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BEYOND THE CPI: AN AUGMENTED COST OF LIVING INDEX (ACOLI)

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Beyond the CPI:
An Augmented Cost of Living Index (ACOLI)[1]

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Abstract

This note examines the question of calculating an augmented cost of living index (ACOLI). The ACOLI is the appropriate deflator to apply to pretax market incomes when calculating economic well-being. Well-being includes, not only conventional consumer purchases, but also goods and services provided by employers, by mandated social regulations, and by tax-financed public goods. Because such augmented consumption is often provided in ways that raise prices but not market incomes, deflating with conventional price indexes may understate real income growth. An application of the ACOLI approach to the United States during the 1960 - 1994 period indicates that the conventional consumer price index has grown about 15 percent faster than the ACOLI. This correction would reduce the augmented cost of living by 0.40 percent per year over the last 35 years.

The United States is currently undertaking a searching inquiry into the measurement of "the cost of living." Ideally, the cost of living would compare the minimum expenditure necessary to maintain the representative consumer at the same level of well-being at two different time periods or sets of prices. In practice, as implemented by the consumer price index (CPI), the U. S. measures the cost of living as a price index of a fixed basket of purchased goods and services in different time periods. It is widely recognized that the CPI has numerous flaws, such as substitution bias and inadequate correction for new goods and quality change. In this note, I address the

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question of whether too-narrow a definition of consumption may also distort our measures of real income.

The question arises because the U. S. and other nations have begun moving beyond traditional measures of national output to include nonmarketed consumption (housework, services of government capital, environmental services, etc.) into their national accounts. The idea is to measure "augmented consumption," which includes items other than private marketed goods and services. Rough estimates indicate that augmented consumption will be at least twice as large as conventionally measured personal consumption expenditures. The major categories of augmented consumption are included in Table 1.

Should we also move beyond the traditional definition of the cost of living to calculate the price of augmented consumption? I call such measures "augmented cost of living indexes" or ACOLI. There are many important questions that would be addressed by an ACOLI. Such an index would correct for defects in the current conceptual definition of the CPI and would include the price of nonmarket and public goods. For example, an augmented measure would take into account the rapid growth in consumption of health services financed by employer-financed fringe benefits; these enter into costs and prices but not into wages. An ACOLI would also capture the fact that some price-raising taxes or regulations have corresponding benefits and may not really raise the cost of living. The purpose of the present paper is to provide a conceptual definition of an extended cost of living index and to provide an exploratory application of the concept to include a limited number of goods and services.

1. **Analytical Background**

The basic idea behind the ACOLI is to measure how much consumer satisfaction in private and public goods can be bought with market incomes at different times and at the prices and taxes of those different periods. The difference between the ACOLI and traditional cost-of-living indexes is that the ACOLI includes certain goods and services that are provided by firms or governments and whose costs enter into market prices. A simple example is a benefit tax. Suppose the government builds a free bridge that is financed by gasoline taxes. The gasoline tax will raise prices and the CPI, [2] and this will be counted as a decline in real wages and real incomes. However, the counterpart of the tax is the benefit provided by the bridge. If the incremental benefits of the bridge just equal its incremental costs, then the apparently lower post-bridge real income will attain just the same level of economic well-being as the higher pre-bridge real income. Hence, in terms of augmented income there is no rise in the cost of living, just as there would be no rise in the cost of living if the bridge was built by a private firm which charged the consumer for crossing the river.

The conceptual basis for an ACOLI extends the standard Konüs cost of living measure[3] to include taxes along with nonmarket and public goods and services. In this extension, because of the spillover effects of taxes and public goods, it is crucial to recognize that there are multiple households and firms. The basic setup is the following. Assume that there are households, $h = 1,..., H$. There are J private goods and services denoted by the vector x. Denote q as the vector of pretax market prices or nonmarket

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[2] For this analysis, I assume that all cost-raising measures are fully shifted to product prices. This is inessential to the analysis, however,

[3] A comprehensive survey is contained in W. E. Diewert, "The Theory of the Cost-of-Living Index and the Measurement of Welfare Changes," in W. E. Diewert and C. Montmarquette, eds., *Price Level Measurement*, Ottawa, Statistics Canada, 1983, pp. 163-239.

shadow prices attached to each of the private goods. τ is the vector of taxes, so that the prices facing households are $p = q + \tau$. G is the vector of public goods.

The preferences of household h are represented by the continuous utility function $u^h = F^h(x^h, G)$. We then represent the expenditure function of household h as $E^h(p, G, \tau, u^{h*})$, where u^{h*} is the reference level of maximum attainable utility level for the reference expenditure level. We then define the price index for individual h as the ratio of expenditures necessary to maintain the reference utility level for the two periods, as defined in (1):

$$(1) \qquad P^h(p_1, p_0; G_1, G_0, \tau_1, \tau_0, u^{h*}) = \frac{E^h(p_1, G_1, \tau_1, u^{h*})}{E^h(p_0, G_0, \tau_0, u^{h*})}$$

The major new element in this specification as compared to the standard one is that it incorporates public goods and taxes into the expenditures and utilities.

The next step is to obtain a price index for all consumers. This can be accomplished in a number of ways. One approach, due to Pollak and Diewert,[4] is to calculate the expenditures necessary to keep all households at a reference level of the Bergson-Samuelson social welfare function. In this approach, let $W = F(u^1, ..., u^H)$ be the social welfare function, while $W^* = F(u^{1*}, ..., u^{H*})$ is the reference level of social welfare that is to be maintained. We then define *the augmented cost of living index* (ACOLI) as the ratio of the expenditures necessary to attain the reference level of social welfare *(W*)* with the new prices, taxes, and public goods *(p$_1$, G$_1$, τ_1)* relative to the expenditures necessary to attain W^* at the original levels *(p$_0$, G$_0$, τ_0)*:

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[4] Robert A. Pollak, "The Social Cost of Living Index," *Journal of Public Economics*, vol. 15, 1981, pp. 311-336 and W. E. Diewert, "The Theory of the Cost-of-Living Index and the Measurement of Welfare Changes," in W. E. Diewert and C. Montmarquette, eds., *Price Level Measurement*, Ottawa, Statistics Canada, 1983, pp. 163-239.

$$(2) \qquad P(\ p_1,\ p_0;\ G_1,\ G_0,\ \tau_1,\ \tau_0,\ W*)\ =\ \frac{E(\ p_1,\ G_1,\ \tau_1,\ W*)}{E(\ p_0,\ G_0,\ \tau_0,\ W*)}$$

In (2), P is the augmented cost of living index for all households. This price index can be implemented in any of the standard ways (Laspeyres, Paasche, Fisher, superlative, etc.). By "expenditures" we mean the expenditure of market incomes. Note that this framework assumes that the social marginal utilities of income of all individuals are equal.

The main feature of the ACOLI is to recognize that price-raising elements which lead to increased levels of public goods, or private goods not purchased by consumers, may raise conventionally measured price indexes such as the CPI while leaving the ACOLI unchanged. This is an important result because some measures will lower the measured standard of living as calculated with the CPI while leaving utility or the true standard of living unchanged.

2. Examples of ACOLI Adjustments

Some examples where the ACOLI would be conceptually preferable to conventionally measured price indexes are the following. For these examples, we assume that all households are identical, except perhaps for stages in the life cycle.

•*Employer-provided fringe benefits.* Say that firms provide their workers with employer-financed medical care that is worth one dollar per dollar to workers. It is likely that these costs would be passed on into higher prices, and therefore raise the CPI. However, the higher prices would simply be a reflection of the fact that the medical care was being paid for by the firm rather than the worker. In this case, the ACOLI would treat the price-raising fringe benefit as a purchase of a service rather than as a price increase.

•*Social insurance taxes*. Say that employment taxes are levied and the revenues from those taxes provide public pensions or medical care to retired workers. In the simplest case, assume that the benefits are actuarially fair, so that the present value of benefits corresponds to the present value of employees' taxes. Here again, costs and prices will rise, but there are offsetting income benefits. In this case, public savings would be replacing private savings and these measures are in reality financial transactions that raise prices. Here, the ACOLI would treat social insurance as a financial transaction rather than a cost-raising item and would therefore omit these costs from the ACOLI.

•*Social regulation*. Many government regulations raise costs and prices to consumers or producers. The counterpart of these higher prices is more stringent levels of environmental, health, and safety regulations. For example, a Department of Transportation regulation might require an airbag, which would raise the price of the car; or an EPA regulation might require reducing sulfur emissions, which would raise electricity prices. In these cases, the higher costs and prices are in effect purchasing private or public goods (automobile safety and reduced health damage from pollution). Current practice is generally to treat such measures as price increases rather than as quality change and therefore to pass them through into higher price indexes (the major exception is for mandated environmental and safety requirements in automobiles, which are removed from the CPI). The ACOLI, by contrast, would treat these higher prices as quality changes in the purchased goods.

The point is the same for each of these examples. We want to compare the expenditures needed to attain the same level of welfare after the price-raising measure with the original expenditure level. But these higher prices are in reality nonmarket transactions which provide health services, environmental protection, or future pensions.

What appear to be price increases are actually purchases of goods and services by entities outside the household sector. Because there are (in these idealized cases) no changes in utility, the augmented cost of living index in (2) in unchanged even though the CPI increases. These measures lower conventionally measured real incomes (nominal incomes divided by the CPI) but leave consumer well-being unchanged.

The major difficulty with actually measuring the ACOLI arises because we have very poor measures of the benefits of many of the expenditure or mandated cost programs. In the case of private expenditures, we feel confident (probably, too confident) that the increment to consumer welfare on the margin is one dollar per dollar of expenditure. For public goods or transfer programs, this linkage is much more indirect; we cannot be confident that the benefit from a mandated regulation, a social insurance program, or an employer-provided fringe benefit will be on a one-for-one basis with the expenditures. Whether the goods are worth 100 cents on the dollar is particularly questionable for mandated private goods like health care or appliance standards; for public goods like smallpox vaccinations or air-pollution regulation, the benefit-cost relationship is controversial but could bias our ACOLI calculations either upward or downward.

3. Narrow v. Broad ACOLIs

There are two ways to calculate the adjustment that would be made by treating augmented consumption properly. The first, which is a "broad ACOLI," includes the augmented items in consumption and then recalculate a deflator which includes augmented consumption. A second approach, which is called a "narrow ACOLI" and followed here, "strips" the augmented items out of consumption and then calculates the price of "stripped consumption." The two approaches can be explained as follows. For simplicity, assume that there is no saving or property income and that government

finances public goods out of indirect business taxes (IBT). Then net national product (NNP) equals IBT, employer financed fringe benefits (FB), and wages (W).

(3) $NNP = IBT + FB + W = C_{mkt} + C_{nonmkt} + C_{pub}$

where C_{mkt} = conventional goods and services purchased by consumers, C_{nonmkt} = private consumption goods financed out of employer-financed fringe benefits, and C_{pub} = government provided public goods financed by IBT.

We conventionally measure real wages as W/P_{mkt}, where P_{mkt} = the price of C_{mkt}. A broad ACOLI is therefore:

(4) $$ACOLI = \frac{P_{mkt} \, C_{mkt} + P_{nonmkt} \, C_{nonmkt} + P_{pub} \, C_{pub}}{C_{mkt} + C_{nonmkt} + C_{pub}}$$

This approach unfortunately requires measuring the value of the nonmarket consumption.

For the narrow ACOLI, we estimate the bias that comes from including IBT and FB in income but excluding the benefits of those expenditures from consumption. To do this we strip C_{nonmkt} and C_{pub} from consumption and calculate the ratio of augmented consumption to market consumption [i.e., we calculate $(C_{mkt} + C_{nonmkt} + C_{pub})/C_{mkt}$]. This ratio is called the ratio of standard to stripped output or consumption in this discussion and in Table 2. This ratio provides an estimate of the measurement error from using the CPI to deflate market incomes as a way of measuring real wages. To see why the CPI is a bias measure, recall that market incomes buy only C_{mkt}, but consumers are also enjoying changing levels of the other components of consumption. We can obtain a better measure of the narrow cost of living (i.e., the cost of reaching the same level of economic well-being given the change in the changes in the levels of $C_{nonmkt} + C_{pub}$) by modifying the

CPI or other narrow consumption deflator by the ratio of augmented to market consumption.

What is the difference between the narrow and the broad ACOLIs? If the augmented items ($C_{nonmkt} + C_{pub}$) have a dollar of benefit per dollar of cost, then the narrow ACOLI will be a good deflator for both narrow and broad consumption. However, to the extent that the benefit-cost ratios for fringe benefits and public goods diverge from unity, the narrow ACOLI will only provide an accurate measure of real income in terms of narrowly defined consumption. In this case, however, the trend in the real nonmarket component ($C_{nonmkt} + C_{pub}$) will not be adequately captured by the narrow ACOLI correction. Augmented consumption will be growing faster or slower than the ACOLI measure indicates depending upon whether the benefit-cost ratio of the omitted items is above or below unity.

To summarize, the definition of the ACOLI is the following:

Definition. The augmented cost of living index (ACOLI) is the appropriate deflator to apply to pretax market incomes for calculating economic well-being, where well-being includes not only privately purchased goods and services but also those goods and services provided by price-raising, non-household expenditures. The narrow ACOLI provides an appropriate deflator for augmented consumption only in the case where the benefit-cost ratio for public goods and fringe benefits is equal to unity.

4. Rudimentary Estimates of the ACOLI Adjustment

How important is the difference between the narrow ACOLI and the CPI or other conventional price indexes? This question is a major policy issue, yet there is apparently no empirical research on this topic. The answer is of considerable importance in light of the ongoing debate about the bias in the CPI as well as the more general debate about appropriate indexes to use for indexing federal programs. [5] To illustrate the quantitative importance, I will provide order-of-magnitude estimates of the difference between the CPI and an ACOLI over the last 35 years.

For this example, I correct conventional cost of living indexes for four biases as follows: (1) Social insurance taxes are considered to be financial transfers rather than price-increasing taxes. (2) Employer-provided fringe benefits are assumed to provide consumer goods and services on a dollar-for-dollar basis; hence, the higher prices induced by the increased costs are assumed to be fully offset. (3) Indirect business taxes are assumed to be benefit taxes which increase the quantity of public goods on a dollar-per-dollar basis. (4) Mandated costs from social regulation are assumed to purchase public goods or publicly mandated private goods on a dollar-for-dollar basis. Clearly, each of these assumptions can be questioned, and there are particularly tricky issues involving the valuation of tax-free fringe benefits, forced saving, and the benefits of public goods.

To examine the effect of augmenting the concept of consumption, we look primarily at conventional personal consumption expenditures and at "stripped" personal consumption expenditure expenditures for the years 1960 and 1994 and years in

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[5] See particularly, *Toward a More Accurate Measure of the Cost of Living: The Final Report of the Advisory Commission to Study the Consumer Price Index*, December 4, 1996, Updated Version (hereafter the "Boskin Commission").

between. To compare conventional measurement of real income with measures of augmented real income, we subtract all four items listed in the last paragraph from consumption, which gives us "stripped consumption" (that is, stripped consumption is consumption less the four price-raising items which do not decrease consumer utilities). We then calculate the growth of the ratio of conventional consumption to stripped consumption.

In addition, for comparative purposes, I have made the calculation of stripped income for both net national product and for national income (which is national output calculated at factor prices). These alternative concepts provide an estimate of a deflator for all market incomes instead of only for wages.

Table 2 shows the results, and the detailed calculations are provided in Table 3. Except for the non-pollution-related components of the mandated regulatory costs, all numbers are derived from the National Income and Product Accounts. The estimates of the non-pollution-related costs of social regulation are from Robert Hahn. [6] The results

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[6] The sources of the data from the national income and product accounts are the following: Social insurance taxes are "employer contributions for social insurance." Employer-provided fringe benefits are "other labor income." Indirect business taxes are that item. Pollution abatement spending is taken from Department of Commerce, *Survey of Current Business*, various issues. The cost of personal pollution abatement expenditures on motor vehicles is subtracted from the total to reflect the correction of the CPI for mandated pollution abatement spending. An additional correction should be made for mandated automobile safety equipment, but no estimates are available for that cost. Non-pollution social regulation includes nuclear power, occupational safety, highway safety, pharmaceuticals, equal opportunity, and consumer products. The estimates for 1988 are from Robert Hahn, "The Costs and Benefits of Regulation: Review and Synthesis," *Yale Journal on Regulation*, vol. 8, 1991, pp. 233-287. For 1988/89, pollution abatement is $83.8 billion while non-pollution social regulation is $26.2 billion. I calculate the cost of non-pollution social regulation for other years by assuming that the ratio of total social regulation to pollution abatement expenditures is constant.

indicate that an augmented cost of living index shows dramatically different results from a standard price index. The total upward bias over the period 1960-94 is 15 percent. This indicates that augmented consumption grew 15 percent more than conventionally measured consumption. The upward bias was around 0.40 percent per year. Note that this bias will be present in any of the major price indexes — CPI, GNP deflator, or personal consumption deflator — and under any index number technique that is currently used.

Table 2 also shows the breakdown of the bias among the four components. Three quarters of the bias is due to fringe benefits and contributions to social insurance, with one quarter due to social regulations and very little to indirect business taxes. Table 3 shows the breakdown by subperiods. The bias was substantial in all subperiods except during the Reagan administration, during which the bias was actually negative. In the most recent period, from 1989 to 1994, the bias was very close to that of the entire period.

There are a number of reservations that apply to this calculation — including numerical ones about the items included in each of the corrections and empirical issues such as whether these fringe benefits and public goods in fact deliver benefits on a dollar-per-dollar basis. A great deal of further refinement is necessary to put an ACOLI on a sound theoretical and empirical framework. Nonetheless, it is striking to find that over the last quarter century conventional price indexes may have overestimated the true cost of living by a total of 0.40 percent per year because of the omission of fringe benefits and mandated public goods. This number is a significant fraction of current estimates of the bias of the CPI.[7]

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[7] Recall that the Boskin Commission estimates that the upward bias in the CPI from index-number problems, outlet bias, and quality change is currently 1.1 percent per annum.

Table 1. Categories in "Augmented Consumption"

Private goods

    Marketed
        Purchased by households (food, clothing)*
        Purchased by other sectors (health care, pension plans)**
    Nonmarket
        Goods and services (leisure, housework)
        Other (longevity)
    Publicly provided private goods
        Market (bridges, town beaches)***
        Nonmarket (crime, drugs, personal safety)

Public goods

    Environmental, health, and safety (pollution abatement expenditures, FDA
        certification)***
    Science and technology (space exploration)

Note:
 *Items with one asterisk are in the CPI.
**Items with one or two asterisks are in personal consumption expenditures in the national
    income accounts.
***Items with one, two, or three asterisks are in the ACOLI concept measured here.

Table 2. Estimated Bias to Inflation Corrected by Using
Augmented Cost of Living Index, 1960-1994

A. Total Difference between ACOLI and Standard Price Index

Output Measure	Ratio of standard to stripped measure of output			Bias in inflation rate, 1960-94 (in basis points per year, average
	1960	*1994*	*Ratio*	*annual rate)*
Net national product	1.173	1.313	1.119	33
National income	1.059	1.192	1.125	35
Consumption	1.264	1.449	1.147	40

B. Contribution of Different Components for Stripped Consumption

Component	Amount of Bias, 1960-94 (basis points per year)
Contributions to social insurance	14
Supplements to wages and salaries	19
Social regulations	10
Indirect business taxes	-2
Total	40

Source: For derivation, see Table 3. The calculation of the contribution of the components in part B is a geometric mean of the individual indexes or contributions calculated from consumption and stripped consumption as a base.

Table 3. Data Underlying Calculation of ACOLI

	1960	1970	1981	1989	1994
Output measure	*Ratio of standard to stripped measure of output*				
Net national product	1.173	1.239	1.293	1.285	1.313
National income	1.059	1.114	1.176	1.175	1.192
Consumption	1.264	1.383	1.468	1.420	1.449

Bias in Standard Price Indexes (basis points per year)

	1960-70	1970-81	1981-89	1981-94	1960-94
Net national product	55	39	-8	43	33
National income	50	50	-1	29	35
Consumption	91	54	-41	41	40

Underlying data (billions of dollars)	*1960*	*1970*	*1981*	*1989*	*1994*
Gross national product	529.8	1042.0	3150.6	5452.8	6922.4
Net national product	469.1	930.1	2730.7	4790.6	6103.7
National income (NI)	426.2	836.6	2470.2	4362.1	5495.1
Consumption	332.2	648.1	1941.3	3594.8	4698.7

Corrections to obtain the augmented social cost of living:

	1960	1970	1981	1989	1994
Employer contributions to social insurance	12.6	34.1	157.1	280.4	350.2
Other labor income	11.2	32.5	153.0	273.1	402.2
Social regulations	0.0	18.7	59.5	95.2	131.3
Price additions to NI	23.8	85.3	369.6	648.7	883.7
Indirect business taxes	45.5	94.3	249.3	414.7	572.5
Price additions to NNP and C	69.3	179.6	618.9	1063.4	1456.2
NNP less price additions	399.8	750.5	2111.8	3727.2	4647.5
NI less price additions	402.4	751.3	2100.6	3713.4	4611.4
C less price additions	262.9	468.5	1322.4	2531.4	3242.5

Sources: All data except non-pollution social regulation from U.S. Commerce Department as published in *The Economic Report of the President, 1996*, Washington, D.C., Government Printing Office. See text for description of treatment. Data on non-pollution social regulation for 1988 are from Robert Hahn and scaled to other years assuming the ratio of total to pollution abatement is constant over time. Personal expenditures on pollution abatement for motor vehicles are subtracted from social regulation.