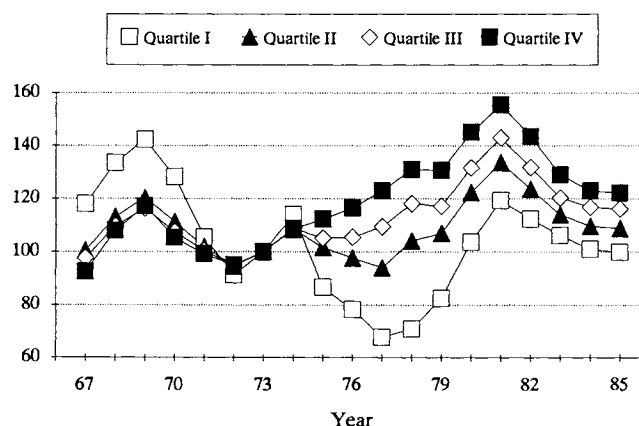


Figure 2. Actual Federal Taxes as a Percentage of CPI-Indexed Taxes, by Quartile.

would have fared better under CPI indexation than under historical tax policy is sensitive to the household's standard of living. All but the lowest quartile would have fared better under CPI indexation than under historical tax policy. In our simulations, actual federal taxes increased 22.3% more between 1973 and 1985 than CPI-indexed taxes for the highest quartile, 16.1% more for the third quartile, and 8.9% for the second quartile.

In contrast, actual federal taxes increased slightly less than CPI-indexed taxes between 1973 and 1985 for the lowest quartile, and the drop in the ratio of actual to CPI-indexed taxes between 1967 and 1985 was almost 30%. The lowest quartile fared especially well under historical tax policy between 1969 and 1977. The ratio of actual to CPI-indexed taxes dropped by 35.9% from 1969 to 1972 and then by 40.6% between 1974 and 1977.

Figure 3 reprises Figure 1 separately for each quartile. It adds to Figure 2 by showing not only the relative sizes of historical and CPI-indexed taxes but also the absolute differences in the rate of taxation. The maximum difference between the two tax premiums for the lowest quartile was less than three percentage points. For the highest quartile, this difference reached more than 14 percentage points. For convenience, we do not present quartile tax premiums under exact indexation. These would be nearly constant over the time period at their 1973 levels and would average a constant 17.7% for the four quartiles combined.

As a means of approximating the conditional effects of a household's standard of living, as well as several other consumer-unit characteristics, we performed a summary regression analysis. The dependent variable was the actual TPI for 1985 expressed as a percentage of the level of the TPI under CPI indexation. As seen from Table 1, the weighted average of this ratio for our sample as a whole was $100 \times (333.3/322.1)$, or 103.5, with a range of individual values from 73.3 to 160.6. The independent variables chosen were (a) C , the individual household's consumption costs ($p_x x$ in our theoretical discussion) in thousands of 1985 dollars; (b) the square

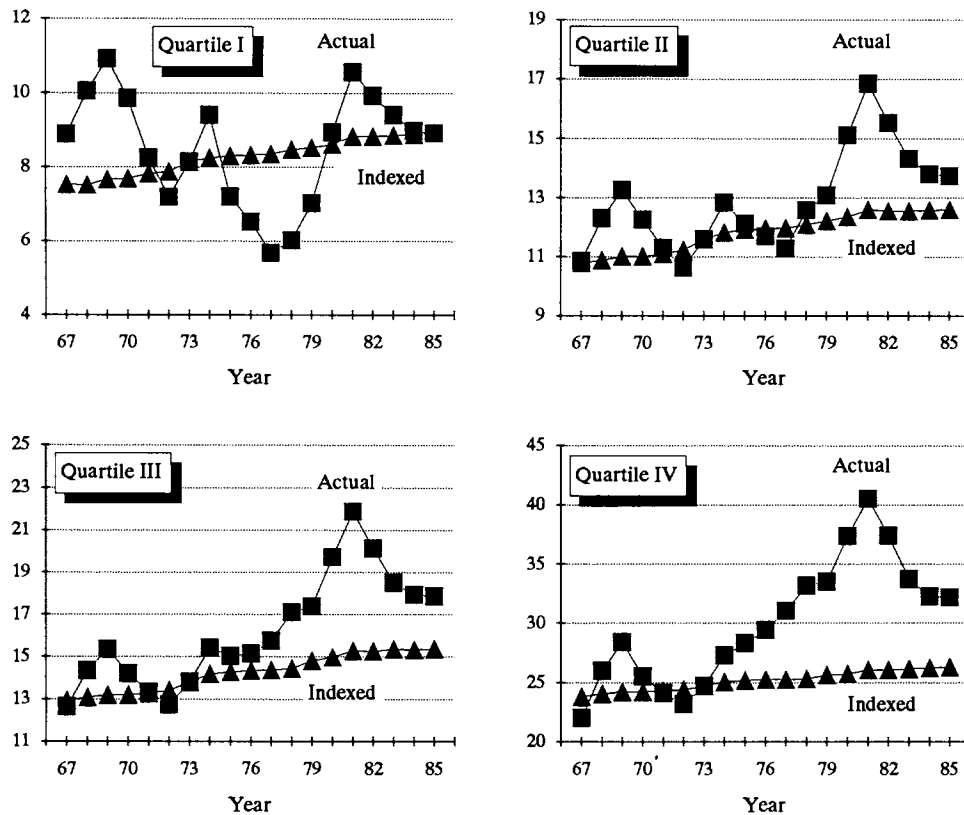


Figure 3. Federal Tax Premiums by Consumption Quartile.

of consumption; and (c) dummy variables indicating when households filed jointly, were self-employed, and were owner occupants. The equation was estimated on data for 7,231 households (we eliminated households with no tax liability in 1967) and weighted by the survey sampling weight. The estimated parameters are

$$\begin{aligned} \text{relative TPI} = & 93.7 + .283 \cdot C - .00123 \cdot C^2 \\ & (.1) \quad (.003) \quad (.00002) \\ & + 1.11 \cdot \text{joint} + .399 \cdot \text{self-employed} \\ & (.08) \quad (.114) \\ & - .0593 \cdot \text{owner}. \\ & (.0597) \end{aligned} \quad (4)$$

Standard errors are shown in parentheses.

The results indicate that, holding other factors constant, the relative TPI increases with consumption, but at a decreasing rate. Filing status and source of income also exhibit significant effects aside from their correlation with income. On average, the ratio of the actual TPI to the hypothetical TPI under CPI indexation was 1.11 percentage points higher for joint filers and .4 points higher for the self-employed. Apparently, observed tax changes (such as the introduction of a new, lower schedule for single individuals in 1971) have been relatively more beneficial to singles and wage and salary workers. The effect of tenure status was not statistically significant.

5. CONCLUSION

In 1981, the idea of indexing tax brackets, exemptions, and zero bracket amounts was a somewhat novel one. Indexation has since become standard procedure at the federal level, as well as in several states. Passage of the TRA of 1986 has, in fact, expanded the use of indexation to such provisions as the earned income credit. In this article, we have analyzed the indexing process, using an approach based on cost-of-living measurement. Our TPI methodology and data base make it possible to simulate and study an indexed system historically, comparing indexation with the CPI to actual tax policy, a tax system with constant parameters, and an exact indexing scheme.

Our analysis reveals that, for the average consumer, the sequence of tax reductions implemented between 1967 and 1985 have fallen short of mimicking indexation. As demonstrated in Figure 1, the federal tax premium has risen much faster than it would have under an indexed system, although since 1981 the ERTA rate cuts have eliminated most of the gap. Indexation would also have led to a different pattern of tax liabilities by household type, as shown in Equation (4) and Figures 2 and 3, with wealthier households in particular benefiting more from indexation than from observed historical tax changes. Finally, the analysis shows that CPI indexation would not have eliminated federal bracket creep entirely, and we present and simulate alternative

factors that would have held the federal tax premium constant over the study period.

We emphasize that we are not proposing the adoption of exact indexation. Nor are we suggesting that it would resolve the myriad of potential indexation difficulties, such as the proper treatment of capital gains and other non-earned income, or the proper timing or location-specificity of a consumption-goods price index. Rather, our analysis of exact indexation had three purposes: (a) to emphasize the need for a clearly stated goal from which indexing procedures can be derived; (b) to demonstrate that, in general, the CPI has potentially important limitations as an income tax indexation series; and (c) to contrast the CPI with a series that fully avoids federal bracket creep induced by goods inflation and the rising burdens imposed by other tax jurisdictions.

Topics of further research include measurement of the cost-of-living impacts of particular historical or proposed tax policies. Such work would provide additional perspective on issues that are typically examined either from a revenue-estimation or a macroeconomic-stimulation viewpoint. We also plan to construct intertemporal measures of tax progressivity, conditional on a fixed real-expenditure level, again as a potentially interesting alternative to measures that do not abstract from changes in the level or allocation of consumption.

ACKNOWLEDGMENTS

We thank Michael Darby, two referees, and the editor and associate editor for helpful suggestions. We also thank Stephen Walker for valuable research assistance. All views expressed are our own and do not necessarily represent the views of the U.S. Department of the Treasury.

APPENDIX: DERIVATION OF INDEXATION FACTORS

To demonstrate our approach to defining and calculating indexation factors, we begin by assuming the following (simplified) tax system:

$$T_S = B_S + r_S(Y - D), \quad (\text{A.1})$$

$$T_F = B_F + r_F(Y - D - T_S), \quad (\text{A.2})$$

$$A = aY, \quad (\text{A.3})$$

and

$$Y = D + N + T_S + T_F + A, \quad (\text{A.4})$$

where Y is gross income; D and N represent deductible and nondeductible direct consumption costs, respectively; T_S , T_F , and A are state, federal, and Social Security contributions; and the remaining terms are tax parameters. Assumed away for convenience of exposition are nonconsumption expenditures other than taxes so that Y is also equal to gross consumption cost as defined in Section 2. We assume that state taxes are deductible on the federal return and there is no Social

Security contributions ceiling, and we ignore many other complexities dealt with in our computations for the text tables and figures. The terms r and B represent, respectively, marginal tax rates and "rate structure premia"—that is, tax liabilities that stem from the differences between inframarginal and marginal rates.

Solving the preceding system in terms of the exogenous variables, we obtain

$$Y = \frac{1}{(1 - r_F)(1 - r_S) - a} \times [N + D(1 - r_F)(1 - r_S) + B_F + (1 - r_F)B_S] \quad (\text{A.5})$$

and

$$T_F = \frac{1}{(1 - r_F)(1 - r_S) - a} \times [r_F(1 - r_S)(N + aD) + B_F(1 - r_S - a) + B_S a r_F]. \quad (\text{A.6})$$

Let the variables P_d and P_n represent price indexes for deductible and nondeductible consumption goods in a comparison period. The consumer price index P is then given by

$$P = \frac{(P_n N + P_d D)}{(N + D)}. \quad (\text{A.7})$$

In the preceding model, indexation amounts to choosing a factor Θ to multiply by B_F in determining federal taxes. One possibility is to set $\Theta = P$, as in CPI indexation. The exact indexation factors simulated were instead chosen so as to yield

$$T'_F / T_F = P, \quad (\text{A.8})$$

where T'_F indicates the value in the comparison period. Substitution of (A.6) and (A.7) into (A.8) gives the following expression for Θ , with primed variables again indicating comparison-period values:

$$\Theta = \frac{P \frac{(1 - r_F)(1 - r'_S) - a'}{(1 - r_F)(1 - r_S) - a} \times [(1 - r_S - a)B_F + r_F(1 - r_S)(N + aD) + r_F a B_S]}{[(1 - r'_S - a')B_F] - \frac{r_F(1 - r'_S)(P_n N + a' P_d D) - r_F a' B'_S}{[(1 - r'_S - a')B_F]}}. \quad (\text{A.9})$$

The implications of Equation (A.9) are best conveyed through several examples. First, Θ will almost certainly not equal P , one exception being the case in which $P_n = P_d = P$ (both categories of consumption goods prices are rising at the same rate), $a' = a$, $r'_S = r_S$, and $B'_S = P B_S$ (i.e., the state tax schedule is indexed at rate P). Alternatively, if we ignore Social Security so that $a' = a = 0$, (A.9) collapses to

$$\Theta = [P B_F + (P - P_n) r_F N] / B_F, \quad (\text{A.10})$$

and if $P_d = P_n$, Θ again equals P . Without Social Security as another source of bracket creep, Equation (A.10) shows that state taxes play no role in determining Θ . This is because of their complete deductibility on federal returns in this model. Such a simple result does not hold in the presence of a federal standard deduction, but it helps to explain why the divergence between Θ and P in Table 1 is more closely related to changes in Social Security rules than to changes in state and local tax rates.

To see how the framework of Equations (A.1)–(A.6) allows us to analyze a multitude of indexing objectives, we will consider the exact indexing rule (3) specified in Section 3. The objective of this rule—indexation by the TPI—would be to index the system by a factor which, if applied to income, would leave the taxpayer unharmed by inflation. As we will see, this rule would be especially attractive if all tax systems were indexed in the same fashion. Under this rule, and assuming an arbitrary specification of state taxes and Social Security contributions,

$$Y = \frac{1}{(1 - r_F)} [N + D(1 - r_F) + B_F + T_S(1 - r_F) + A] \quad (\text{A.11})$$

and

$$\begin{aligned} \Theta = \frac{Y'}{Y} &= \frac{P_n N + P_d D(1 - r_F) + \Theta B_F + T'_S(1 - r_F) + A'}{N + D(1 - r_F) + B_F + T_S(1 - r_F) + A} \\ &= \frac{1}{Y - T_F} \left[w_1 P_n + w_2 P_d + w_3 \frac{T'_S}{T_S} + w_4 \frac{A'}{A} \right], \end{aligned} \quad (\text{A.12})$$

where the w 's are the after-federal-tax expenditures on nondeductible and deductible goods, state taxes, and Social Security contributions.

With an arbitrary determination of T_S and A , this indexation rule requires federal indexation to compensate for any change in state tax and Social Security rules, a presumably unattractive feature. If state taxes and Social Security contributions are indexed in the same manner as federal taxes, however, this system has more appeal. In the system defined by Equations (A.1) to (A.4), this would require indexing B_S with Θ and holding r_S and a constant, yielding

$$\begin{aligned} \Theta = \frac{N}{N + D(1 - r_F)(1 - r_S)} P_n \\ + \frac{D(1 - r_F)(1 - r_S)}{N + D(1 - r_F)(1 - r_S)} P_d. \end{aligned} \quad (\text{A.13})$$

In this case, Θ would be an index of after-tax consumption costs, and indexation of all tax systems and income by a single index would achieve the required objective. Note that Θ in Equation (A.13) is also, by definition, the TPI and, as discussed in Section 3, it differs from P , our "CPI", in that the latter is an index of before-tax consumption costs (compare Eq. A.7).

[Received May 1988. Revised April 1990.]

REFERENCES

- Gillingham, Robert, and Greenlees, John S. (1987), "The Impact of Direct Taxes on the Cost of Living," *Journal of Political Economy*, 95, 775–796.
- Howe, Howard (1975), "Development of the Extended Linear Expenditure System From Simple Saving Assumptions," *European Economic Review*, 6, 305–310.
- Pollak, Robert A. (1989), *The Theory of the Cost of Living Index*, New York: Oxford University Press. (Original manuscript written for the U.S. Bureau of Labor Statistics in 1972.)
- Sunley, Emil M., and Pechman, Joseph A. (1976), "Inflation Adjustment for the Individual Income Tax," in *Inflation and the Income Tax*, ed. H. J. Aaron, Washington, DC: The Brookings Institution, pp. 153–166.
- U.S. Congress, Joint Committee on Taxation (1981), "General Explanation of the Economic Recovery Tax Act of 1981," Washington, DC: U.S. Government Printing Office.