What Was the Consumer Price Index Then? A Data Study

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[The author is grateful to Christopher Hanes, Peter H. Lindert, and Samuel H. Williamson, for useful comments. The study is the responsibility of the author alone.]

The purpose of this study is the generation of an annual long-run series of the consumer price index (CPI) for the United States. The desired series should be continuous, without missing years. Also, it should have maximum length; that is, (1) begin in the earliest year possible, consistent with acceptable data; and (2) continue to the present and be ongoing, meaning readily updatable for future years.

A tremendous amount of original work on U.S. CPI series exists. Therefore no attempt here is made at original series construction. No one existing series, whether constructed by an official entity or private author, is of sufficient length to encompass the entire period for which data exist; therefore no such series alone can serve as the new series. Of necessity, the new CPI series is a composite of existing series, official and private.

All the original series that the present author could find in the public domain are described and evaluated here. Other scholars have offered long-run series that are composites of these original series; all that the present author could find of such composite series are also reviewed, and the judgments of their authors considered in developing the new composite CPI series.

Only one CPI series is generated here: that for the United States rather than component areas, and incorporating the entire basket of commodities purchased by consumers rather than subsets of this basket. Of course, to evaluate existing series to serve as component series in the new CPI series, one must consider the geographic span and commodity composition of the existing series. Geographically, while the United States is the focus, it would be unwise to exclude information and series for individual states or even individual cities—especially in the early years, for which availability of ideal series is limited.

This study is divided into seven sections. Section I describes the structure of any CPI, in terms of the ingredients of the CPI. Section II describes the official U.S. CPI series, and section III does the same for unofficial—private or state—original series. Section IV establishes the criteria to be used to select component series of the new CPI. Section V shows that any long-run CPI series must be a composite series, and summarizes the potential component series for this purpose. These potential component series are composed of both official series (of which there are three, not just one, as discussed in section II) and unofficial (of which there are many, presented in section III). Naturally, previous scholars have constructed composite CPI series from the potential component series, and these composite series are reviewed in section VI. Section VII exposits construction of the new CPI series and the relationship of this series to the existing composite series to which it is closely aligned. Brief concluding comments are presented in section VIII, followed by references.

Any long-run historical CPI series has general limitations, and the CPI series developed in this study is no exception. While some tensions associated with selection of an index-number formula are discussed in section I and the shortcomings of existing specific CPI series (whether a component or composite series) exposited in sections II-VI, some general warnings to the potential user of this (or any) historical CPI series are in order:

1. The CPI pertains only to commodities purchased by consumers; it is not a price index of all production or all consumption (purchases by all entities) in the economy.

2. Changes in quality of commodities and introduction of new commodities are issues that plague CPI construction, all the more for long-run series.

3. Consumption patterns differ among social and economic classes. A CPI cannot be equally applicable to all groups.

4. The same comment applies to geographic areas. Most CPIs are confined to urban areas, a minority is purely rural.

5. Existing CPIs for the 18th century, 19th century, and early 20th century omit commodities (such as housing; services in general; and, for the 20th century, automobiles) important in consumption at the time, or include them only after an inappropriate time lag.

6. A CPI is only as good as the basic price and weight (expenditure) data. In general, these data are of lower quality as one goes further into the past.

7. Combining differently constructed CPI series to serve as components of a composite CPI (an inevitable characteristic of a long-run series) generates inconsistencies in the long-run series.

8. In seeking to summarize disparate price movements of many commodities into one number (per time period), a CPI (or any price index) is attempting to "square the circle." Any index in its nature can provide only an approximation of reality. An index number attempts to represent a film by a photograph. A photograph can be a useful summary of a film, but it is only a summary. Concretely, for some purposes, one might want to look at the movement of prices of individual commodities, or of CPI indexes of specific commodity groups, or of CPIs for specific economic areas. In contrast, the CPI series developed in this study, as well as all the CPI series surveyed here, are (or at least purport to be) in the nature of an overall index (albeit for a certain area type, generally urban).

For further discussion along these lines, Hanes (2006, pp. 151-53) may be consulted.

A digression on nomenclature: the word "index" will be used sometimes as a synonym for "series," sometimes as a synonym for "index number (formula)." The context makes clear which meaning of the word is in play.

I. Structure of Consumer Price Index

A. Inputs to the Index-Number Formula

1. Prices

The first, and obvious, element of a CPI is the set of prices of the commodities in the consumer's market basket. In practice, these prices are used only in the form of price relatives (ratio of price in current period to price in a past period), so that information on absolute prices is not necessary. Only the past-period to current-period price ratio (or percentage change in price) need be obtained.

2. Aggregation structure

The typical—or, rather, ideal—CPI has multiple levels of components of the market basket, that constitute the aggregation structure of the CPI. One can consider six levels of aggregation. Using the terminology in International Labour Office (2004, p. 155), the first, or lowest, level is the "sampled product," for example, "brand-A white bread." The second level is obtained by aggregating the sampled products into "representative products," in the example, "white bread." For the third level, representative products are aggregated into "sub-classes," for example, "bread." In turn, the fourth level is "classes," aggregated from the representative products, with "breads and cereals" as the example class. The fifth level is "groups," aggregates of the classes, with "food and non-alcoholic beverages" the example group. The sixth level is the overall CPI itself, an aggregate of the groups.

In principle, there could be any number of intermediate levels, between the "sampled product" and the overall CPI. In practice, historical CPI series for periods earlier than a certain date—for the United States, series antedating World War I—omit several of the levels in the above schemata.

3. Weights

Quantity (meaning physical-quantity) or expenditure (price-times-quantity) weights are applied to the prices or price relatives. The weights are needed both for items, at the elementary level, and for aggregates, at higher levels.

4. Base periods

Three base periods can be distinguished, as is done in International Labour Office (2004, p. 165):

"price reference period": the period of the price used as the denominator in the index (or in the price relatives)—termed period 0 in this study.

"weight reference period": the period to which the quantity weights or expenditure weights pertain—termed period b in this study.

"index reference period": the period for which the index is set equal to 100.

A base period is usually a specified month or year, but it can be an average of selected months or years. Index-number theory often (but not always) assumes that the price and weight reference periods are identical; in practice, these periods often (but not always) differ. The index reference period is inherently arbitrary. It is simple to alter: divide the series by the average value of the index in the desired index reference period, and multiply by 100. The index reference period is sometimes called the "time base period," or simply "time base" or "base period" or even "base" (providing the context is understood); the Bureau of Labor Statistics uses the term "reference base period."

The "current period," or "comparison period," is the period for which the index is being computed—of course, relative to the reference periods. It is termed period t in this study.

B. Index-Number Formula

1. Cost-of-goods index versus cost-of-living index

The cost-of-goods (COG) index in the current period (t) is the expenditure in period t required to purchase the weight-reference-base-period (b) market basket, divided by this expenditure in the price-reference period (0). The market basket is the set of quantity weights, which, as stated, here pertain to the weight reference base period.

The cost-of-living (COL) index in the current period (t) is the minimum expenditure in period t required to attain the same level of utility (standard of living) achieved in the price reference period (0), divided by this expenditure in the price reference period. Unlike the COG index, the market basket for the COL index is permitted to vary over time.

The COG index is used in the "statistical approach" to index-number theory, whereas the COL index is used in the "economic approach." For more on the COG-COL distinction, one may consult Schultze and Mackie (2002, esp. ch. 2) and International Labour Office (2004, esp. chs. 1 and 17). Only the barest essentials are discussed here.

The following is common to the COG and COL indexes. Each accepts the representative-consumer's selection of the quantity of each commodity in the weight reference period. Each also presents the period-specific set of prices of commodities as parameters to the consumer in all periods. However, the indexes differ in an important respect. The COG index assigns the weight-reference-period quantities also to the price reference period and the current period. In contrast, the COL index allows the quantities to vary in all periods—perhaps in a constrained, perhaps in an unconstrained way.

Whether the CPI is in principle a COG or COL index, and whether in practice efforts should be made to construct the official CPI as one or the other type index have been matters of great controversy in CPI history.

2. index-number formulas

An index-number formula is a mathematical expression that combines weighted prices or weighted price relatives.

a. unchained indexes

An unchained index is characterized by an unchanged weight reference period over time (except insofar as a changing weight reference period is inherent in the formula.) What are presented here are only those index-number formulas that have been used in construction of CPI series for the United States. The following symbols (some from section A.4 above) are used to index variables:

t = current period
b = weight reference period
0 = price reference period
k = arbitrary period
i or j = commodity

Summation or multiplication is over i, except where otherwise stated.

Fundamental variables are:

p_{ik} = price of commodity i in period k
q_{ik} = quantity consumed of commodity i in period k

Then $p_{ik} \cdot q_{ik}$ is the expenditure on commodity i in period k.

A variable of interest is:

s_{ik} = expenditure share of commodity i in period k, defined as follows:

$$s_{ik} = p_{ik} \cdot q_{ik} / \Sigma p_{ik} \cdot q_{ik}$$

Of course, $\Sigma s_{ik} = 1$. So the s_{ik} may serve as expenditure weights in the index.

The index-number formulas, each for the current period, are:

L_t = Laspeyres index
LO_t = Lowe index
G_t = geometric-mean index
T_t = Tornqvist index

For convenience, and following traditional usage, an "index-number formula" may also be termed an "index number" or simply an "index."

i. Laspeyres index

$$L_t = \Sigma p_{it} \cdot q_{i0} / \Sigma p_{i0} \cdot q_{i0} \qquad (1)$$

$$= \Sigma s_{i0} \cdot (p_{it}/p_{i0}) \qquad (2)$$

The Laspeyres index may be expressed either in terms of quantity weights or expenditure weights, equations (1) and (2). Concomitantly, equation (1) involves absolute prices; while equation (2), price relatives.

ii. Lowe index

Following the exposition in Balk and Diewert (2003, pp. 2-3),

$$L0_t = \Sigma p_{it} \cdot q_{ib} / \Sigma p_{i0} \cdot q_{ib} \qquad (3)$$

$$= \Sigma s_{i*} \cdot (p_{it}/p_{i0}) \qquad (4)$$

where $s_{i*} = p_{ib} \cdot q_{ib}(p_{i0}/p_{ib}) / \Sigma p_{ib} \cdot q_{ib}(p_{i0}/p_{ib})$

Equation (3) is the Lowe index with quantity weights, equation (4) is the index with price-updated expenditure weights. Again, equation (3) involves absolute prices, equation (4) price relatives. In practice, period b (weight reference period) usually antedates period 0 (price reference period); but any time relationship between these periods is consistent with the Lowe index.

The difference between the Lowe and Laspeyres indexes may be expressed in two ways. First, the Laspeyres is a special case of the Lowe, with the price reference period and weight reference period the same; whereas the Lowe in general has these as distinct periods. Second, although both the Lowe and Laspeyres indexes are an arithmetic mean of expenditure-weighted price relatives, the Lowe price-updates the expenditure weights from the weight reference period, whereas the Laspeyres does not update the weights. The Lowe index is sometimes called a "modified-Laspeyres" index. This terminology makes sense in terms of the second expression. However, the Lowe is in fact the more-general index; so the term "modified-Laspeyres" is illogical. Perhaps the term should be reversed, so the Laspeyres is called a "modified Lowe" index!

The Lowe (and therefore Laspeyres) index involves a fixed market basket. The weights are fixed quantities. Even as relative prices change, the quantities of commodities purchased by the representative consumer do not change. There is no substitution among commodities; the elasticity of substitution between any two commodities is zero. Failure to account adequately for substitution is known as "substitution bias." With total failure

to do so, the Lowe (or Laspeyres) index is a COG index par excellence. In COL theory, the Laspeyres is an upper bound to a COL index.

iii. geometric-mean index

$$G_t = \Pi(p_{it}/p_{i0})^{S_{i0}} \qquad (5)$$

It may be noted that the geometric-mean index is analogous to the Laspeyres index, in that both indexes have weight reference period at the price reference period. However, there are differences between the Laspeyres and geometric-mean indexes.

While the Laspeyres (and Lowe) index imposes constant quantities as weights, the geometric-mean assumes an unchanged expenditure share for each commodity. The Laspeyres and geometric-mean indexes are means of non-updated expenditure-weighted price relatives; but the Laspeyres index is the arithmetic mean, while the geometric-mean index is, of course, the geometric mean. While the Laspeyres (and Lowe) index has zero substitution among commodity quantities as relative prices change, the geometric-mean index allows substitution as long as weight-reference-base relative expenditures are unaffected. The elasticity of substitution between any two commodities is unity under the geometric-mean, whereas it is zero under the Laspeyres (and Lowe) index. Because some substitution—albeit constrained substitution—is permitted under the geometric mean, the geometric mean is usually considered to come closer to a COL index than does the Laspeyres (or Lowe).

iv. Tornqvist index

$$T_t = \Pi(p_{it}/p_{i0})^{(S_{i0} + S_{it})/2} \qquad (6)$$

The Tornqvist index is similar to the geometric-mean index in two respects. Both indexes are the expenditure-weighted geometric mean of price relatives. Also for both indexes, the weight reference period (b) is the same as the price reference period (0). However, Tornqvist has as weights the average of expenditure shares in the current (t) and price-reference base (0) periods, while geometric-mean has as weights expenditure share in the price-reference base period (0). The geometric-mean index is a special case of the Tornqvist index, obtained by replacing the current-period (t) expenditure weights with the price-reference-period (0) weights.

Of the four indexes presented, the Tornqvist comes closest to the COL ideal. A specific value of the elasticity of substitution between commodities is not assumed. Rather, the symmetrical use of expenditure shares in both current and price-reference base periods as weights incorporates a broad range of substitution behavior.

b. chained indexes

For any time-series index of fixed quantity weights, the weights become increasingly out of date as time passes. The reasons are many; but among them are changing tastes of

consumers, changes in relative prices, changes in incomes of consumers, introduction of new goods, and improvement in quality of existing goods. As stated in International Labour Office (2004, p. 6):

> When a time series of Lowe or Laspeyres indices is calculated using a fixed set of quantities, the quantities become progressively out of date and increasingly irrelevant to the later periods for which prices are being compared. The base period, in which quantities are set, has to be updated sooner or later and the new index series linked to the old. Linking is inevitable in the long run.

The long-run CPI series created in this study is a chained index; for the long-run series will be a composite of existing original series that must be linked together. However, even a given original series would typically involve linking if it is constructed over a sufficiently long time period; for the quantity weights would have to be updated to remain relevant. The advantages of linking are that substitution among commodities is permitted, and that new goods and changing qualities of remaining goods are incorporated—albeit all in a discrete periodic way, that is, at intervals. Linking makes sense even for index numbers, such as the geometric mean and Tornqvist, which do not involve fixed quantities; for the base-period expenditure share also becomes increasingly out of date. For a discussion of chain indexes, one can consult International Labour Office (2004, pp. 6-7, 280-84).

An "original" (non-composite) index series can be chained with the same frequency as the unit of observation of the series itself, usually monthly; that gives rise to the purest kind of chained index. For composite series, and sometimes for non-composite series, chaining occurs with less frequency than the unit of observation of the series.

c. area series

CPI series are sometimes constructed for intra-national geographic areas. This procedure allows the computation of a more-precise national index. There is the issue of combining individual-area indexes into a national index. Either a weighted or unweighted average of the area indexes may be taken. The logical weighting pattern would be proportional to population.

II. Official U.S. CPI Series: BLS Series

A. History

The history of the development of the U.S. official CPI series, the series of the Bureau of Labor Statistics (BLS), is well-told in several places, and will not be repeated here; although pertinent history will be addressed as relevant for specific issues. For the history of the official CPI index, one can consult Williams, Hogg, and Clague (1935), Cost of Living Division [of BLS] (1940), Williams and Stewart (1941), Bureau of Labor

Statistics (1959, 1966, 1978, 1997 updated), Shiskin (1974), and Greenlees and Mason (1996).

B. Structure

The aggregation structure of the BLS CPI has different nomenclature from that of the International Labour Office. Sampled products are termed "item samples" or "entry-level items." Representative products are called "item strata" or simply "strata." Sub-classes are "expenditure classes;" classes, "intermediate aggregates;" and groups, "major groups."

The BLS also constructs the CPI for geographic areas (cities, metropolitan areas, or other urban areas). These areas are sometimes termed "index areas." Suppose that there are x item strata and y index areas. Then there are xy "item stratum - area index" cells. A "basic" (or "elementary") index is constructed for each cell from the corresponding "item stratum - index area" sample. This procedure is called "lower-level aggregation." As stated by Lane (1996, p. 19): "The item stratum - index area combination is the basic building block of the CPI."

The resulting xy stratum-area indexes are combined into various indexes: for a given stratum (or higher level of commodity) over all areas, or for a given area across all strata (or other level of commodity). Ultimately, overall CPI, called the "U.S. city-average, all-items CPI," is obtained. That is the national CPI over all major groups, representative of the nature of the desired long-run CPI series

C. Types of Series

In fact, BLS provides three different all-item national CPI series, the distinguishing features of which are summarized in Table 1. The traditional series, which begins in 1913, is oriented to urban wage-earners and salaried or clerical workers. The first column provides the year in which the series was introduced (which could be later than the initial year of the series). The second column traces the changing nomenclature of this series, the final term for which is CPI-W (consumer price index for urban wage earners and clerical workers). In 1978, a second series, CPI-U (consumer price index for all urban consumers), was introduced.

In terms of index-number formula, both the CPI-W and CPI-U are Lowe indexes for upper-level aggregation, and, until 1999, also for item-level aggregation. In 1999, the geometric mean replaced the Lowe for item-level index computation, except for selected strata (listed in the table). In 2002, the C-CPI-U (chained consumer price index for all urban consumers), beginning in 2000, was initiated as the third CPI series. It is a continuous chained index, with the weights chained monthly (which is the typical highest frequency of any CPI). The C-CPI-U reference base period differs from that of the CPI-W and CPI-U, with reference-base-period history presented in the third column of

the Table. Elementary index computation is the same for all three indexes. The final two columns of Table 1 summarize the index-number formulas as they changed over time.

Table 1
BLS Consumer Price Indexes
(all items, U.S. city average)

Year Intro-duced	Index Name[a]	Reference-Base Period[b]	Index-Number Formula	
			Item Level[c] (Elementary Indexes)[d]	Upper Level[e] (Aggregate Indexes)
1920	**(I)** cost of living[f]	1913	Laspeyres	Lowe[g]
1935	index of cost of goods purchased by wage earners and lower-salaried workers in large cities	1923-25[h]	”	”
1940	”	1935-39	”	”
1945	consumers’ price index for moderate-income families in large cities	”	”	”
1953	consumer price index	1947-49	”	”
1962	”	1957-59	”	”
1964	consumer price index for urban wage earners and clerical workers	”	”	”
1971	”	1967	”	”
1978	consumer price index for urban wage earners and clerical workers (CPI-W), **(II)** consumer price index for all urban consumers (CPI-U)	”	”	”
1988	”	1982-84	”	”
1999	”	”	geometric mean[i], except Laspeyres for selected (1) shelter services, (2) utilities and government charges, (3) medical-care services	”

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(all items, U.S. city average)

Year Intro-duced	Index Name[a]	Reference-Base Period[b]	Index-Number Formula	
			Item Level[c] (Elementary Indexes)[d]	Upper Level[e] (Aggregate Indexes)
2002	**(III)** chained consumer price index for all urban consumers (C-CPI-U)	December 1999	”	Tornqvist[j]
2004	CPI-W, CPI-U, C-CPI-U	1982-84, 1982-84, December 1999	geometric mean[i] also for cable and satellite television and radio services (within “utilities and government charges”), and eyeglasses and eye care (within “medical-care services”)	Lowe[g], Lowe[g], Tornqvist[j]

[a]New index concept preceded by Roman numeral in bold.
[b]Period for which index is set equal to 100. Termed “index reference period” in International Labor Office (2004, p. 165).
[c]Creation of basic indexes, termed “lower-level aggregation” or “elementary-level aggregation.”
[d]Termed “item strata.”
[e]Aggregation of basic indexes to upper-level indexes: ultimately all items, U.S. city average.
[f]Also termed “index number of cost of living” or “cost-of-living index.” Apparently, usage of term continued to 1945.
[g]Also called “modified Laspeyres” or (inappropriately) “Laspeyres.” Characterized by fixed quantity weights, assumption of zero elasticity of substitution.
[h]Omitted in Bureau of Labor Statistics (1966, p. 84). Incorrectly stated as 1923-35 in Bureau of Labor Statistics (1997 updated, Appendix 1).
[i]Characterized by fixed expenditure proportions, assumption of unitary elasticity of substitution.
[j]Characterized by average expenditure weights in current and base periods, no specific value of elasticity of substitution assumed.

BLS = Bureau of Labor Statistics

Sources: Abraham (2003, pp. 49-51); Bureau of Labor Statistics (2003, p. 6; 1997 updated, esp. Appendix 1; 2004); Cost of Living Division (1940); Dalton, Greenlees, and Stewart (1998); Cage, Greenlees and Jackman (2003, pp. 8-20); *Monthly Labor Review*, various issues; Shiskin (1974, p. 4); Williams, Hogg, and Clague (1935).

For lower-level aggregation, replacement of the Laspeyres index with the geometric mean, in 1999, meant that the assumption of no substitution in response to relative-price change was replaced with the assumption of unitary elasticity of substitution. The Laspeyres index was retained for certain strata for which the former assumption seemed more plausible than the latter. For a detailed list of, and justification for, the items retaining Laspeyres, see Dalton, Greenlees and Stewart (1998) and Cage, Greenlees, and Jackman (2003, p. 9). Note that the geometric mean permits substitution only within a given stratum (or, rather, stratum-area cell) rather than between strata. Thus, as a hypothetical example, two item strata may be "bread" and "cereal." Then substitution between brand-A cereal and brand-B cereal (in a given area) is accommodated, while substitution between "bread" and "cereal" (in that area) is not.

For substitution between strata, and between commodities at higher levels of aggregation (all under the rubric of upper-level aggregation), the C-CPI-U index was adopted. Use of the Tornqvist index-number formula combined with month-to-month chaining permits the C-CPI-U to give full scope to substitution between strata, and between commodities at higher levels of aggregation. A problem with the C-CPI-U series is that it is available only since the year 2000. Scholars using the BLS CPI for earlier periods must have recourse to the CPI-U or CPI-W; and prior to 1978, only the CPI-W—and these two series use the Lowe index-number formula for upper-level aggregation. The Lowe (as does the Laspeyres) index does not allow for substitution—except when there is a change in the quantity or expenditure weighting pattern.

Fortunately, the weights for upper-level aggregation in the CPI-W and CPI-U have been changed from time-to-time, biennially in the 21st century. The weights emanate from BLS consumer expenditure surveys; and the history of these changes in weighting pattern is shown in the first and second columns of Table 2. A change in the weighting pattern is important not only for "catching-up" of substitution between items in response to relative-price changes and income changes, but also for incorporation of new goods and changes in quality of ongoing goods.

Table 2
BLS Consumer Price Index for All Urban Consumers (CPI-U)[a]
Expenditure Weights—Group Level

Applicable Years	Survey Year(s)[b]	Linking Month[c]	Restrictions for Inclusion of Consumers in Survey			
			Family Composition	Family Head or Chief Earner	Family Income	Other
1913-24	1917-19		Husband, wife, and at least one child not a boarder or lodger. No boarders, no more than three lodgers.	Wage-earner or salaried worker[d]	At least 75 percent from principal breadwinner or others who contribute all earnings to family fund.	White. In locality entire year. No slum or charity families. No non-English-speaking families who have been in the United States less than five years.[e]
1925-29	average of 1917-19 and 1934-36		See entries for 1913-24 and 1930-49.	See entries for 1913-24 and 1930-49.	See entries for 1913-24 and 1930-49.	See entries for 1913-24 and 1930-49.
1930-49	1934-36		Two or more persons. Not more than two boarders or lodgers (104 boarder/lodger weeks) or guests for more than 26 guest-weeks.	Wage-earner or lower-salaried clerical worker. Must have worked at least 1008 hours spread over a minimum of 36 weeks during the year. Must have earned at least $300 during year. For clerical worker, earnings must be less than $2000 during year and less than $200 during any one month.	At least $500 annual income. No more than one-fourth income from interest, dividends, royalties, speculative gains, or rents (not including net receipts from boarders and lodgers). No rent in payment of services. No more than three-months' free rent. No gifts or income in kind equal to [at least] one-fourth total money income.[f] Family must	Family must have resided in the area for nine months or more. Family must have eaten at least two meals a day prepared at home for at least 11 months of the year. No family who received direct relief or work relief. Family must not have boarded for more than one month. No subsidiary clerical worker

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Applicable Years	Survey Year(s)[b]	Linking Month[c]	Restrictions for Inclusion of Consumers in Survey			
			Family Composition	Family Head or Chief Earner	Family Income	Other
					not have received income from an owned business equal to more than half the chief-earner's earnings.	earning over $2000 during year or $200 during any one month. Homemaker must not have worked away from home both day and night for more than 78 days in the year.
1950-52[g]	1947-49[h]		Two or more persons.	Family-head must have been employed at least 26 weeks in year.	Under $10,000 after taxes, in survey year. Families with no income from wages or salaries excluded.	_____
1953-63	1950	December 1952	Two or more persons.	Wage-earner or clerical, sales, or service worker (except domestic worker). Must be employed.[i]	No more than $10,000 after taxes.	_____
1964-77	1960-61	December 1963	Two or more persons; also single workers. At least one full-time wage-earner or clerical worker. Employment for a minimum of	_____	More than half of combined family income from wage-earner or clerical-worker occupations.	_____

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Expenditure Weights—Group Level

Applicable Years	Survey Year(s)[b]	Linking Month[c]	Restrictions for Inclusion of Consumers in Survey			
			Family Composition	Family Head or Chief Earner	Family Income	Other
			37 weeks for at least one family member			
1978-86	1972-73	December 1977	_____[j]	_____	_____[j]	_____
1987-97	1982-84	December 1986	_____[j]	_____	_____[j]	_____
1998-2001	1993-95	December 1997	_____[j]	_____	_____[j]	_____
2002-03	1999-2000	December 2001	_____[j]	_____	_____[j]	_____
2004-05	2001-02	December 2003	_____[j]	_____	_____[j]	_____

[a]Prior to 1978, "consumer price index for urban wage earners and clerical workers" (CPI-W); see Table 1.
[b]For group weights. For surveys providing item weights, see sources.
[c]Where known.
[d]Income limitation of $2000, for salaried workers, incorrectly stated in Bureau of Labor Statistics (1966, p. 84; 1997 updated, Appendix 1).
[e]Latter restriction incorrectly interpreted as two separate restrictions, in Bureau of Labor Statistics (1966, p. 84; 1997 updated, Appendix 1).
[f]Restriction incorrectly included as part of general non-wage one-fourth income restriction, rather than separate clause, in Bureau of Labor Statistics (1966, p. 84; 1997 updated, Appendix 1).
[g]Index corrected, back to 1940, for rent-component "new-unit bias" (downward bias of CPI under rent control, with rent for most new units exempt from control but excluded from computation for lack of "earlier" rent comparison). See Bureau of Labor Statistics (1951, pp. 1-10).
[h]1934-36 weights adjusted to postwar pattern, based on expenditure surveys in seven cities in 1947-49, and other sources, including food-consumption surveys by Department of Agriculture.
[i]Bureau of Labor Statistics (1966, p. 84; 1997 updated, Appendix 1) states that "major portion of income of family head must be from employment as wage earner or salaried clerical worker." This restriction is not found in Lamale (1959, p. 235), who writes: "No restrictions are placed on the sources from which [family] incomes were obtained."
[j]Above (1964-77) restriction applies only to "consumer price index for urban wage earners and clerical workers" (CPI-W).

BLS = Bureau of Labor Statistics

Sources: Anonymous (1953, p. 163), Bureau of Labor Statistics (1924, p. 2; 1954, p. 17; 1966, p. 84; 1997 updated, pp. 1, 8, 11, Appendix 1), Cage, Greenlees and Jackman (2003, p. 41), Lamale (1959, pp. 189-91, 208-10, 234-36), Williams and Hanson (1941, pp. 359-61).

Even for a given weighting pattern, a CPI, in principle (and whether under the COG or COL approach), involves a constant quality of goods in the market basket; so the prices of commodities should be adjusted downward to reflect any quality improvement. Otherwise, the CPI is biased upward over time. The BLS uses various methods to adjust for quality change within a given expenditure pattern—as discussed, for example, in Hulten (1997), and Johnson, Reed, and Stewart (2006, pp. 14-17). For a critique, see Schultze and Mackie (2002, ch. 4).

Returning to changes in expenditure weights; when there is such a change, then the old series (based on the former weighting pattern) must be linked to the new series (based on the new weighting pattern), in order for there to be a consistent series over time. Therefore the CPI-U and CPI-W are, in fact, chain indexes—though with the chains occurring discretely. The linking months, such as are known, are listed in the third column of Table 2. BLS publications do not reveal when (and, indeed, how) linking occurred in its series prior to the year 1952. Clearly, linking did occur in connection with earlier changes in weights; for a BLS publication states:

> Linking Old and New Series…continuous indexes are shown in historical tables from 1913 to date. This is made possible by 'linking' or 'splicing.' This means double calculation for a single date of old and new samples, with old samples or weights used for comparison with earlier periods and new samples or weights for comparison with later periods.—Bureau of Labor Statistics (1966, p. 72)

The final four columns of Table 2 summarize the consumer, or household, coverage of the pertinent consumer expenditure survey, and therefore the coverage for the weighting pattern. In terms of geographic area, the *urban* consumer has always been the focus of the BLS CPI. Household coverage has also been subject to restrictions of other kinds, as the table shows. Important liberalization occurred in 1964, when single-person households were included in the survey (and therefore in the expenditure pattern). However, for the CPI-W, restriction to consumer units that have a wage-earner or clerical worker goes back to initiation of the BLS CPI and continues to this day. The representativeness of the resulting weighting pattern is discussed from a historical standpoint in Bureau of Labor Statistics (1966, p. 9). Currently, "the urban wage earner and clerical worker population consists of "consumer units with clerical workers, sales workers, craftworkers, operatives, service workers, or laborers" (Bureau of Labor Statistics, 1997 updated, p. 1, n. 1). The "W-population" has always excluded households composed exclusively of workers that are professional or self-employed or part-time or unemployed, or composed exclusively of persons not in the labor force.

The "U-population"—in effect since 1978 for the CPI-U, and since 2000 for the C-CPI-U—does not have these exclusions. Both the W-population and U-population are confined essentially to the urban civilian non-institutional population

D. Characteristics of Samples

Tables 3 and 4 summarize important characteristics of the BLS CPI as these characteristics changed over time.

Table 3
BLS Consumer Price Indexes
Characteristics of Samples[a]

Years	Nature of Prices[b]	Number of Urban Areas[c] for Price Collection		Census for Population Weights[d]
		Food	Other Items	
1913	retail prices for food, wholesale prices for other items[e]	40	—	———
1914	retail	41	19	unweighted
1915	"	42	"	"
1916	"	45	"	"
1917	"	"	32	"
1918-19	"	50	"	average of 1920 and 1930
1920-29	"	51	"	"
1930-39	"	"	33	1930
1940-42	"	"	34[f]	"
1943-49	"	56	"	1940[g]
1950-52	"	"	"	1950
1953-63	"	46[h,i]	46[h,i]	"
1964-65	"	50	50	1960
1966-77	"	56	56	"
1978-86	"	85	85	1970
1987-97	"	91	91	1980
1998-	"	87	87	1990

[a]Updated to include later revisions.
[b]All price data are collected by BLS.
[c]Cities or metropolitan areas. Maximum number during year.
[d]For combining area indexes.
[e]Extrapolation for United States based on these prices. See *Monthly Labor Review* 10 (January 1920, p. 97).
[f]34 largest cities in 1940.
[g]Supplemented by ration-book registration data.
[h]Until this date, no small cities (under 50,000 population).

[i]Urbanized areas and small cities, to represent places of all sizes down to 2500 population.

BLS = Bureau of Labor Statistics

Sources: Bureau of Labor Statistics (1925. p. 59; 1966, pp. 9-10, 84; 1997 updated, pp. 7-9, Appendix 1), Bureau of the Census (1949, p. 230; 1975, p. 191), Cost of Living Division (1940, p. 373), *Monthly Labor Review* (various issues), Williams (1943, p. 82), Williams and Stewart (1941, p. 30).

1. Nature of prices

In essence, the BLS "true" CPI begins in the year 1914. As the second column of Table 3 shows: from that year, the CPI was composed exclusively of retail prices. The BLS desired to have 1913 as the index reference base for the CPI; because, after World War I, this year was the reference base for indexes of whatever kind. The BLS employed retail prices of food but wholesale prices of other items to carry the index back to 1913: "From data relating to food prices and to the *wholesale* prices of other groups of commodities, the changes from 1913 to December 1914…have been computed." (*Monthly Labor Review*, 10, January 1920, p. 97) [italics in original]. This procedure means that the CPI figure for 1913 is suspect—of course, whether or not 1913 is the index reference period. Other scholars have so commented:

"Later BLS publications began consumer price series with a number for 1913, but that is merely an extrapolation based on data for retail food prices and *wholesale* prices of some consumer commodities."—Hanes (2006, p. 154) [italics in original]

"Since the cost-of-living figures did not run back of December, 1914, the increase between 1913 and that date could be only an estimate based on the movement of retail food prices and that of the wholesale prices of clothing, fuel and light, house furnishings, and so forth, during this period. The amount of this increase was set at 3 per cent, so that with 1913 serving as 100, the index for December, 1914, was expressed as 103."—Douglas (1930, p. 45)

2. Geographic areas

The number of geographic (urban) areas for price collection is listed in the third and fourth columns of Table 3. The watershed year is 1953. Until that year, sampling occurred only in large cities (over 50,000 population). Also until that year, the number of cities was always greater for food than for the other items. As stated in a BLS publication,

> Up to the 1953 revision, the cities priced for the index were not chosen by systematic sampling methods to represent the total U.S. urban population. They were selected primarily because of their individual importance in

> wage negotiations. Some effort was made to obtain regional representation for the food index, but not through systematic sampling procedures. Small cities (under 50,000 population) were not represented…In the 1953 revision, a new sample of 46 urbanized areas and small cities was selected to represent urban places of all sizes down to 2,500 persons….The 1953 revision placed emphasis on the national average. City indexes, except those for very large cities, were considered to be byproducts of the U.S. index calculation.—Bureau of Labor Statistics (1966, pp. 9-10)

Geographic areas (still sometimes termed "cities") for the CPI include both metropolitan areas and nonmetropolitan urban areas, but rural nonmetropolitan areas remain excluded, as they always have been.

3. Weighting pattern for city indexes

For the U.S. national index, city indexes must be averaged. An arithmetic average has always been employed. The final column of Table 3 summarizes this computation. From 1918 onward, a population-weighted average was eventually used. However, for 1913-17, an unweighted average was originally taken and has never been revised via a population (or other weighted) average—unbelievable though this appears. This BLS decision (or, rather, non-decision) is important for construction of the new long-run CPI series. Therefore one ought to be certain of the fact. Fortunately, BLS publications over the years are explicit on the issue.

"The 19 city indexes available from 1913 through 1917 were originally combined without population weights, and this method has been retained for this period."—Cost of Living Division [of BLS] (1940, p. 391)

"The 19 city indexes available from 1913 through 1917 were originally combined without population weights, and this method has been retained."—Williams and Stewart (1941, p. 30)

In a BLS 1966 publication, in a table column headed "Census providing population weights," the entry for 1913-17 is "None."—Bureau of Labor Statistics (1966, p. 84). In the most-recent *BLS Handbook of Methods*, the same column heading has "None" as the entry until the year 1918.—Bureau of Labor Statistics (1997 updated, Appendix 1).

4. Intra-annual frequency

For 1914-18, the CPI was originally published only for December. For 1919-20, it was published for June and December; for 1921, for three months; and for 1922-29, for four months. Regular quarterly figures began in 1935 and monthly in 1940. Eventually, the BLS presented the U.S. all-items CPI monthly, continuously from January 1913. How were monthly figures obtained when monthly price data were not collected? A BLS publication reveals the technique: "Prior to September 1940, indexes were calculated for the United States and individual cities at irregular intervals. Subsequently, a monthly U.S.

all-items index was estimated back to 1913 based on food prices and estimates for other groups assuming an even rate of change between pricing dates." (Bureau of Labor Statistics, 1966, p.10). So linear interpolation was applied, along with some other (principally food) price information, between monthly dates of true figures. BLS publications do not make clear how these two elements were integrated.

5. Major groups

Table 4 presents the major groups of the BLS CPI as it changed over time. There are many types of changes in aggregation structure, only some of which are apparent in the table. Using changes in 1953 and 1998 as examples, and making use of Lane (1996, p. 24) for information regarding the latter year, the various kinds of changes are listed and illustrated with examples from these years.

Table 4
Major Groups of BLS Consumer Price Index

Initial Year of Publication	Groups
1920[a]	Food, Clothing, Housing, Fuel and Light, Furniture and Furnishings[b], Miscellaneous
1940	Food; Clothing; Rent[c]; Fuel, Electricity, and Ice; House Furnishings; Miscellaneous
1948	Food; Apparel; Rent; Fuel, Electricity, and Refrigeration; Housefurnishings; Miscellaneous
1953	Food, Housing, Apparel, Transportation, Medical Care, Personal Care, Reading and Recreation, Other Goods and Services
1964	Food, Apparel and Upkeep, Housing, Transportation, Health and Recreation, Other Goods and Services
1978	Food and Beverages, Apparel and Upkeep, Housing, Transportation, Medical Care, Entertainment, Other Goods and Services
1998	Food and Beverages, Apparel, Housing, Transportation, Medical Care, Recreation, Education and Communication, Other Goods and Services

[a]Year in which index for United States (as distinct from individual cities) first published.
[b]Also called "House-Furnishing Goods."
[c]Also called "Housing."

Source: BLS website; Bureau of Labor Statistics (1966, pp. 81, 97-98; 1978, p. 22); Cost of Living Division [of BLS] (1940, p. 370); Mason and Butler (1987, p. 3); *Monthly Labor Review* (various issues); Williams, Hogg, and Clague (1935, pp. 820, 826).

Division of major group: In 1953, the Miscellaneous major group was divided into Transportation, Medical Care, Personal Care, Reading and Recreation, and Other Goods and Services.

Amalgamation of major groups: Again in 1953, Rent and Fuel, Electricity, and Refrigeration were combined into Housing.

All examples below pertain to 1998.

Change in name of major group: Entertainment was changed to Recreation.

Creation of new major group: Education and Communication was created via transfer of components from other major groups (for example, "education" components from Other Goods and Services).

Transfer of component from one subgroup to another: "Maintenance and repairs" was moved from "housing—shelter" to "housing—household furnishings and operations."

Transfer of component from one major group to another: "Recreational reading materials" was transferred from Other Goods and Services to Recreation.

Restructuring of components within major group: In Food and Beverages major group, "butter" was moved from "dairy products" to "fats and oils."

Merging of strata: Within Medical Care, three hospital strata were collapsed into one stratum ("hospital services").

Division of stratum into multiple new strata: Within the Food and Beverages major group, "food away from home" was restructured into "full-service restaurants," "limited-service restaurants," "food at employee sites and schools," "food from vending machines and snack bars," and "other food away from home." These replaced "lunch," "dinner," and "other meals and snacks."

III. Unofficial CPI Series

A. List and Summary Characteristics of Series

Why would one need to consider unofficial (that is, non-BLS) CPI series at all? One reason is that the earliest BLS CPI series begins only in 1913, although a series for food exists earlier. For a long-run CPI series, recourse to unofficial (privately created or individual-state produced) series is mandated. A second reason is the possibility that, even for the BLS era (1913 onward), for some years, an unofficial series might be superior in quality to the BLS series.

Tables 5 and 6 present salient characteristics of non-BLS CPI series that can be described legitimately as original. Series of a composite nature are excluded, as these are logically considered in separate sections, which follow. If an author has more than one original

series, they are listed in the table as separate entries; their composite feature is recognized in section VI.

For each series, Table 5 shows the period for which the series is available (annual period, except if only monthly figures are shown in the source), the nature and source of price data, and the nature and source of weight data. All the series use the Laspeyres (or modified-Laspeyres) index-number formula; some involve a change or changes in weights, so that a chained index results. Table 6 presents the major commodity groups of the unofficial series. This table is comparable to Table 4, for the BLS series. The text that follows considers each unofficial series in turn, providing some additional description, offering criticisms, and listing sources where the series is described and/or critiqued.

Table 5
Characteristics of Pre-1913 Non-BLS Series of Consumer Price Index
Original Series[a]

Series and Source	Period	Price Data		Weight Data	
		Nature	Source	Nature	Source
Falkner-1, in U.S. Senate [Aldrich Report] (1892, p. LIX)	June 1889 - September 1891	retail	specially collected	expenditures of 2562 "normal" families in 1888-90, detailed expenditures of 232 families in 1891	Commissioner of Labor (1891, 1892), budgets especially collected and provided to Committee on Finance by Department of Labor
Falkner-2, in U.S. Senate [Aldrich Report] (1893, p. 93)[b]	1840-91	wholesale	"	"	"
Mitchell (1908, p. 91)[c]	1860-80	retail	Weeks (1886)	expenditures of 2567 families in 1888-90, detailed expenditures of 232 families in 1891	Commissioner of Labor (1904), budgets especially collected and provided to Committee on Finance by Department of Labor
NICB, in Biederman (1967, p. 128)[d]	1914-58[e]	retail	collected by NICB via mail questionnaires, except BLS price indexes used for food until 1940-41	expenditures of wage-earner and clerical-worker families	separate weights for four periods[f]

Table 5
Characteristics of Pre-1913 Non-BLS Series of Consumer Price Index Original Series[a]

Series and Source	Period	Price Data		Weight Data	
		Nature	Source	Nature	Source
Burgess (1920, p. 54)[g]	1841-1920	retail	various[h]	expenditures of typical wage-earner's family in 1901	Commissioner of Labor (1904)
CNL (1920, p. 118), DNL (1938, pp.13-17)[i]	1910-38	Massachusetts: retail	questionnaires, interviews, special studies, trade quotations[j]	expenditures of wage-earner and clerical-worker families	1910 - June 1931: NICB (see note f, for 1914-30); in July 1931, new weighting pattern "after much study and investigation" (DNL, 1931, p. 21; 1938, p. 9)
Hansen-1 (1925a, p. 32)	1820-40	Boston and New York: wholesale[k]	Boston newspapers, Report of the Secretary of the Treasury for 1863	expenditures of 2562 "normal" families in 1888-90, detailed expenditures of 232 families in 1891; weights in British cost-of-living index used for clothing items	see Falkner-1, Silberling (1923, p. 234)
Hansen-2 (1925a, p. 32)	1890-1913	food: retail, other items: wholesale[l]	BLS	expenditures of wage-earner and clerical-worker families in 1917-19[l]	*Monthly Labor Review* (May-July 1919)
Douglas-1 (1926, p. 22; 1930, pp. 41, 60)	1890-1914	wholesale converted to retail; retail for some food items, 1890-1914, and for coal and gas, 1907-14	BLS	expenditures of 11,156 "normal" families and of 2567 families, in 1901	Commissioner of Labor (1904)
Douglas-2 (1930, pp. 57, 60)[m]	1914-26	BLS index revised by taking city averages, weighted by population, and by interpolating	BLS	expenditures of wage-earner and salaried-worker families in 1917-19	Bureau of Labor Statistics (1924)

Table 5
Characteristics of Pre-1913 Non-BLS Series of Consumer Price Index Original Series[a]

Series and Source	Period	Price Data		Weight Data	
		Nature	Source	Nature	Source
		missing months (via CNL and NICB indexes)			
T. M. Adams (1944, pp. 20-21)[n]	1800-1940	Vermont: retail prices paid by Vermont farmers	Store sales records[o], physicians' records, farmers' accounts books	expenditures of Vermont farmers; weights computed at 10-year intervals and shown at 20-year intervals	volume of sales of general stores, Tiffany (1939)
Hoover-1 (1960, pp. 142, 143)[p]	1851-80	retail	mainly Weeks (1886)[q]	expenditures of 397 Massachusetts wage-earner families in 1875, expenditures of 232 families in 1891	Massachusetts Bureau of Statistics (1875), see Falkner-1
Hoover-2 (1960, p. 162)	1880-90	food: retail; clothing: wholesale	Burgess, Falkner-2	expenditures of families in 1891	Commissioner of Labor (1891, 1892)
Long (1960, p. 157)	1880-90	retail, mainly for specific localities or states, some for U.S.; some prices annual, others for scattered years	U.S. Senate (1892), Massachusetts Bureau of Statistics of Labor (1901), Commissioner of Labor (1904), T. M. Adams (1944), Post Office Department (1956), various individual-state reports[r]	expenditures of 2567 families in 1901, detailed expenditures of 232 families in 1891	Commissioner of Labor (1904), see Falkner-1
Rees (1961 p. 74)[s]	1890-1914	mainly retail, some wholesale; advertised rents	Douglas (1930); Sears, Roebuck and Montgomery Ward mail-order catalogue data; newspapers in six cities; BLS publications;	expenditures of 25,440 families and detailed budgets of 2567 families, in 1901, expenditures of families of wage-earners and salaried	Commissioner of Labor (1904), Bureau of Labor Statistics (1924), some use of Commissioner of Labor (1891, 1892)

Table 5
Characteristics of Pre-1913 Non-BLS Series of Consumer Price Index Original Series[a]

Series and Source	Period	Price Data		Weight Data	
		Nature	Source	Nature	Source
			questionnaires completed by gas companies in eight cities; reports of New Jersey Bureau of Industrial Statistics	workers in 1917-19, expenditures of some families is 1888-90[t]	
Lebergott (1964), p. 549	1860-80	retail	food: Mitchell (1908); clothing and fuel: Hoover (1960); rent: Wells for benchmark change 1860-68, interpolated 1861-67 and extrapolated 1869-80 via equally weighted index of cost of construction materials and labor[u]	expenditures of 397 Massachusetts wage-earner families in 1875, budget reports for employees in various New England and Middle Atlantic states	Massachusetts Bureau of Statistics (1875), Special Commissioner of the Revenue [Wells Report] (1869), some use of other information
D. R. Adams (1967, p. 221; 1968, p. 424)	1790-1830	Philadelphia: wholesale	Bezanson, Gray, and Hussey (1936-37)	expenditures of laborer's family in Philadelphia in 1833	Carey (1833)
Brady-David-Solar, in David and Solar (1977, p. 16)	1774-1851	benchmark years: retail prices; for some years, housing prices obtained via rent index, itself proxied by construction-costs index (equal weighting of materials and labor), allowing for productivity growth;	Brady (1966); T. M. Adams (1939); Bezanson, Gray, and Hussey (1936-37); Bezanson, Daley, Denison, and Hussey (1951)	expenditures of families in 1830s; weighted average of farm, village, city; modified weights for benchmark years for which transportation price index missing	Brady (1972); for rent and fuel, weights assigned "close" to those of Hoover (1960) and "roughly approximate" those of D.R. Adams (1968); for some clothing items, weights based on information in Seaman (1852)

Table 5
Characteristics of Pre-1913 Non-BLS Series of Consumer Price Index
Original Series[a]

Series and Source	Period	Price Data		Weight Data	
		Nature	Source	Nature	Source
		1800-51: interpolator series constructed from prices paid by Vermont farmers; 1774-99: wholesale prices converted to retail			

[a]Or original component of composite series. "All items," or the equivalent.
[b]Reprinted, 1860-80, in Mitchell (1908, pp. 59-60).
[c]Reprinted in Hoover (1960, p. 153).
[d]Series published in many other NICB publications; for example, Stecker (1926, pp. 30, 59), Beney (1936, pp. 57-61), and Sayre (1948, pp. 35-42). Series reprinted, in part, in Carr (1924, p. 495), Douglas (1930, p. 50), and Bureau of the Census (1949, p. 236).
[e]Series discontinued after 1958.
[f]1914-30: Weights based on consumer-expenditure studies of BLS and other entities, conducted between 1901 and 1917. 1931-39: Weights based on consumer-expenditure studies of BLS and other entities, conducted between 1921 and 1929. 1939-54: Weights from BLS consumer-expenditure survey of 1934-36, supplemented by NICB survey of one city (Joliet) in 1940-41. 1954-58: Weights from BLS consumer-expenditure survey of 1950. Series segments made consistent by recomputing indexes on common time base.
[g]In dollars. Published as index number in Tucker (1934b, pp. 26-27) and Bureau of the Census (1949, p. 235; 1960, p. 127; 1975, p. 212).
[h]Source is not stated explicitly; Burgess (1920, p. 52) mentions only that the price data emanate "from a number of different sources." In a broader context, involving prices beyond the components of his index, Burgess (1920, pp. 46-47) lists "a number of sources: reports of the United States Bureau of Labor Statistics and the Massachusetts Bureau of Statistics of Labor; the Aldrich Report of the Senate; records of Army and Navy purchases, and other miscellaneous records and reports."
[i]Also published in the other annual reports of the Commission and the Division (its successor entity). Reprinted, in part, in Stecker (1926, p. 89) and Douglas (1930, p. 50).
[j]See Stecker (1926, pp. 95-96) and Douglas (1930, p. 49). "The retail prices of each article…have been collected by the Commission from original Massachusetts sources" (Commission on the Necessaries of Life, 1920, p. 20).
[k]See Hansen (1915, p. 804).
[l]See Hansen (1925b, p. 294).
[m]Also published, 1914-24, in Douglas (1926, pp. 23, 24).

[n]Index number of retail prices of commodities and services purchased by Vermont farmers for family living.
[o]Records of general stores "until past the middle of the nineteenth century, when their usefulness for this purpose was greatly diminished by the increasing specialization in merchandising" (T. M. Adams, 1944, p. 17).
[p]Reprinted in Bureau of the Census (1960, p. 127; 1975, p. 212) and Carter, Gartner, Haines, Olmstead, Sutch, and Wright (2006, p. 167), contribution of Peter H. Lindert. Reprinted, 1860-80, in Long (1960, p. 156).
[q]Other sources: Retail prices for fruit derived from wholesale prices [source: Bezanson, Denison, Hussey, and Klemp (1954), U.S. Senate (1893)]. Prices for a few items from T. M. Adams (1944), and for newspapers from eight newspapers themselves.
[r]Also, prices of newspapers from newspapers themselves, for eight cities.
[s]Reprinted in Bureau of the Census (1960, p. 127; 1975, p. 212).
[t]Weights vary annually for fuel-and-light group, to account for growth in gas component during period.
[u]For cost of labor, Lebergott's own series of daily wages of nonfarm employees.

BLS = Bureau of Labor Statistics
CNL = Commission on the Necessaries of Life
DNL = Division on the Necessaries of Life
NICB = National Industrial Conference Board

Table 6
Characteristics of Pre-1913 Non-BLS Series of Consumer Price Index
Original Series[a]
Major Groups of Commodities

Series and Source	Groups
Falkner-1, in U.S. Senate (1892, p. LVIII)	Food, Cloths and Clothing, Fuel and Lighting, Metals and Implements, Lumber and Building Materials, Drugs and Chemicals, Housefurnishing Goods, , Miscellaneous
Falkner-2, in U.S. Senate (1893, pp. 61, 63, 85, 91)[c]	Food, Cloths and Clothing, Rent[b], Fuel and Lighting, Housefurnishing Goods, Miscellaneous
Mitchell (1908, p. 84)	Food, Clothing, Rent, Fuel, Lighting, Sundries
NICB, in Biederman (1967, p. 99)	Food, Apparel, Housing, Transportation, Sundries[d]
Burgess (1920, pp. 52-53)	Food, Other[b]
CNL (1920, p. 111)	Food, Clothing, Shelter, Fuel and Light, Sundries
Hansen-1 (1925a, p. 29)	Food, Clothing, Fuel, Light
Hansen-2 (1925b, p. 294)	Food, Cloths and Clothing, Fuel and Light, House Furnishing
Douglas-1 (1930, p. 41)	Food, Clothing, Fuel and Light, Furniture and Furnishings, Liquor and Tobacco
Douglas-2: see Table 4 (entry for 1920)	Food, Clothing, Housing, Fuel and Light, Furniture and Furnishings, Miscellaneous

Table 6
Characteristics of Pre-1913 Non-BLS Series of Consumer Price Index
Original Series[a]
Major Groups of Commodities

Series and Source	Groups
T. M. Adams (1944, p. 17)	Food, Clothing, Building Materials, Medical Care, Taxes, Fire Insurance, Transportation, Other
Hoover-1 (1960, p. 142)	Food, Clothing, Rent, Fuel and Light, Other
Hoover-2 (1960, p. 162)	Food, Clothing, Rent[b], Other[b]
Long (1960, p. 157)	Food, Clothing, Rent, Fuel and Light, House Furnishings, Other
Rees (1961, p. 74)	Food, Clothing, Rent, Fuel and Light, Home Furnishings, Liquor and Tobacco, Other Items
Lebergott (1964, p. 549)	Food, Clothing, Rent, Fuel and Light, Other
D. R. Adams (1967, pp. 136, 138)	Food, Clothing, Fuel
Brady-David-Solar, in David and Solar (1977, p. 46)	Food, Clothing, Rent, Fuel, House Furnishings, Personal Care, Tobacco, Transportation

[a]Or original component of composite series.
[b]Price index assumed constant or given the same movement as average of other groups.
[c]See also Hansen (1925a, p. 29, n. 5).
[d]Transportation and Sundries combined until 1955. Prior groups: originally, Food, Clothing, Housing, Fuel and Light, Sundries (Stecker, 1926, p. 30; Beney, 1936, p. 13); then, Food, Housing, Clothing, Fuel, Housefurnishings, Sundries (Sayre, 1948, p. 35).

B. Discussion of Series

1. Falkner

Falkner-1: Roland P. Falkner, Statistician for the Senate Committee on Finance, developed the earliest U.S. CPI series, listed in the tables as Falkner-1 and Falkner-2. These series are identified with the Senate documents in which they appear—usually termed the "Aldrich Report," after Nelson W. Aldrich, chairman of the Subcommitee on Tariff, under whose auspices the Falkner series were published.

Falkner-1 is praiseworthy for its early use of retail prices in a CPI series. In fact, two such series are provided: an unweighted average of component series, and a weighted average (with weights described in Table 5). Descriptions of Falkner-1 are in U.S. Senate (1892, pp. XI-LIX) and Bureau of the Census (1975, p. 183). In a critique, Hoover (1960, p. 159) observes the short time period of the series: "The retail price data cover a twenty-eight month period and thus have such limited usefulness that they are referred to infrequently."

Falkner-2: Falkner-2, which applies wholesale prices to weights obtained from consumer expenditure surveys—a combination to be adopted by other developers of CPI series—is described in U.S. Senate (1893, pp. 59-94) and Hansen (1925a, p. 30). Falkner-2 has been subjected to much criticism. Hansen is an admirer, and notes that (1) the food component consists of genuine food items, and (2) while cloth represents much of the clothing group, in the period covered by the series, cloth rather than clothing constituted much of consumer purchases in that group. However, even Hansen admits: "It is, of course, impossible to say to what extent the wholesale prices of these things give a correct picture of the movements of the cost of living."

A deficiency of Falkner-2 (and Falkner-1), shared by the series of many early scholars (see Table 6), is the absence of direct measurement of the price movement for the major group "rent" (or "housing," or "shelter"). The Falkner-2 series accounts for this omission by providing two indexes, differing in the assumption made about rent (and the prices of other items for which price data were not available). In one index, rent (and these other prices) is assumed constant throughout the time period; in the other index, they are omitted from the index (equivalent to given the same movement as the index for the items for which price is measured). Neither assumption is a good substitute for true data!

Mitchell (1908, pp. 61-62) discusses Falkner-2. He has two criticisms. First, "applying weights drawn from family expenditures in purchases at retail to series of relative prices at wholesale is illogical." Second, "the articles for which Falkner had wholesale prices and to which he applied the weights are in large part not articles which enter into family consumption but raw materials from which consumption goods are produced or articles which a family does not consume in any form" (Mitchell, 1908, p. 62)

Hoover (1960, p. 159) has four criticisms of the Falkner-2 series. (1) Averaging relative prices without correcting for gaps in the series, which could be done by interpolation or linking. (2) Using January prices to represent prices for the entire year, although quarterly prices were available. (3) Representing retail by wholesale prices, without adjustment. (4) Lack of data for rent and for services in general. Points (2) and (3) are also made by Bureau of the Census (1975, p. 183): "These indexes were prepared as estimates of changes in wage earners' cost of living, but, in actuality, they were indexes of wholesale prices for one month of each year."

Long (1960, p. 50), referring explicitly to the Falkner-2 as well as Hansen series, offers an excellent summary of the advantages and disadvantages of using wholesale prices to represent retail prices (implicitly, for the 19th century). Advantages: "the wholesale prices apply to more commodities and were collected in greater abundance and possibly with more precision as to quality-grade and date." Disadvantages:

> the prices presumably charged the working man [retail prices]…could deviate widely from wholesale prices among different localities because of transportation cost from the wholesale markets, or differences in degree of competition among retail stores or differences in quality, in credit policy, and in delivery service. They could wander widely from the path followed

> by wholesale prices over time, because retail stores absorb wholesale price increases at some times or increase their margins at other times—depending on competition, store policy, and consumer resistance, on variations in wages of store and delivery clerks and cost of fuel, light, and heat, or on changes in the standards of cleanliness and attractiveness of packaging. Also, retail prices can be collected for finished goods and services of the kind not ordinarily reported in the nineteenth century sources on wholesale prices—confined as the latter were to basic or raw materials.

2. Mitchell

Mitchell (1908, pp. 63-88) describes his own series, acknowledging that his data source, the Weeks Report of the 1880 Census, "…is far from being an ideal source of information" (p. 65). Mitchell rejects all series in the Report that either are not expressly annual averages or not continuous for the entire period (1860-80). Hoover (1958, p. 313) comments that these restrictions were imposed to avoid errors due to differences in quality over space and poor representativeness of a June 1 price for an annual average. Hoover criticizes Mitchell for not making interpolations for missing data in other situations.

In truth, and as noticed by Long (1960, p. 52), Mitchell (1908, pp. 85-86) is skeptical of the accuracy of his own index, for several reasons: (1) small number of towns from which prices emanate, (2) conjecture entering into determination of weights, (3) weights for much later period applied to prices of 1860-80, (4) only 56 percent of expenditure covered by prices, (5) application of constant weights over long period of time.

Elsewhere, Hoover (1960, p. 152) praises Mitchell's index: "The weighted cost of living index compiled by Wesley C. Mitchell for his study of *Gold, Prices and Wages under the Greenback Standard* was the result of manifest care and attention to every detail." While summarizing Mitchell's work, Hoover (1960, pp. 152-57) does make a few criticisms, implicitly or explicitly: (1) Mitchell's data criteria mean that he discards more than half the series in the Weeks Report. (2) Mitchell assumes that the price change for all unpriced items averaged the same as prices changes for the priced items in the index as a whole, whereas this assumption is better made group-by-group.

Long (1960, pp. 50-56) discusses Mitchell's index, noting Mitchell's self-criticisms and making some additional ones of his own: (1) loose specification of items, concealing quality differences, (2) uncertainty of the time of year to which prices refer, (3) Deep South not represented, (4) unweighted rather than weighted average of individual-city series, (5) underweighting clothing, while overweighting rent, (6) averaging price relatives rather than actual prices for a given commodity, leading to upward bias in index.

Lebergott (1964, pp. 338-43) defends Mitchell. Lebergott shows that different weighting patterns make little difference in results. Also, he approves of Mitchell's restrictions for

data inclusion: “the wisdom of Mitchell’s exclusion of June 1 and nonspecified series is suggested by an examination of the detailed price quotations.” (Lebergott, 1964, p. 338).

3. National Industrial Conference Board (NICB)

For descriptions of the NICB series, one may consult Stecker (1926, pp. 5-6, 28-62, 102-107), Beney (1936, pp. v-vi, 3-42, 57-61), Vaughan (1954), Sayre (1948, pp. 1, 6-42), and Bureau of the Census (1949, p. 229; 1975, p. 183). The NICB series emanates from true surveys for July 1914; June and November, 1918; March, July, and November, 1919; and then monthly from 1920 to 1958. So the NICB series is distinguished by having continuous monthly surveys much earlier than the BLS series. Therefore, for the early years, the NICB annual average is superior in technique to that of BLS.

Comparisons of the early BLS and NICB series are performed by Barnett (1921) and Carr (1924). Douglas (1930, pp. 46-53) discusses the NICB series and performs a comparison with the BLS index over a longer period. His evaluation of the NICB series relative to BLS is most instructive, and is rearranged here to highlight the differences between the two indexes.

Advantages of NICB over BLS are: (1) NICB collects prices from a larger number of cities; (2), NICB index for sundries (miscellaneous group) is based on direct quotations, whereas, prior to 1918, the corresponding BLS index is a weighted average of indexes of the other groups; (3) NICB weights items within clothing group, whereas BLS does so only from 1920 onward.

Disadvantages of NICB versus BLS are: (1) NICB data are obtained via questionnaire, whereas BLS data are collected by field agents—the latter a more-reliable method; (2) NICB group indexes are generally based on fewer commodities than those of BLS; (3) NICB classifications of commodities can be more general than those of BLS, leading to price quotations for non-identical items within the same category; (4) NICB estimates of rent are usually made by an official of a local real-estate board, leading to overestimation of rent increases, as only dwelling units for which rents have changes are likely to be considered; (5) NICB reports are not always for the same cities, in contrast to BLS reports; (6) NICB weighting system is more out-of-date than that of BLS.

4. Burgess

Hoover (1958, pp. 313-14; 1960, pp. 159-60) offers a good summary of the Burgess index. Descriptions of Burgess are also in Bureau of the Census (1949, p. 229; 1960, p. 111; 1975, pp. 192-93). The Burgess index number pertains solely to ten staple food items. Burgess assumes that the prices of other items change in proportion to the food index. In another context, Williams, Hogg, and Clague (1935, p. 819) write: “In a period of rapidly increasing prices during and immediately following the World War, it became increasingly clear [to BLS] that a measure of changes in food costs was not an adequate measure of changes in total living costs.” Long (1960, p. 52) criticizes Burgess

specifically, not only for relying entirely on prices of food items but also for providing little information on data sources.

5. Commission, and Division, on the Necessaries of Life (CNL, DNL)

This entity—and the index it produced—pertains to the state of Massachusetts, with the DNL a successor body to the CNL. The CNL-DNL index is described in CNL (1920, pp. 20, 111-18), DNL (1931, pp. 21-24; 1938, pp. 9-12), Stecker (1926, pp. 6-7, 87-101), and Douglas (1930, pp. 48-50). The index is praiseworthy for its true monthly figures, even going back to 1910: "Monthly quotations have been secured before and after the base period [1913]" (CNL, 1920, p. 112). The principal limitation of the index is its geographical limitation, confined to only one state.

6. Hansen

Hansen-1: The Hansen-1 index is described in Hansen (1925a, pp. 29-30). Hansen (1925a, p. 29) defends his use of wholesale prices: "In so far as it is impossible to get retail prices, we shall at least be much nearer the truth as to changes in the cost of living if we construct an index for food, clothing, fuel, light, and house furnishings weighted roughly according to the expenditure of workingmen's facilities." However, his use of wholesale prices is criticized by Long (1960, p. 50) and David and Solar (1977, p. 18). The latter authors also note unfavorably the narrow scope of the index (see Table 6).

Hansen-2: Hansen-2 is described in Hansen (1925b, p. 294) and Coombs (1926, p. 115). The scope of Hansen-2 is only slightly greater than that of Hansen-1. The absence of rent, in particular, mars both Hansen indexes.

7. Douglas

Douglas-1: The Douglas-1 series is described in Douglas (1926, pp. 17-22; 1930, pp. 19-42), Hoover (1958, p. 314), Bureau of the Census (1949, p. 229; 1960, p. 111; 1975, p. 193), and Hanes (2006, p. 156). Rees (1961, pp. 76-80, 105-106, 113-16) not only describes Douglas-1 but also subjects it to criticism, as follows:

1. The weight for starchy foods within food is biased downward, partly explained by the relatively high income of the families in the BLS 1901 survey (employed by Douglas).

2. The use of the wholesale price index "cloths and clothing" to represent clothing prices at retail creates problems. First, the wholesale index includes some items (carpets, sheets, blankets) that are not clothing. Second, the index includes items (leather, linen, shoe thread, raw silk, wool, yarn) that require processing, if bought by consumers.

3. The "fuel and light" group includes crude petroleum before 1907, omits gas before 1907, and omits kerosene after 1907.

4. The prices of unpriced items (rent and price of sundries) are assumed to move with the entire index of priced items. Because the unpriced items are largely services, the better assumption would have their prices moving with the index of nonfood groups.

5. Douglas does not justify using weights only of "normal" families in the 1901 study. Using the weights of all families would have been preferable on three grounds: (a) definition of "normal" is restrictive, (b) restriction to "normal" lowers average family size, (c) "all families" sample is larger, almost double the size, of "normal families" sample, (d) average income of normal families is greater than that of all families.

One might add to this list the omission of rent from the Douglas-1 index. Douglas (1930, p. 41) himself comments: "It is unfortunate that no accurate index of rents could be included in the final figures."

Douglas-2: None of the criticisms of Douglas-1 apply to the Douglas-2 index, described in Douglas (1930, pp. 53-59). What Douglas-2 does is take the BLS series for 1914-26 and make several improvements, as follows:

1. To construct the U.S. overall CPI, Douglas takes the average of the overall CPI for each city, whereas BLS takes the average of the city indexes for each major group and then computes the weighted average of these U.S.-wide group indexes. The BLS procedure involves the, overly restrictive, assumption that the weighting pattern for each major group is the same in all cities. Douglas (1930, p. 46) observes that "The Bureau, moreover, has not changed its method of computing a countrywide index. This is still based upon the average fluctuation in the main groups of commodities for the country as a whole, rather than upon the average for the cities." However, it appears that the BLS later did change its procedure to that of Douglas, retroactively—but only from 1918 onward (see section II.D.3 above).

2. Douglas computes the U.S. index as a population-weighted average of the city indexes, whereas BLS uses an unweighted average. Again, BLS changed its procedure to that of Douglas, retroactively from 1918 (see section II.D.3 above).

3. The BLS series was computed from direct price collection not continuously but only for scattered months, between December 1914 and December 1926. Douglas provides figures for the missing months. He writes: "It is desirable to secure an average index for each year as a whole, and in order to do so it is necessary to compute the most probable indexes for each of the months which intervened between the dates when the Bureau of Labor Statistics made its periodical surveys. The average of the monthly indexes gives us, in turn, the yearly figure." (Douglas, 1930, p. 54)

To obtain the missing monthly figures, Douglas (1930, p. 56) rejects linear interpolation: "There is no surety, however, that this easy assumption of even changes within a period is true. Such a movement is not only highly improbable on logical grounds, but is disproved by the uneven rate of movement of retail prices." Interestingly, linear interpolation constitutes a large component of the method used retroactively by BLS to

obtain the missing months—undertaken by BLS about a decade after Douglas wrote (see section II.D.4).

In contrast, to estimate CPI for the intervening months, Douglas uses as interpolators the CNL index for 1915-19 and the NICB index for 1920-26. The method is "based on the assumption that the cost of living as it would have been shown by the Bureau of Labor Statistics during these missing months *followed the same general relative movement* as those of the Massachusetts and Conference Board's indexes, and that any difference over a period in the rate of the movement of the two indexes which were being used was distributed evenly throughout the period in question" (Douglas, 1930, pp. 56-57) [italics in original]. The method is described in greater detail in Douglas, 1930, pp. 626-28). [That is Appendix F, not Appendix E (wrongly stated by Douglas, 1930, p. 56).]

8. T. M. Adams

The series of T. M. Adams receives praise from Hoover: "This report is enlightening for cost of living studies, because it includes costs for some services, such as medical care and shoe repairs" (Hoover, 1958, pp. 314-15). "I am convinced that, despite its geographical limitations, it is a pretty good indicator of what happened to retail prices in this period [1800-51]…These Vermont indexes are unique for this period in that they are the only indexes available that are based on retail prices" (Hoover, 1959, pp. 391, 400).

However, Hoover (1959, pp. 400-401) also criticizes the Adams series, in two respects. Her first point is that price movements in Vermont may differ from those in the more heavily populated areas of the eastern seaboard. This problem would be less acute after 1850, she argues, because of improved transportation and communication. However, Kendrick (1960, p. 188) sees an advantage of the rural nature of the series, for the first half of the 19th century: "As we move back in time, the relative important of consumer outlays in rural areas increases."

Hoover's second criticism is that averages are composites of various goods and qualities purchased in a given year, so that the index reflects changes in both price and quality of commodity. David and Solar (1977, p. 18) make the same criticism. In fairness, one should comment that the criticism, in various degrees, can apply to any historical CPI series.

Margo (1992, pp. 179-180, 189) supports Hoover's first criticism, as he comments that the Adams series does not cover working-class nonfarm households. That group, of course, is the traditional target consumer of a CPI. Margo also notes that the behavior of the series from the early 1820s to the early 1830s is inconsistent with other information.

Lebergott (1964, pp. 334-35) echoes two of the criticisms made by others. First, an index for Vermont farmers may differ from that for the rest of U.S. consumers. Second, the weighting pattern of the food group—zero or low weight for meat, bread, and flour; high weight for tea, butter, and fish—was not reflective of wage-earner, as distinct from farmer, expenditure. The same remark might be made regarding the absence of rent from

the index. David and Solar (1977, p. 18) echo this criticism, and also mention two other limitations of the series: the geographical isolation of Vermont, and the heavy weight of imported goods in the index.

9. Hoover

Hoover-1: The Hoover-1 index is described in Hoover (1960, pp. 141-61, 183-85) and Bureau of the Census (1960, p. 110; 1975, p. 192), Long (1960, pp. 53-56), and Lebergott (1964, pp. 338-43). Hoover-1 differs from the Mitchell index in extensive use of the data in the Weeks Report. Hoover includes, rather than excludes, (1) price quotations for a single date in the year (or without any date stipulated), and (2) price series that are incomplete over the time period of the series.

Long praises Hoover for using more price data for a given year, thus reducing the impact of extreme quotations. He is also pleased with Hoover's averaging of price relatives rather than actual prices (Mitchell's procedure). However, Lebergott and David and Solar (1977, p. 22) point out that inclusion of prices for June 1 (alone for a given year) can distort the annual price changes, due to seasonality. Thus Lebergott (1964, p. 338) observes "the wisdom of Mitchell's exclusion of June 1 and nonspecified series."

Margo (1992, p. 190) notices another defect of Hoover-1: it underestimates increases in 1851-56, in particular, for food prices and rent. The reason, he points out, is that the Weeks data pertain largely to company stores and company-owned housing in small towns. The small increase in rent is inconsistent with "considerable anecdotal evidence of rising housing prices, particularly in northeastern cities in the early 1850s, due to massive immigration."

Hoover-2: This index, presented in Hoover (1960, pp. 162-63), is not discussed by other authors, probably because it was quickly superseded by the Long series. Hoover-2 is a particularly weak index: retail prices used for food—the only reasonable feature of the index—wholesale prices employed for clothing, direct pricing for no other commodity group.

10. Long

Regarding retail price data, Long's index (like that of Hoover-2) pertains to a difficult time period, 1880-90, between the Weeks Report data (ending in 1880) and the start of BLS monthly data on food items (beginning in 1890). The series is described in Long (1960, pp. 56-61), and Long acknowledges the paucity of basic data: "whereas the Burgess index included only food, the present one includes food, shelter, fuel and light, clothing, house furnishings, and miscellaneous items. The retail price data for these items are extremely thin and derive from a wide variety of sources" (Long, 1960, p. 56). Considering the latter point made by Long, he even uses the Weeks Report (for rents in 1880).

Given the problem of data availability, it is not surprising that scholars are not enthusiastic about Long's series: "The sparseness of the available data obliged him to use linear interpolation over the decade for important components, such as rent" (David and Solar, 1977, p. 23). "Clarence Long constructed a consumer price index for 1880-1890…from scanty retail price data and a series for rent that is nothing more than a straight-line interpolation between observations for 1880 and 1890" (Hanes, 2006, p. 156).

11. Rees

This series is described in Rees (1961, pp. 74-119, 154-57), Hoover (1959, p. 401), Bureau of the Census (1960, p.111; 1975, pp. 184, 193), David and Solar (1977, pp. 23-24), and, briefly, in Hanes (2006, p. 156). The series receives high praise from David and Solar (1977, pp. 23-24): "By tapping a wide variety of sources for retail prices in the years 1890-1914, Rees (1961) has provided a valuable successor to Douglas' index" (David and Solar, 1977, p. 23). Rees' effective use of mail-order price data is especially noteworthy.

12. Lebergott

This index is described by Lebergott (1964, pp. 337-52), David and Solar (1977, pp. 22, 75-76 [n. 23]), and Hanes (2006, p. 156). Lebergott takes the best of the CPI series of previous scholars and also does original work. David and Solar (1977, p. 75, n. 23) observe, approvingly, Lebergott's use of the Wells Report: "Lebergott's eclectic approach is justified by [his own] comparisons between the components of the existing indexes and the price changes over the interval 1860-1867/68 as estimated by David Wells....Wells' statistical skills were unchallenged by his contemporaries, and what indications we have of his sample show it to cover the North geographically and industrially."

13. D. R. Adams

Descriptions of this series are in Adams (1967, pp. 131-66, 215-21; 1968, pp. 412-14, 424). David and Solar (1977, p. 18) criticize the index for its reliance on wholesale prices and the absence of rent. Adams (1968, p. 413) admits to these limitations and also states another weakness: an unchanged weighting pattern over time. However, he considers that these problems have a small quantitative effect on the index. Whether an index confined to Philadelphia can legitimately represent the index for the entire country—even for the early time period treated—is an unasked, and therefore unanswered, question.

14. Brady-David-Solar

Descriptions of this index are in David and Solar (1977, pp. 1, 3, 15-21, 24-27, 40-57); Carter, Gartner, Haines, Olmstead, Sutch, and Wright (2006, p. 159), CPI team (see section VI.B.9); and, briefly, Hanes (2006, p. 156). Margo (1992, pp. 180-81, 188-91) criticizes the index on several grounds:

(1) The use of Adams' Vermont data to interpolate between benchmark dates is questionable, because of the behavior of Adams' series (see section 8 above).

(2) As a proxy for housing costs, Brady-David-Solar present an index of annual reproduction costs. "There is considerable qualitative evidence that rental prices of housing deviated from reproduction costs in the short run, particularly during periods of high emigration" (Margo, 1992, p. 180). Also, Margo states that "the adequacy of a proxy based on common laborers' wages and building materials remains to be demonstrated." Although not mentioned by Margo, David and Solar are to be praised for incorporating productivity growth in their construction-cost index (which proxies rent). However, the understating of actual rent might thereby be exaggerated.

It is interesting that Douglas (1930, pp. 39-40) argues against proxying an index of rent by an index of construction costs, even if one allows for productivity increase—but he sees the proxy series as *overstating* actual rent: "the resultant index would measure merely the movement of building costs; it would not measure the relative rents actually paid by the tenants themselves. The experience of the last decade indicates that in periods of rising prices, rents increase more slowly than ether the general price-level or the cost of building."

(3) The series underestimates price increases in the mid-1830s, in part because the benchmark data "show sharp declines in prices of coffee and tea…[and] extraordinary short-run declines in the prices of several clothing items" (Margo, 1992, p. 189).

(4) The weight for food is lower "than is customary in nineteenth-century price indices" (Margo, 1992, p. 189).

The present author can make two further criticisms of the Brady-David-Solar series. First, the conversion of the *Philadelphia wholesale* prices to *entire-U.S retail* prices in 1774-1800 rests on some strong assumptions. David and Solar themselves recognize the situation: "In extending the BDS index back to 1774, we have assumed that the correspondence between the movements of consumer prices and wholesale prices observed during the first part of the nineteenth century reflected the persistence of conditions which had obtained in the Eastern seaboard region during the last quarter of the eighteenth century" (David and Solar, 1977, p. 21). The implicit equating of Philadelphia prices with Eastern seaboard prices may be noted.

Second, without explanation, David and Solar use data from the preliminary work of Adams (1939) rather than his final study (Adams, 1944).

IV. Criteria for Selection of Component Series of New Long-Run CPI Series

Having exposited the various "original" CPI series, how is one to choose among them, in order to construct the desired long-run composite series? While judgment is required, a set of criteria makes the basis of judgment explicit. The criteria used in this study are established below. Much of the judgments made by other scholars on these series

implicitly reflect these criteria. It behooves someone to make the criteria explicit, and the present author has no qualms about taking the responsibility.

A. Nature of Prices

Ideally, prices used in any CPI series are at the retail level. A second best would be wholesale prices converted to retail by some sensible method. A third best would be unconverted wholesale prices. Then comes cost of inputs, then one among simple interpolation, assignment of movement of other prices, and assumption of constancy of prices.

B. Comprehensiveness of Coverage

One wants to maximize the coverage of the typical-consumer's market basket. Omission of a major group, such as rent or housing (which omission occurs in some historical CPI series) would be a clear deficiency of the series.

C. Intra-Annual Frequency of Prices

An average of twelve monthly prices, uniformly collected over the year, is the ideal. If this ideal is not attainable, then an annual average of prices taken with greater frequency is generally superior to the average of prices taken with lesser frequency. However, there are exceptions to this rule. An example would be frequency involving only a few months, one of which has a strong seasonal component.

D. Applicability of Quantity or Expenditure Weights

The issues regarding applicability of the weighting pattern were mentioned in section I.B.2.b. A weight reference base period too far away from the current period loses its relevance, in the light of changing tastes, changing incomes, changing quality of existing goods, and introduction of new goods. The series becomes increasingly out of date and loses its COL characteristic. The preference is for a weight reference base period as close as possible to the series period. If the series goes beyond a reasonable length, then one must resort to a chain index.

E. Quality of Data

The price and quantity data should be of high quality. If they are not of high quality, then there might be a trade-off with another criterion. For example, a high-quality wholesale price of a commodity might be superior to a low-quality retail price.

F. Computation and Use of Area Series

For precision of the series, it is desirable to have comprehensive geographic coverage. The ideal technique would be the construction and population-weighted (not unweighted)

averaging of area series. For early CPI series, this criterion is difficult to meet, due to lack of data.

G. Number of Series

Other things being equal (which phrase applies to all the criteria), there should be a minimum number of component (original) series; for introduction of a component series carries an inconsistency to the long-run series. Obviously, there could be a trade-off between this criterion and applicability of the weighting pattern (criterion D).

H. Length of Series

Unless it fills a gap in the long-run series or fulfills one or more of the other criteria, a short series is undesirable; for it introduces inconsistencies in the long-run series while providing only a small number of observations.

V. Need for Composite Series

No one original series, all of which are exposited in section IV, exists for a sufficiently long time period to constitute the desired long-run CPI series all by itself. It follows that any long-run CPI series must be a chain series—but not with annual linking, rather with longer-period linking of component (selected-original) series. Availability of original CPI series arranged chronologically according to time-period coverage is shown in Table 7. Any long-term CPI series is composed of some combination of these "pristine" series.

Table 7
Availability of Consumer-Price-Index Series

Series	Period
Brady-David-Solar	1774-1851
D. R. Adams	1790-1830
T. M. Adams	1800-1940
Hansen-1	1820-1840
Falkner-2	1840-1891
Burgess	1841-1920
Hoover-1	1851-1880
Mitchell	1860-1880
Lebergott	1860-1880
Hoover-2	1880-1890
Long	1880-1890
Falkner-1	1889-1891
Hansen-2	1890-1913
Douglas-1	1890-1914
Rees	1890-1914
CNL, DNL	1910-1938

Table 7 Availability of Consumer-Price-Index Series	
Series	Period
CPI-W (1967 = 100)	1913-2005
CPI-W (1982-84 = 100)	1913-2005
NICB	1914-1958
Douglas-2	1914-1926
CPI-U (1967 = 100)	1978-2005[a]
CPI-U (1982-84 = 100)	1978-2005[a]
C-CPI-U	2000-2005

[a]1913-2005 on BLS website, but 1913-1977 is CPI-W series.

BLS = Bureau of Labor Statistics
CNL = Commission on the Necessaries of Life
DNL = Division on the Necessaries of Life
NICB = National Industrial Conference Board

Source: Tables 1 and 5, BLS website.

VI. Existing Composite Series

A. List of Series

Table 8 summarizes the composite series that previous scholars and official entities have placed in the public domain. The first column states the source or sources where the series is listed; the second and third columns present the period of each component series and the name of the component series. The authors of composite series differ in several respects: whether their own original series is/are included as a component series, whether they actually identify the component series, and whether they take care to justify the component series that they use. Each composite series is discussed in turn, and the present author uses the criteria established in section V to evaluate the series. It is obvious that a composite series is only as good as its component series!

Table 8 Composite Series of Consumer Price Index		
Study	Component Series	
	Period	Series[a]
Hansen (1925a, p. 32)[b]	1820-40	Hansen-1
	1840-90	Falkner-2
	1890-1913	Hansen-2
	1913-23	BLS[c]
Snyder-1 (1927, p. 290)	1875-90	Burgess
	1890-1910	BLS (retail food index)
	1910-25	BLS[d]

Table 8
Composite Series of Consumer Price Index

Study	Component Series	
	Period	Series[a]
Snyder-2, in Tucker (1934b, p. 26)	1860-1932	unstated[e]
Douglas (1930, p. 60)[f]	1890-1914	Douglas-1
	1914-26	Douglas-2
Federal Reserve Bank of New York (1957)[g,h]	1820-40	Hansen-1
	1840-60	Falkner-2 (per Hansen, 1925a)
	1860-80	Mitchell
	1880-90	Burgess
	1890-1910	Douglas
	1910-12	CNL
	1913-57	BLS
Hoover (1959, pp. 397-98)	1800-51	T. M. Adams
	1851-80	Hoover-1
	1880-90	Hoover-2
	1880-1913	Rees
	1913-58	BLS
Hoover (1960, pp. 142, 143, 162)	1851-80	Hoover-1
	1880-90	Hoover-2
	1890-1914	Rees
Long (1960, pp. 156-57)	1860-80	Hoover-1
	1880-90	Long
Bureau of Labor Statistics (1979, p. 397)[i]	1800-51	T. M. Adams
	1851-90	Hoover-1,2
	1890-1913	Rees
	1913-77	BLS
David and Solar (1977, pp. 16-17)[j]	1774-1851	Brady-David-Solar
	1851-60	Hoover-1
	1860-80	Lebergott
	1880-90	Long
	1890-1914	Rees
	1914-74	BLS (CPI-W series)[k]
HSUSME, in CGHOSW (2006, pp. 158-59): "David-Solar-based series"	1774-1974	David and Solar
	1974-2003	BLS (CPI-U series)[l]
HSUSME, in CGHOSW (2006, pp. 158-59): "BLS-based series"	1774-1913	David and Solar
	1913-2003	BLS (CPI-U series)[l]

[a]See Table 1 for description of BLS series, Table 5 for description of non-BLS series.
[b]Reprinted in Bureau of the Census (1949, p. 235) and, 1890-1923, in Coombs (1926, p. 116).

[c]Source: *Monthly Labor Review* (October 1919, July 1921, November 1924). "Since these data are given only at semi-annual or quarterly intervals, interpolations were made to get consistent yearly averages"—Hansen (1925b, p. 294).
[d]Incomplete or anomalous description, as BLS CPI begins in 1913. Monthly figures for this index interpolated from CNL data.
[e]"A full description of Snyder's revised index of the cost of living has not been published"—Tucker (1934a, p. 16, n. 11; 1934b, p. 27, n. 4). Snyder (1934, p. 390) writes only that his indexes of "retail prices and wages…are themselves composites from several sources." Snyder (1934, p. 391) does refer to the "pioneering work of Dr. W. R. Burgess, Professor Alvin H. Hansen, Dr. Ralph Hurlin, Dr. Roland P. Falkner, Professor Paul H. Douglas, Dr. Leonard Ayres, and others," but this is in reference to an entire set of indexes: wholesale prices, wages, retail foods, cost of living, urban rents, and building costs.
[f]Reprinted in Bureau of the Census (1949, p. 235; 1960, p. 127; 1975, p. 212).
[g]Some earlier versions are known outside the Bank: Federal Reserve Bank of New York (1938, 1941, 1953).
[h]Reprinted, on an earlier time base, for 1820-1913, in Bureau of the Census (1949, p. 235; 1960, p. 127; 1975, p. 212).
[i]Series for 1800-1972 in Bureau of Labor Statistics (1973, p. 287); for 1800-1970 in Bureau of the Census (1975, pp. 210-11).
[j]Reprinted as main part of HSUSME "David-Solar-based series." See next entry.
[k]1914-72: Bureau of Labor Statistics (1973, p. 287), 1972-74: *Monthly Labor Review* (1975, p. 95). CPI-W is the only BLS series for this period (see Table 1).
[l]Actually, and following BLS: CPI-W to 1977, CPI-U 1978-2003, with no linking of these series.

BLS = Bureau of Labor Statistics
CGHOSW = Carter, Gartner, Haines, Olmstead, Sutch, and Wright
CNL = Commission on the Necessaries of Life
HSUSME = Historical Statistics of the United States, Millennial Edition

B. Discussion of Series

1. Hansen

The Hansen composite series is clearly out of date; which is not surprising, given that it is the earliest such CPI series. Hansen (1925a, pp. 29-30; 1925b, p. 294) describes the component series that he adopts, but provides no explanation of their selection—although inclusion of his two series is logical. It is strange that he does not use Mitchell's series for 1860-80; perhaps the reason is that inclusion would involve splitting Falkner-2. Hansen does deserve praise for interpolating missing months of the BLS component (see note c in Table 8). However, the Hansen composite series, with reliance on wholesale prices for most of the period and the omission of rent throughout, clearly fails to satisfy criteria A and B in section IV.

2. Snyder

Snyder-1: The series is described in Snyder (1927, p. 137), but the component series are not justified. The index for most of the period pertains to food alone, thereby violating criterion B.

Snyder-2: Precise information on component series is not available; so this series is even less satisfactory than Snyder-1.

3. Douglas

This composite series is presented in Douglas (1930, pp. 60-64). The series is, of course, composed of the two Douglas original indexes, which are chained with December 1914 as the linking month. Douglas assesses the reliability of his composite series, identifying two sources of error. First, expenditure weights are unchanged over the period. He sees this problem as overcome by the use of 1901 weights for 1890-1914 and 1917-19 (1918) weights for 1914-26. Second, the same limitation applies to items within groups; consequently (he states) commodity substitution in response to relative-price changes is ignored. His defense is that the error is minimized, because the weighting patterns are mid-period rather than at the beginning or end of each period.

As discussed in section III, the Douglas-1 component of the composite series is subject to several criticisms; but the Douglas-2 component marks a clear improvement over the BLS series of the time—and, for the early years, even the current, revised and updated, BLS series. So the two components of the Douglas composite series vary sharply in quality.

4. Federal Reserve Bank of New York

The series is described in Federal Reserve Bank of New York (1957, p. 2), Bureau of the Census (1949, pp. 228-29; 1960, p. 111; 1975, p. 192), and Hoover (1958, p. 314). The Federal Reserve Bank does not justify the component series; but these are many, calling into question criterion F. Several of these series have limitations already mentioned in connection with composite series previously discussed. In fairness to Federal Reserve Bank of New York, as well as the previous authors of composite series, higher-quality series for much or all of their period had not yet been created. Certainly, the Federal Reserve Bank deserves credit for using the Mitchell series.

5. Hoover

Hoover's two series—discussed in Hoover (1959, pp. 391-93, 400-402; 1960, pp. 162-63)—are distinguished as the earliest composite series to employ component series all of which are of reasonably high quality. Use of the Adams series in preference to Hansen represents an improvement in terms of criterion A. Also, the Adams series permits Hoover to begin her composite series earlier in time.

6. Long

The Long composite is clearly the best that could be done at the time. The series is described in Long (1950, pp. 50, 60-61). Long , quite correctly, argues that his series is superior to the Mitchell-Burgess segment of the Federal Reserve Bank of New York composite:

> a new series of consumer prices for 1860-90, which behaves very differently from the series of the Federal Reserve Board [sic] prepared by linking the Mitchell and the Burgess indexes….How accurately this new index measures the cost of living is probably impossible to say. It rests on more data and is less subject to bias than the Mitchell-Burgess index, and it is surely more representative than a wholesale price index for adjusting wages of working people. But it is undoubtedly inferior to modern indexes, and could surely be improved by an exhaustive examination of newspaper advertisements, store catalogues, and business and family records."—Long (1960, p. 60)

7. Bureau of Labor Statistics

The BLS composite series is merely the Hoover (1959) composite rebased and updated. No credit is given to Hoover for the earlier composite.

8. David and Solar

To their credit, David and Solar (1977, pp. 15-17, 22-27) justify the adoption of each pre-BLS component of their composite series. An excellent summary description is in Carter, Gartner, Haines, Olmstead, Sutch, and Wright (2006, p. 159), CPI team (see section 9). In effect, David and Solar adopt the following rule for the pre-BLS components of their series: for any given segment of their time period, the series created by the latest author is selected. Consider each component of their composite series in turn:

1774-1851: In spite of its own limitations, Brady-David-Solar is the most-sophisticated CPI series for the first half of the 19th century that has yet been published, and clearly beats the competition: Hansen-1,2; T. M. Adams (1944); and D. R. Adams (1968)—as the discussion in section III demonstrates. The 18th-century component of Brady-David-Solar is less defensible; but it surely beats the alternative of an unaltered locality-specific wholesale price index.

1851-60: Hoover-1 is the most-recent CPI constructed for this decade, and is clearly superior to the older series (T. M. Adams, Falkner-2, Burgess). David and Solar comment that Hoover's inclusion of annual data limited to June 1 can give rise to harmful seasonality. However, and fortunately, David and Solar (1977, p. 75, n. 22) also report that Hoover-1 is consistent with an extended Brady-David-Solar series as well as with the Adams Vermont series.

1860-80: The Lebergott series trumps Hoover-1 for these decades. The eclectic nature of Lebergott's index is praised by David and Solar. They note that the Lebergott series exhibits a more-moderate decline over the period than does the Hoover series—"a divergence largely explained by Lebergott's substitution of a sub-index for purchased foods derived from Mitchell's work" (David and Solar, 1977, p. 22).

1880-90: The Long index is superior to its closest competitor, Hoover-2, though a comparison is not made by David and Solar. At least, Long uses retail prices for all groups, whereas Hoover does so only for food. Yet the data are sparse. David and Solar (1977, p. 23) are correct in their assessment: "Admittedly, Long's index is a comparatively weak link in the chain between the more solidly fashioned indexes for the periods 1860-1880 and 1890-1914, but it is the best of the series presently available for this purpose."

1890-1914: Selection of Rees over Douglas-1 makes eminent sense. Rees is based on retail prices much more than Douglas, and uses 1901 expenditures from all families rather than just "normal" families. Improvements over Douglas are well summarized by David and Solar.

1914-74: For the most-recent component of their composite series, David and Solar do not justify their adoption of CPI-W (the only BLS series available at the time). Alternative series were in the public domain when David and Solar wrote. Chief among these series were NICB and Douglas-2. True, substitution of these series for CPI-W could have been done for only part of the period, thereby bringing criterion F into play. Also true: Douglas compared the BLS and NICB series (see section III.B.3) and judged that, on balance, the BLS series (CPI-W) is superior to NICB. However, Douglas goes on to make improvements in the BLS index, generating the Douglas-2 series (see section III.B.7). Combining these two points, Douglas (1930, pp. 53-54) writes: "But while the index of the Bureau of Labor Statistics is probably the best for our purposes of any now being compiled, it can be improved in several respects." Yet the Douglas-2 series is ignored by David and Solar.

Though they do not comment on the matter, David and Solar adopt the Rees series over its complete length, 1890-1914, and link Rees to CPI-W in 1914. If the BLS series were the series of ultimate quality, then one would link in 1913—the beginning year of CPI-W. The treatment of David and Solar is correct, because the BLS figure for 1913 rests on a particularly weak foundation (see section II.D.1).

9. HSUSME

The HSUSME (Historical Statistics of the United States, Millennial Edition) series are a team effort. For the CPI, the team is composed of Christopher Hanes, Peter H. Lindert, Robert A. Margo, and Richard Sutch. The HSUSME "David-Solar-based" series continues the David-Solar series, updating it to 2003. Thus this HSUSME series has all the virtues and deficiencies of the David-Solar composite series. The HSUSME

"BLS-based series" has an additional defect over David-Solar, because the link to David-Solar (that is, to Rees) from BLS is made in 1913 rather than 1914—and, as just noted, the BLS figure for 1913 is not reliable.

Both HSUSME composite series suffer from an additional deficiency. These series take CPI-U as the BLS series. In fact, that BLS series is CPI-U only from 1978. Up to, and including, 1977, the so-called "CPI-U" is really CPI-W. True, it cannot be any other series, as CPI-U begins in 1978. The problem is that there is no linking from CPI-W to CPI-U. This is not the fault of the HSUSME team; for it simply reproduces the official CPI-U series.

VII. New CPI Series

A. List of Component Series

The component series of the new CPI series are listed chronologically in Table 9. The chronological order is descending rather than ascending, because component series are chained to the new CPI series proceeding backward in time and via the year of overlap. Obviously, the new series owes a lot to the pioneering data development (both original and composite) of David and Solar. Also, the new series must pay attention to the most recent composite series, those of HSUSME, which are themselves heavily based on the work of David and Solar. However, as a comparison of Tables 8 and 9 shows, the new series does differ from the composite series of these authors. A step-by-step explanation of construction of the new series is in order.

Table 9
Components of New Consumer Price Index

Period	Series[a]	Source
1982-2005	BLS: CPI-U (1982-84 = 100)	BLS website
1978-1982	BLS: CPI-U (1967 = 100)	"
1917-1978	BLS: CPI-W (1967 = 100)	"
1914-1917	Douglas-2	Douglas (1930, p. 57)
1890-1914	Rees	Rees (1961, p. 74)
1880-1890	Long	David and Solar (1977, p. 16)
1860-1880	Lebergott[b]	
1851-1860	Hoover-1[b]	
1774-1851	Brady-David-Solar[b]	

[a]For references, see Tables 1 and 7.
[b]Used in form of David and Solar composite series.

B. Foundation

The foundation of the new CPI series must be a currently available BLS series, because a desired feature of the new series is that it be readily updated—and no entity other than BLS currently provides an ongoing CPI series for the United States. Then which BLS index should one select? Table 1 shows the history of the three currently BLS series: CPI-W (consumer price index for urban wage earners and clerical workers), CPI-U (consumer price index for all urban consumers), C-CPI-U (chained consumer price index for all urban consumers). CPI-W is the latest-period component of the David-Solar composite; and at their time of writing, CPI-W was the only index produced by BLS. In contrast, all three BLS indexes were available when the HSUSME team offered its composite series. The HSUSME team selects CPI-U, without direct explanation of its choice; but the reasons for CPI-U over CPI-W are implicit in a comment by Hanes (2006, p. 155): "The current CPI-U series is based on consumption patterns of all urban consumers, while the CPI-W continues the older approach, with weights based on consumption of employed urban wage earners and clerical workers". So CPI-U is superior to CPI-W on two grounds: CPI-U is the more recently developed series, and its coverage is broader. It is reasonable to follow HSUSME and choose CPI-U over CPI-W.

Further, C-CPI-U can be ruled out. It is true that, from a COL perspective, C-CPI-U is the best of the three BLS series; but C-CPI-U has two disadvantages that CPI-U does not. First, as previous sections of this study have indicated, all other potential components of a composite series—whether these components are BLS-based or produced by other entities or authors, and whether the components are purely historical or current ongoing—have Laspeyres or modified-Laspeyres (Lowe) as index-number formula. So C-CPI-U would destroy a consistency feature of a composite series. Second, the C-CPI-U series begins in 2000. The number of observations that it would add to the composite series is so small that, arguably, criterion G would be violated (see section IV).

C. Enhancement of Reliability of Decimal Digit, 1967-82

The BLS website provides CPI-U annually to the present both on the 1982-84 and 1967 index reference period. These series are shown rounded to one decimal place. (BLS has plans to publish its CPI series rounded to three decimal places, but only for 1987 onward.) Going backward in time, the "1982-84 = 100" series falls below 100, and therefore exhibits only three significant digits, in 1983 and earlier; whereas this is true for the "1967 = 100" series in 1966 and earlier. So linking the latter series to the former on the basis of the 1982 overlap enhances the reliability of the 1967-81 component of the new series, so far as the decimal digit is concerned. This technique of reducing rounding error appears to be unique to the present data development. In particular, the technique is used neither by David and Solar nor HSUSME.

D. Linking of CPI-W to CPI-U

As stated in section VII, the HSUSME composite series adopt the official BLS "CPI-U" for the entirety of the 1913 (or 1914) to 2003 period; but that official series is true CPI-U

only for 1978 onward, reverting to an *unlinked* CPI-W for 1913-77. The new CPI series corrects this conceptual anomaly by linking CPI-W (1967 = 100) to the new CPI series via the 1978 overlap. This overlap incorporates the CPI-U versus CPI-W difference, where each series is on reference base 1967 = 100. True, the figure (on 1967 = 100) for CPI-U is close to that for CPI-W, at 195.4 versus 195.3. However, the adopted procedure is warranted; for it achieves not only conceptual consistency but also superior reliability of the pre-1978 figures.

E. Replacement of CPI-W by Douglas-2 Series

The early years of the BLS CPI (that is, CPI-W) were called into question by Paul Douglas, who created what is here called the Douglas-2 series with the express purpose of improving the BLS CPI figures (see section III.B.7). Previous scholars generating composite CPI series have overlooked the Douglas-2 series—perhaps because it was overshadowed by the Douglas-1 series, for the pre-BLS period. However, as exposited in sections III.B.7, and VII.B.3, Douglas-2 is a clearly superior series to CPI-W from December 1914 to December 1918.

To summarize the discussion in these sections, the improvements made by Douglas are: (1) obtain national CPI by averaging overall CPI over cities rather than by averaging each group index over cities and then applying group weights nationally, (2) average population-weighted rather than unweighted city indexes, and (3) interpolate missing months with minimal use of linear interpolation. It appears, from the discussion in sections II.D.3 and II.D.4 that, for the period 1914-17, none of the three Douglas-2 improvements have been made by BLS.

However, one should investigate anew whether that BLS failed to make the three Douglas-2 improvements for the entire 1914-17 segment of its series. While it is clear that BLS had not done so up to the time of Douglas' work, it is conceivable that BLS did so, retroactively, at a later date. The evidence thus far from BLS own publications is that BLS never made the Douglas-2 improvements for any of the years 1914-17. Corroborative evidence is sought.

No additional evidence is required for improvement (3), for which the situation is obvious. As described in section II.D.4, BLS did not provide true (non-interpolated) monthly figures until 1940, and the situation was worst in 1914-18, when only December figures were obtained directly. So that Douglas-2 improvement (3) is most critical for the 1914-18 period. No further evidence need be sought on the matter of improvement (3).

The situation is somewhat different for improvements (1) and (2). As shown in section II.D.3, these Douglas-2 improvements were made retroactively by BLS—but, it was argued there, only from 1918 onward. The objective here is to pinpoint the beginning year of the BLS improvements (1) and (2), made retroactively, after 1930 (the year of Douglas' main writing on CPI). As mentioned above (and see section II.D.3), BLS publications give no indication that these improvements have been made for the pre-1918

period; but independent evidence is introduced here to test that conclusion. This evidence emanates from BLS CPI figures themselves. The evidence is presented in Table 10.

Table 10
Consumer Price Index, December dates, 1914-18

Entry	Series and Source	Reference-Base Period[a]	Percentage Change over December 1914			
			Dec. 1915	Dec. 1916	Dec. 1917	Dec. 1918
1	Douglas (1930, p. 55)[b]	Dec. 1914	1.5	15.9	42.8	72.9
2	BLS (1927, p.112)[c]	Dec. 1914	2.0	14.9	38.3	69.3
3	CPI-W, BLS website	1967	2.0	13.8	34.9	62.5
4	”	1982-84	2.0	13.7	35.3	62.7
5	CPI-U, BLS website	1967	2.0	13.8	34.9	62.5
6	”	1982-84	2.0	14.9	35.6	63.4

[a]Period for which index is set equal to 100. Termed “index reference period” in International Labor Office (2004, p. 165), sometimes called “time base” (see section I.A.4).
[b]Douglas-2 series (see Table 5).
[c]Identical to BLS computations emanating from Douglas (1930, p. 55), who states as source “*Handbook of Labor Statistics*, p. 112.” Reference is clearly to BLS (1927). Reference base period is also the same.

Table 10 shows CPI December figures, for the years 1915-18, as percentage changes over the December 1914 figure. These five are the only pertinent months, because the BLS CPI (CPI-W) for these months alone, during 1914-18, emanates from direct price collection. Hence these figures do not reflect interpolation. Entry 1 is the Douglas-2 series, also obtained without interpolation. Entry 2 shows the Douglas-contemporary BLS figures for these months. Entries 3-6 exhibit computations from up-to-date BLS figures, taken from the BLS website. What can one conclude from comparing the entries for each December, 1915-18, relative to December 1914?

December 1915: There is no revision in BLS CPI for that date (relative to December 1914). With the Douglas figure substantially different from that of BLS, the Douglas-2 improvement in CPI-W clearly remains ignored by BLS.

December 1916: The BLS up-to-date (website) figures are inconsistent. Rounding differences or rounding errors (possibly compounded with revisions and changing reference base period over time) could be an explanation. It is uncertain which way such rounding differences or errors could go. With one BLS website figure (entry 6) identical to the Douglas-contemporary BLS figure (entry 2), one can conclude that the evidence in Table 10 is inconclusive, and therefore the conclusion drawn from BLS publications is not refuted. Hence the Douglas-2 improvements stand uncorrected by BLS for this date (relative to December 1914) as well.

December 1917: For this month, there is both a reasonable consistency among the BLS website figures and a distinct difference between these figures and the Douglas-

contemporary BLS figure. One cannot reject that BLS made substantive revisions for this month relative to December 1914. Looked at another way, one can compare the ratio of the average of entries 3-6 to entry 2, for each December. For 1915, this ratio is, of course, 100 percent. For 1916, the ratio is 94.3; whereas for 1917 and 1918, it is 91.8 and 90.6, respectively. It is known, from BLS publications, that BLS made the Douglas (2) and (3) improvements for 1918. The closeness of the 1917 and 1918 ratios is suggestive that the improvements were also, in effect, and at least partially, made for 1917—if not deliberately, then inadvertently in the context of more-general revisions, such as mentioned in Williams, Hogg, and Clague (1935, p. 827) or Cost of Living Division [of BLS] (1940, p. 392).

It behooves one to err on the side of conservatism and therefore to give BLS the benefit of the doubt for December 1917 and, from that month, for the entire year 1917—even though the situation is uncertain when one moves from Decembers to entire years. Therefore CPI-W is retained over Douglas-2 for the year 1917. However, evidence is sufficiently strong to support replacement of CPI-W by Douglas-2 for 1914-16. This is done, as shown in Table 9.

The problem is that Douglas does not provide a 1914 figure for the Douglas-2 series. He links Douglas-2 to Douglas-1 via the December 1914 overlap (Douglas, 1930, p. 60). It is true that Douglas (1930, p. 57) presents the Douglas-2 series, monthly and annually, for 1915-26, on index reference base 1914 (his Table 12). The series is headed "(1914 = 100)," and Douglas makes the express statement: "In this table, the point of reference has been shifted from December, 1914, to the year 1914 as a whole." Also, Douglas (1930, p. 58) goes on to discuss subsequent movement in the series relative to the "1914 level." However, this is one of the rare occasions in which Douglas is in error.

Douglas (1930, p. 55, Table 11) shows Douglas-2, in comparison to the BLS CPI, for the non-interpolated months. The reference base is stated, correctly, as "December 1914 = 100." The figure for December 1915 in Table 11 (December 1914 = 100) is 101.5; in Table 12 (ostensibly 1914 = 100), it is 100. It follows that the year 1914 as a whole had a higher price level than December 1914. However, there is an inconsistency; for Douglas (1930, p. 49) quotes approvingly an NICB estimate of a two-percent increase in the "cost of living" between July 1914 and December 1914:

"On the basis of retail food changes and wholesale commodity indexes, it was estimated that a liberal allowance for the change in the cost of living level between July, 1914 and December, 1914 was 2%" (Stecker, 1926, p. 64). (The Stecker volume is a revision of the NICB publication cited by Douglas.) In conformity, Douglas (1930, p. 49) states: "The Conference Board has estimated that the increase in all commodities during these five months [July-December 1914] was approximately 2 per cent." He surely accepts this estimate, because he uses it to scale down the NICB CPI series from July to December 1914 as reference base.

Given that acceptance, and given that Stecker (1926, p. 28) also writes of "the fact that the increase between the immediately preceding pre-war year, 1913, usually accepted as

normal, and July, 1914 was probably not more than 1%," it is not logical that Douglas believed that CPI decreased at all from January to July 1914, let alone decreased by an amount sufficient to explain a December 1914 figure lower than that for year 1914. It follows that the index reference period is incorrectly described as year 1914 in Douglas' Table 12. Then what is the reference period for that table, and therefore for the Douglas-2 series? The table shows a figure of 100 for October, November, and December, 1915. So December 1915, the figure for which is non-interpolated, can be construed as the index reference base period. Therefore the Douglas-2 series, taken for the new CPI series and listed in Table 9 here, is on base December 1915 = 100.

The problem is generating the 1914 figure for the Douglas-2 series on index reference base December 1915 = 100. The December 1914 figure (on base December 1915 = 100) is readily obtained as follows. The December 1915 figure is 101.5 relative to December 1914 = 100. Then 100·(100/101.5) = 98.52 is the December 1914 figure on index reference base December 1915. However, for linking purposes, Douglas-2 for1914 (December 1915 reference base) must pertain to the entire year, not just to December. Consider CPI-W (1967 = 100) on the BLS website. The (year 1914)/(December 1914) ratio for that series is 30.1/30.4. Therefore the year-1914 figure for Douglas-2 (December 1915 = 100) is estimated as (30.1/30.4)·98.52 = 97.5. It may be noted that this makes the Douglas-2 1915/1914 ratio 98/97.5 = 1.005, compared to the BLS CPI-W (1967 = 100) ratio of 31/30.4 = 1.020.

F. The Year 1913

Douglas-2 justifiably replaces the BLS series for 1914-16, but what about the year 1913? The BLS CPI figure for 1913 rests on an even weaker foundation than the BLS 1914-16 figures (see section II.D.1). Unfortunately, Douglas-2 lacks a figure for 1913 or any month thereof. Fortunately, the Rees series, for 1890-1914, has been judged to be an excellent index (see section III.B.11). So it is logical to use the entirety of the Rees series, covering year 1913 and providing a link to the new CPI (represented by Douglas-2) in 1914.

G. Pre-BLS Period

The David-Solar composite series is a landmark in historical CPI development for the United States, as far as the pre-BLS period is concerned. The most-recent long-run CPI series, the two HSUSME composites, each link the David-Solar composite series to the BLS CPI. For completeness, one must ask the question: did David and Solar make the best choice of component series for the pre-BLS period of their long-run series? If so, the David and Solar selection should be respected here. If not, an adjustment may be warranted for one or more of their component series.

From the discussion in section VI.B.8, it is apparent that David and Solar did indeed make the best selection of component series, shown in Table 8. This is not to deny that scope exists for superior "original" series. In particular, the Brady-David-Solar and Long

components have serious limitations—but they are the best series available for their respective time periods.

For completeness, and to minimize any rounding error, one should redo the linking process that David and Solar underwent to construct their consistent component series. Only part of the linking procedure can be replicated. David and Solar (1977, p. 16) exhibit the Brady-David-Solar (1774-1851) component already linked to the Hoover (1851-60) component. The Hoover and Lebergott (1860-80) component series are originally on time base 1860 = 100. Therefore one begins with the 1774-1880 segment of the David-Solar series already on a consistent time base, 1860 = 100. Entering as separate component series are Long (1880 time base) and Rees (1914 time base). Linking involving these components is redone, for the new CPI.

H. Comparison with Existing Series

1. David and Solar, 1774-1914

The new series has index reference base 1982-84 = 100, because all component series are linked, directly or indirectly, to the CPI-U (1982-84 = 100) component; see Table 9. For comparison with the pre-BLS (1774-1914) segment of the David-Solar composite series, which has index reference base 1860, the new CPI series is rebased to 1860 = 100. This is done—and for this purpose only—by dividing all years of the new CPI series by the new-CPI figure for 1860.

The HSUSME David-Solar-based composite series is identical to the David-Solar composite series for the full length of the David-Solar series, therefore also for the 1774-1914 segment. Thus the new CPI series, for the time period 1774-1914, is compared with both the David-Solar series and HSUSME David-Solar-based series.

The new CPI and the David-Solar composite series are identical to all significant digits of David-Solar (which does not have a decimal component). This result is not unexpected; for the differences in construction between the new CPI and David-Solar (apart from time base) are minimal (see section G). In fact, all that can be concluded from the comparison is that David and Solar link component series properly, as far as can be ascertained.

2. Bureau of Labor Statistics, 1913-2005

The logical BLS series to which comparison of the new CPI series should be made is the BLS official CPI-U series on the 1982-84 reference base, because CPI-U on the 1982-84 reference base is the foundation of the new CPI series. Note, for this comparison, no transformation of the new CPI series is required. The official CPI-U (1982-84 reference base) series is identical to the HSUSME “BLS-based series” for the time period 1913-2005; therefore comparison of the new CPI is made automatically also with that series.

Table 11 exhibits all cases of divergences between the new CPI and the BLS official CPI-U series. Divergences emanating from conceptual differences, or different component series, are quantitatively noticeable. These divergences are for the years 1913-1916, for which the Rees and Douglas-2 series are adopted in the new CPI in lieu of the BLS CPI. Less important quantitatively are the remaining divergences, scattered over the years 1952 to 1973. These, remaining, divergences result from the minor conceptual improvement (linking of CPI-W to CPI-U in 1982) and the technique of reducing rounding error.

Table 11
Divergences Between BLS CPI-U Series and New CPI Series, 1913-2005
(1982-84 Reference-Base Period[a])

Year[b]	BLS CPI-U[c]	New CPI[d]	Divergence	
			Level[e]	Percent[f]
1913	9.9	9.6	0.3	3.2
1914	10.0	9.7	0.3	3.2
1915	10.1	9.7	0.4	3.7
1916	10.9	10.6	0.3	2.5
1952	26.5	26.6	-0.1	-0.2
1953	26.7	26.8	-0.1	-0.2
1957	28.1	28.2	-0.1	-0.2
1959	29.1	29.2	-0.1	-0.2
1962	30.2	30.3	-0.1	-0.2
1965	31.5	31.6	-0.1	-0.2
1966	32.4	32.5	-0.1	-0.2
1973	44.4	44.5	-0.1	-0.1

[a]Average value 100 for 1982-84.
[b]For which magnitude of level divergence is at least 0.1 (allowing for rounding up from at least 0.05).
[c]Source: BLS website. Identical to 1913-2003 component of HSUSME "BLS-based series" (Carter, Gartner, Haines, Olmstead, Sutch, and Wright, 2006, pp. 158-59).
[d]Source: see text and Table 9.
[e]BLS CPI minus new CPI.
[f]Level divergence as percent of new CPI.

3. HSUSME, 1774-2003

HSUSME offers two composite CPI series, critiqued in section VI.B.9. Its stated reason for two series, in lieu of one series, is the avoidance of rounding error. Thus: "The user should refer to series Cc2 (base year 1860 [David-Solar-based]) to reduce rounding error for the pre-1913 era, when the absolute numbers were small. For more recent comparisons, refer to series Cc1 (base year 1982-84 [BLS-based])" (CGHOSW, 2006, p. 159). However, the use of two series for the purpose of reducing rounding error is unnecessary.

The new CPI is offered as a single series. The series involves all computations in double-precision (16-digit accuracy); and results are shown to two decimal places, the minimum necessary to incorporate all significant digits of the component series. It should be noted that the original component series to 1918 have two or three significant digits, while the BLS component series, for 1918 onward, have three or four significant digits. Digits beyond that number—whether in the new series or in any series based on the same components—are not a reflection of accuracy; they are presented for two reasons: (1) to have one rather than two series to incorporate all years, and (2) to aid in computations involving the new CPI.

VIII. Concluding Comments

The importance of the work of Paul A. David and Peter Solar in the new CPI series is apparent. Much as he tried, the present author could not improve their series for the pre-BLS era. The present author is also indebted to Christopher Hanes, Peter H. Lindert, Robert A. Margo, and Richard Sutch, for their generation of the HSUSME composite series that update the work of David and Solar. The Bureau of Labor Statistics must also be commended, for improvements in their series, even retroactively, over time. The new CPI study is properly viewed as an improvement to the work of these six authors and of the BLS.

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