

Measuring Worth is Better Without the CPI

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This paper is a rough draft and may be edited before the presentation. Please do not quote or cite.

* This paper is a continuation of the work started by Lawrence Officer and myself. We have collaborated on many of the issues discussed here. I also appreciate comments from Louis Cain and Bill Williamson.

Prologue

A version of this paper was submitted to the Quarterly Journal of Economics in 2005. It was more technical and even had a model, but the theme was the same. The article was rejected and it was based on the following referee's comments.

"...the CPI answers a specific economic question of great relevance. It estimates a first-order approximation to the expenditure function, and therefore provides an approximate measure of the amount of compensation required to allow an individual to purchase her consumption bundle at time t , but at time $t + 1$ prices.

Using prices to compare worth at a point in time and price indices to compare it over time is an imperfect approach, to be sure. Sometimes dollar prices are not readily available and must be imputed or calculated from a model as shadow prices. And there are many well-known flaws with index numbers. But these approaches are well-defined attempts to answer specific economic questions of measurement; the measures provided here are not."

Sometimes imperfect and flawed should over rule well defined approaches.

"The *real price* of every thing, what every thing really costs to the man who wants to acquire it, is the toil and trouble of acquiring it. What everything is really *worth* to the man who has acquired it, and who wants to dispose of it or exchange it for something else, is the toil and trouble which it can save to himself, and which it can impose upon other people.... But though labour be the *real measure* of the exchangeable value of all commodities, it is not that by which their value is commonly estimated.... Every commodity, besides, is more frequently exchanged for, and thereby *compared with, other commodities* than with labour.—Adam Smith, *The Wealth of Nations*, 1776.

"Cecil Graham: What is a cynic?

Lord Darlington: A man who knows the *price* of everything, and the *value* of nothing.

Cecil Graham: And a sentimentalist, my dear Darlington, is a man who sees an absurd *value* in everything and doesn't know the market *price* of any single thing." —Oscar Wilde, *Lady Windermere's Fan*, 1892.

As these quotations show, both economists and non-economists have long commented on the nature of "worth" and "value." Economists are often asked, "What is something worth?" Our usual answer is to use the language of "opportunity cost." We say that the worth of something is "the cost of the most valuable forgone alternative." What we tell people (explicitly or implicitly) is that the worth of something can only be measured in terms of the value of something else. And, as Adam Smith did in 1776, we tend to interchange the concept of "real price" with the concept of "worth."

The problem is that the alternative may differ for each individual. Thus, we usually use the price of the thing as its worth and let everyone "compute" the most valuable alternative that this money would buy for him or her. There are many shortcomings with this answer, particularly when we are making comparisons over different places or times, or between people with different backgrounds or resource endowments.

There are alternatives to these answers. One is suggested in the Adam Smith quotation: we can measure the worth of something as the number of hours of labor (by perhaps the average worker) it takes to earn the amount of money that the item costs. This helps to alleviate some of the comparison problems, as “labor value” can be used with different currencies, different time periods, and different places. However, this approach has its problems and is only one of many.

For the last 10 years I have provided relative value comparators on MeasuringWorth.com. The site receives around 100 thousand visits a month and about 60% of those are visits to the relative value comparators. Over the years, we have received innumerable requests from all manner of people asking us, “What is the worth today of a particular good or service that existed in a past year?” As examples, queries come from lawyers trying to settle old claims (even back to the 18th century, based on old treaties), from NASA historians trying to determine the relative cost of a Saturn rocket in the 1970s, and from ordinary citizens interested in the “real cost” of a gallon of gasoline.

To answer these queries as consistently as possible, there are now four comparators on MeasuringWorth that help explain to the user that the answer to “how much is something worth” depends on the context of the question. These are available for each of four countries: Australia, Spain, the U.S. and the U.K. Measuring the worth of a loaf of bread differs substantially from measuring the worth of the Interstate highway system. Users of our comparators often come back to us and ask how they are to decide which index to use. This paper presents an explicit answer to that question.

It is unfortunate that modern conventional wisdom presents the problem of the measurement of “worth” over time as solved, when it is not! Specifically, in the measurement of “worth,” almost all empirical application identify “real price” or “real worth” with “deflation” by the consumer price index (CPI).¹ Yes, it is important to remove the inflationary component in intertemporal comparisons of worth. We maintain, however, that “real price”—in practice, deflation by the CPI—often does *not* provide the comparison that one wants. The reason is that the result has been corrected only for the change in relative price between the item in question and a (conceptually) fixed or even varying bundle of consumer goods and services. While economists are trained to think in terms of relative prices, most people do not do so most of the time. Indeed, this is an issue in which the average person would find “affordability” to be more understandable, and there is a lesson here for the economist.

This difference is illustrated by the changes in the price of gasoline. This year, the “real price” of gasoline has been fluctuating around what it was in 1981 (\$2.90 in 2015 dollars.). Economists might say the burden was the same as it was a quarter century ago. Those who focus on affordability, however, would note the fact that real incomes have increased by about 75 percent during this period—in many contexts a fact more pertinent than the movement of the consumer price index.

¹ See the CPI Inflation Calculator at https://www.bls.gov/data/inflation_calculator.htm

The question is: what is the “worth” of something—whether a commodity, the input of a factor of production, the wealth of a person, an investment project, or a government service? That is what our comparators answer, and the purpose of this paper is to provide a methodological foundation for those answers. The question of “worth” is more complex than it seems, and we show that an unambiguous answer is impossible absent a specific context. Indeed, our empirical computations exhibit different definitions of the worth that can give answers that differ by up to 2,000 times for a comparison between 1800 and today, depending on the “deflator” selected². The purpose of this paper is to develop a process to be used when “worth” is computed, and to provide guidance for selection of the best definition, or often combination of definitions of worth.

The paper begins with different a process to create different definition of worth for a single time period (or point in time). Empirical case studies are applied statically to the year 1931, with subjects ranging from the famous (salary of Babe Ruth, unpaid taxes of Al Capone, cost of Empire State Building) to the mundane (wage of an accountant), and from the billion dollar (U.S. defense budget) to the small (price of a loaf of bread). We show that worth of subjects that existed in 1931 (or any other year) can be readily measured in terms of that year itself.

Then the methodology is extended to intertemporal comparisons, with comparative-static computation of worth. Subjects of 1931 are assigned worth in terms of the year 2015, but any other year could be chosen.

What Is Something Worth at a Point in Time?

In considering worth at a point in time (or a single time period) rather than in one point relative to another, the conventional technique of inflating or deflating by an annual price index, such as the often-employed CPI, is inapplicable. In principle, there can be thousands of ways to measure worth; most of them are independent of time. Every daily transaction involves an explicit or implicit computation of the relative worth. Each transaction can be looked at from more than one perspective; so one measure may well not be sufficient.

What we do here is present a general framework that defines nine broad based terms or definitions that can be easily recognized and helps the user measure the relative worth of an item. To start, we suggest that when talking about the (relative) worth of an item, first it should be categorized as a commodity, a project, or an observation of compensation or wealth. Then (and only then) to put the item in perspective it should be measured related to well-defined indexes of economic activity. We call these indexes “measures.”

The types of measures we suggest fall in three categories: an index of spending patterns, an index of income, and an index of output. Below we will add an index of price. In each case, the items relative worth is obtained by comparison with a measure: the “formula” is the cost or price as a proportion or multiple of the measure.

² The result from the US compare comparator is: In **2015**, the relative value of **\$1.00** from **1800** ranges from **\$18.30** to **\$37,600.00**.

The measures we use on MeasuringWorth in these three categories are the expenditures of the average household, two kinds of average wage and per-capita GDP, and total output as measured by GDP.³ These are selected for general use by the thousands of visitors to our website, since each user has their own context to measure against. Sometimes there is good reason to think that other measures would be more appropriate for a particular application as we will explain.

The Measures

Household Expenditures One of the most often asked question when deciding to buy something is “Can we afford it?” Each person approaches the market with a budget constraint. How much is spent on entertainment is measured against what is spent on food and housing. They are each part of the total household’s expenditures. Each purchase is measured against this total.

For the economy as a whole we can create the index called the “average household expenditure” (AHE). In the United States, average annual expenditures are measured by the BLS Consumer Expenditure Survey.⁴ For 2015 there were 128,437,000 households in the country with an average size of two and half people with 1.3 earners. The mean income of these households after taxes was \$60,448 and the measure of the AHE was \$55,629. Converted to a daily basis, this is \$153. As an aside, these surveys are what is use to define the content of what is measured in the CPI—the most widespread measure in the computation of worth.

Sometimes a specific bundles could be more appropriate. If one was writing a study of the spending by mine workers or the residents of a Springfield, then the average expenditures of those groups could be more informative than the AHE.

Output The total production of the economy as measured by GDP is the most comprehensive measure to evaluate worth. The GDP flow is usually measured over a year or at an annual rate, but again this is arbitrary. The U.S. GDP of approximately \$18 trillion per year corresponds to about \$570,000 per second. Again more specific measures of output may be more relevant to a particular question. When talking about a government program, the size of the government budget, or the size of the non-defense budget may be more appropriate.

Income Any index of income can be use. Usually the most used measure of income is the wage rate, which can refer to a specific worker, a group of workers (for example, unskilled workers), or all workers. The time period for the wage rate (hour, day, week, month, year) is arbitrary. For different comparators we have different measures of wage, such as average earnings, the unskilled wage and the wage of production workers. A second measure is per-capita GDP, which can be interpreted as a person’s average slice of GDP.⁵ Again, the time flow for GDP (year, quarter-year) is arbitrary.

³ There could be others that would be more appropriate for a particular item.

⁴ See Appendix A for a discussion of the history of these surveys.

⁵ The term GDP refers to three different measures of the output of the economy. They are the output, what is being spent to purchase it, and the income received for producing it. The

The Categories Of Things Being Observed

Commodity: Commodities in this context mean final (usually consumer) goods and services.

Project: A “project” is either an investment, such as construction of a church or new factory; or government expenditure, such as the financing of Medicare or a war. Also within this category are such items as the size of a government budget deficit, and the total assets or net worth of a company.

Compensation or Wealth: This is a flow of earnings or stock of wealth. It can be the earnings of a specific type of labor, such as a star athlete or an ordinary plumber, or the (average) earnings of a broad group, such as teachers.

Whatever is being observed, it must be expressed as the monetary amount of a unit, and it is the worth of that particular amount that is to be measured. The unit must be specified precisely, but the unit is arbitrary. Conventional units are often used (for example, a gallon of gasoline, a loaf of bread, an hour of unskilled labor, a professor’s annual salary); however, the unit could be any quantity (for example, 1000 loaves of bread, or total production of bread). Also, an entire project or stock could be the unit (for example, the U.S. Civil War, a government deficit, a person’s real-estate holdings). Anything may be assigned a “worth,” provided the “anything” is expressed in money terms (for example, the price of a gallon of gasoline or a loaf of bread, the value of all bread production, the cost of a war).

INSERT TABLE 1

Definitions of Relative Worth (Point in Time)

The definitions we present use the words *value*, *cost*, *share*, *status* and *power*. At this point we do not use either the words price or wage, as that is a bit tautological. Those are the units of the items we are looking at, so we need to present concepts that are independent of the price or wage we are measuring. Philosophers state that the most common way of preventing or eliminating differences in the use of languages is by agreeing on the definition of our terms. The terms used here are not new, however, I think everyone would agree there is no agreed upon definition of their meaning.

We present here a specific definition for each of the combinations of one of the three measures applied to each of the three types of items. The nine are presented in Table 1. For each cell, the formula for a definition of a measure of worth is the ratio of the type of item to one of the three measures. We present how the three measures can be applied to the items as they are generally categorized.

national income accountants measure the later two and try to resolve the small differences when reporting it. GDP per capita can mean the average share of the total income generated in the economy, so an income measure. It could also be thought of a way of comparing the output per person.

Household Bundle

(1,1) *Real Value* -- We define the *real value* of a commodity to be the ratio of that commodity's price (or value) to the size of the average household expenditure (AHE). For example, in 2015 the average nominal price of a one-pound loaf of bread was \$1.44, thus we can say that the real value of that bread was $1/106^{\text{th}}$ the daily AHE. This measure can be construed as the real value of the loaf of bread in terms of consumables forgone. In this case, the physical amount of the commodity is one loaf, but it can be greater, for example, the total number of loaves produced during a time period.

(1,2) *Opportunity Cost* -- The construction of a church or a government project requires the use of resources that are then not available for current (say, consumption) expenditure. We define *Opportunity cost* as the cost of the project divide by the AHE, that is, the average household expenditure that is forgone in order to build the project.

(1,3) *Purchasing Power* -- The household bundle is a useful way to measure relative incomes and wealth. We define the ratio of a particular income, salary or wage to the AHE, as its *purchasing power*. For example in 2015, the average wage in the United States according to the Social Security Administration was \$46,200.⁶ This is only 83% of the AHE, so we are not surprised that with this purchasing power, the average household has more than one "bread" earner. On the other hand, the median average hourly wage of a neurosurgeon was \$175, and over nine and a half times the average hourly AHE. Given that the weekly AHE was \$1,076, the neurosurgeon could cover that in about six hours of work (the cynic might say "and now have lots of time for golf.") Consider now a stock variable. The reported wealth of Bill Gates is \$81 billion, or a wealth that is worth about 1,445,000 of what the average household spends in a year.

Output

(2,1) *Economy Share* -- Occasionally it makes more sense to measure the worth of a commodity as its share of total output. We define this ratio as the *Economy Share*. In 2015 there were over six million cars and trucks produced in the US and in the national income accounts it is reported that the production of motor vehicles and parts was \$464.8 billion out of the GDP of over \$18 trillion. So the economy share of cars and trucks that year is 2.6%. For comparison the \$40 billion output of bread was a mere .22% of the output of the economy.

(2,2) *Economy Cost* -- Projects or expenses, such as large-scale investments, government deficits, or wars, logically have their project's opportunity cost measured as an *Economy*

⁶ This is the Average Wage Index that "is based on compensation (wages, tips, and the like) subject to Federal income taxes, as reported by employers on Form W-2." Beginning with the AWI for 1991, compensation includes contributions to deferred compensation plans, but excludes certain distributions from plans where the distributions are included in the reported compensation subject to income taxes. We call the result of including contributions, and excluding certain distributions, net compensation.

Cost, the ratio of project cost to GDP. For these items, share of GDP is often the measure of choice, because it focuses on opportunity cost in terms of the total output of the economy.

(2,3) *Economic Power* -- Comparing compensation or wealth to GDP provides a sense of the amount of *economic power* it commands. Any debate involving the Citizens United case focuses particularly on this issue. Many believe that the rich have access to political favors that are denied to the average person. Their income and wealth as a share of the output of the economy is one measure of their power.

Income

(3,1) *Labor (or Income) Value* -- When the worth of a commodity is measured as the ratio of its price to a wage rate, (for example, the unskilled-labor or average earnings) we define this ratio as the *labor value* of the commodity. For example, this measures the price of a loaf of bread in terms of the number of paid labor hours required to purchase it. In 2015 the average hourly wage of a food and beverage worker was \$9.16 per hour.⁷ Thus for these workers to purchase a \$1.44 loaf of bread it took (or had a *labor value* of) about nine minutes of labor.

Sometimes it is preferred to measure the price of a commodity in terms of an income, for example the per-capita GDP or the average income of doctors. We define this measure as the *income value* of the commodity. In 2015 the GDP per capita is \$56,066 and a new Chevy Cruze was \$22,000. Thus the income value of this car is about 40% of per-capita annual income. The income value of a Cadillac Escalade is 134%.

(3,2) *Labor Cost* -- The ratio of a project's cost to a wage rate, or per-capita GDP is another way to talk about the relative worth of a project. We define this as the *Labor Cost*. An example of a beneficial use of this definition is discussing the Erie Canal⁸ that was constructed mostly with unskilled labor, so the ratio of its cost to the unskilled wage is a good measure of its opportunity cost in terms of what else might have been built. Of course the cost of labor is only part (though often the largest) of the total cost. In some ways using the per-capita GDP mitigates some of this problem.

(3,3) *Real Earnings & Economic Status* -- The ratio of one's wage rate or wealth to the unskilled wage or average wage, or the ratio of one's annual salary to annual GDP per-capita can be defined as relative *Real Earnings* and it can also connote *Economic Status*. Again in 2015 the food and beverage workers at \$9.16 per hour earn a relatively low 40 percent of the average wage. These workers had a wage that not only involved low purchasing power (or low real earnings) but also conveyed low status. In contrast, the neurosurgeons earned 1,170% of the average wage, and can belong to the best clubs and travel first class, which would be measures of their status.

Picking the Right Definition

⁷ <https://www.bls.gov/ooh/food-preparation-and-serving/food-and-beverage-serving-and-related-workers.htm>

⁸ Built at a cost \$7 million from 1817 to 1825/

What is the appropriate term or definition to use discussing the worth of a commodity? In most cases it is not one, but a combination of two or three! It is almost like the parable of the blind men and the elephant. Each is a correct answer, but they tell a different story.

Consider the sale of a cutting board at a craft fair. The buyer is trying to decide the worth of it to give as a gift. She has a catalog of alternatives in mind and the prices of these alternatives are a part of how she decides to buy or not. But she also had a budget for all the gifts she is shopping for. That budget is part of her total household expenditure and helps her determine the *Real Value* of the cutting board.

The seller of cutting boards has different thoughts about their relative worth. He may have been working as a carpenter building houses when he decided to try to make more money at craft fairs. His wage as a carpenter is an important opportunity cost. The income of plumbers might also be part of his calculation, but be less relevant as he may lack the immediate skills to switch to that career easily. In deciding his offer price, he has an implicit index of the worth of his time, an index computed in a similar way that an average wage index would be computed. The seller is computing the *Labor Value* of his time in constructing the cutting board.

In looking at such projects all three terms can easily be used. If a historian was writing about the construction of a new church, there could be a discussion of the tithing required of each parishioner as a share of their annual expenditures or their *opportunity cost*. The resources used to build the church also could be discussed, and a proxy for that could be the amount of labor they would have to hire or the *labor cost*. Another part of the story would be how important this church will be to the entire community. The cost of the church as a ratio of the GDP of the community or its *economy cost* would explain that.

Finally almost any discussion of the wealth and income of the new super rich can use all three terms from the table. They have the *purchasing power* to buy very large yachts; they donate large sums to political campaigns and have lawyers to help them reduce their taxes reflecting their *economic power*. And compared to (lowly) neurosurgeons their *real earnings* would be many times greater. The *economic status* of the super rich is often measured by the reports on the society pages of the amount they spend to have their daughters be a high-society debutante.

Empirical Application -- 1931

As case studies, we report the worth of a number of subjects in one year, 1931. The year 1931 is chosen because it was a year of at least three memorable events, involving Babe Ruth, the Empire State Building, and Al Capone, respectively. Also, it is a year far enough in the past so that nearly everyone living today has no memory of, and therefore cannot think in terms of what he or she remembers, “things cost then.”

That was the year in which Babe Ruth, the indomitable baseball player and personality, was asked how he could justify his annual salary of \$80,000, which was greater than that of President Herbert Hoover. The Babe made his famous reply: “I had a better year than he did.” This was also the year in which construction was completed on perhaps the most

famous building in the twentieth century, the Empire State Building. That structure was completed in May 1931, taking only fourteen months to build and for forty years was the tallest building in the world. The total cost of the building, including the land, was \$40,948,900. Finally, in 1931, the legendary gangster Al Capone was convicted of tax evasion, of failing to pay taxes of \$215,000 on income earned (albeit illegally) over the years 1925-1929.

It is of interest to extend the subjects to include the price of a common commodity and the wage for a particular occupation in the year 1931. A one-pound loaf of white bread, on average over several major cities, was priced at 7.7 cents, while an accountant earned an annual wage of \$2,250. At the other extreme in magnitude, we take what is now called the defense budget of the U.S. government as the project expense. The total of outlays of the Departments of the Army and Navy for fiscal year 1931 was \$839,910,000.

The worth of the 7.7¢ one pound loaf of bread in 1931 is straightforward. The loaf had a *real value* of 1.8 percent of the *daily* AHE, and an *income value* of 4.5 percent of *daily* GDP per capita. The *labor value* for a production worker is nine minutes of work to earn enough to pay the 7.7¢,

Turning to the accountant, his or her annual income sufficed to buy 1.43 household bundles—a decent *purchasing power* for the period. The *real earnings* and *status* of this occupation was over three and a half times the GDP per capita and 50% more than a full time, 60 hour a week production worker.

Of course, Babe Ruth's *purchasing power* was discernibly high, with his annual wage equivalent to 50 household bundles. The Babe's *real earnings* and *status* was correspondingly enviable: his wage constituted multiples 52 and 107 of the annual average wage of a production worker and the per-capita GDP. His *economic power* as measured as his income divided by GDP, was 25 times that of the accountant.

Capone's unpaid taxes reflect a very large unreported income. It is reported that he said: "This is preposterous! You can't tax illegal money!" The fine of \$215,000 alone constituted multiples of 146 and 345 the annual average wage of a production worker and the per-capita GDP respectively. Capone's fine had 2.7 times the *economic power* of the Babe's salary.

The *opportunity cost* of the Empire State Building was 26,100 household bundles. The *labor cost* was 27,900, and 65,700 as multiples of the average wage of a production worker and the per-capita GDP. The *economy cost* of this project was 0.053 percent of GDP.

Finally, the defense outlays on the Departments of the Army and Navy for fiscal year 1931 had an *opportunity cost* of 535,000 household bundles and a *labor cost* was 570,000 and 1,348,170 as multiples of the average wage of a production worker and the per-capita GDP. The defense share of GDP had an *economy cost* of 1.08 percent perhaps the most pertinent measure from the standpoint of societal opportunity cost.

What is Something Worth at Another Time?

What is the worth today of an item in the past? There is a straightforward and literal answer to this question that is probably not what people are looking for. That is, find the price of the

item in both periods and compare them. If the good does not exist today, then find something that is the analogue to that item and compare that. Take the example of a one-pound loaf of bread. As we have discussed above in 2015 the price of a one-pound loaf of white bread was \$1.44 and in 1931 it was 7.7 cents. So the “worth today” of a 7.7¢ loaf of bread from 1931 is \$1.44. Q.E.D. That is an increase of 2,060%.

There are several problems with this comparison. First, there is no “1931 loaf of bread” in 2015. Yes, there are loaves of bread in 2015; but the 1931 loaf of bread may have been made from a quite different recipe with different ingredients, and, even were the loaves to be identical, they may have played different roles in the overall diet, the consequences of which we do not know. And there were no Chicago deep-dish pizzas in 1931. And there is no Babe Ruth in 2015. Yes, there is Kris Bryant in 2015; but he is not Babe Ruth.

Let us take the example of an ounce of gold that exists in both 1931 and 2015. Unlike most everything else, it is an exact analogy of itself; it exists in every year. In 1931 the price of gold was \$20.67 an ounce, as fixed by the government. The average price of gold in 2015 was has averaged \$1,160 an ounce. This is an increase of 5,610%.⁹ Another Q.E.D. But are these the number users want?

Thousands of visitors to the MeasuringWorth website say they want to know what an item in the past is worth today. In nearly all cases, this is not the question they want answered. What they want is a current dollar amount associated with the worth of that item in the past that they can compare to the values of all the commodities, incomes, wealth, etc. they know today. They want an algorithm that transfers the value of that item in the past to a “comparable” value today so they can compare it to “what they know.”¹⁰ The woman buying the cutting board may be thinking about a cutting board her mother gave her twenty years ago. She is wondering if the board she is buying today to give to her daughter has the same relative worth of the one she received. Inflating by a price index is the usual, and usually flawed, approach.

Let us discuss how to measure the worth of an ounce of gold from year to year. If a historian writes “In 1931, John went to Alaska and had a good month in that he found 5 ounces of gold (that is about \$5,800 in today’s prices.)” This is correct (5 times \$1160). But is that what the historian would have said? It is not likely. If John had found \$103.35 worth of gold in 1931 prices, it is likely the she would have said (that is about \$1,640 in today’s prices.)¹¹. She would have found that at the CPI Inflations Calculator on the BLS web site.¹²

⁹ An interesting aside is that the gold price of a loaf of bread has fallen by two thirds from .0037 of an ounce to .0012 of an ounce.

¹⁰ Many times they even ask the question “item A cost \$X in period one, today it costs \$Y and that seems too much or too little.” Some understand that relative prices change over time for all sorts of reasons.

¹¹ Or if she had looked at the MeasuringWorth website would have said, “In 2015, the relative value of \$103.35 from 1931 ranges from \$1,330.00 to \$24,100.00” and then explained which values she would use.

But the historian could have said that John could have exchanged the \$103.35 for 80% of a month's worth of the AHE (103.35/130.80) and that in 2015, 80% of the AHE would cost about \$3,700 (a lot more than the \$1,640.) And she could add that selling five ounces of gold today puts 50% more the table today that it did in 1931. (5,700/3,700)"

Prospecting for gold in 1931 was a good idea if John was out of work. But what is the relative value of his prospecting measured by the wage he might have given up? What is the *labor value* of working in the gold fields?¹³ If he had been a production worker earning 51¢ an hour for 60 hours a week, in a month he would have earned \$122. As an unskilled worker he might have made \$90. So if John was unemployed or an unskilled worker and could prospect around five ounces of gold a month in the Alaskan gold fields, he made a smart move by heading north. If he had been a production worker, he should have stayed home. With the price of gold fluctuating so much these days, it would be harder for John to decide. With the monthly income of a production worker being about \$5,000 a month, John would only have needed to find three ounces of gold in 2012 to replace potential production earnings. Today he needs to have a claim where can find over four ounces a month to do the same.

This discussion about gold mined in 1931 has produced some meaningful comparison in today's terms. By determining the *real value* and *labor value* of the five ounces of gold in that year, we can apply those relative values to today and report meaningful comparisons. Notice that in these discussions contain many more things than "that is about \$1,640 in today's prices". We have not use the term or concept of "real price" or "real wage" to describe John's expedition to Alaska.

The Additional Measure

Price Indexes It is a fundamental principle of economics that changes in relative prices change the distribution of purchases. It is the application of the expenditure function that monetizes the process of maximizing a utility function subject to a budget constraint. So the "first order" measure of the relative worth of an item is a vector of all prices at the time of the purchase. (Those of close substitutes will be more relevant.)

Construction of the current *real value* of something bought in the past. --

The Consumer Price Index (CPI)

If an item a household bought in 2014 was associated with a vector of prices observed in 2014, and you could find a vector of these prices in 2015 such that the household bought that that same item in 2015, you would have "the relative worth" the bundle from 2014. I would like to again say Q.E.D., "case closed," the question is answered.

There are three problems with this solution:

¹² https://www.bls.gov/data/inflation_calculator.htm It is a government statistic, so must be "official."

¹³ There was 460,000 ounces of gold mined in Alaska in 1931 according to Bulletin 844-A of the US Department of Interior. <https://pubs.usgs.gov/bul/0844a/report.pdf>

First, there is no easy way to compare a vector of prices. A solution to this problem is to create a single number that is a weighted index of the more relevant prices. If the item is something the average household buys, then a good index would be the price of the AHE.

Second, what if the item bought in 2014 does not exist in 2015. The solution is to find a close substitute for this item found in 2015 and use the price of the substitute in computing the weighted index.

Third, there are 2015 prices for other items (that would effect the purchase) that did not exist in 2014. The solution is to find a close substitute for the 2015 item and value the amount purchase of the substitute in 2014 at the 2015 prices of the substitute. If the item is something the average household buys, then a proxy for this process is to say that the utility of the item as part of the bundle that was bought in 2014 would be the same as the utility derived from its consumption in 2015 when and if it exists.

This is what how the BLS uses the AHE to create the Consumer Price Index (CPI.) This process is called using a Laspeyres index. Appendix A explains how the CPI has been constructed from 1774 to the present.

(Another way of) Construction of the past *real value* of something bought in the present. – The GDP deflator.

What if we were not interested comparing the value of the same item between one year and another? What if we just wanted to know the value of what you spent today in a base year's prices? Then we do not have to worry about items from the past that no longer exist today, nor how much of each item was purchased. We do have the second problem mentioned above in reverse. That is, there is no price in the base year for an item bought today. This happens more and more the farther in the past one goes. There are no prices for smart phones in 1931. The solution is to find the price in the past of a substitute for these items. This is what the Bureau of Economic Analysis (BEA) does in constructing the GDP deflator. This process is called the Paasche index.

It is important to note that the GDP deflator is not measuring a fixed bundle of items. So the percent change in it is not a measure of inflation.

Three more Definitions of Relative Worth

The nine definitions presented above were for a point in time. We used them to discuss the relative worth of different items using three measures. These definitions are equally useful for discussing relative worth over time as we demonstrated in the discussion of the gold prospector.

Using the Household Bundle as the measure we found that the daily *real value* of a one-pound of bread in 2015 was \$1.44 divided by \$153 or $1/106^{\text{th}}$ the AHE. The daily *real value* of a one-pound of bread in 1931 was 7.7¢ divided by \$4.30 or $1/56^{\text{th}}$ the AHE. The real value of bread was more expensive then. But another way to look at this would be to ask what is $1/56^{\text{th}}$ of the daily AHE in 2015? The answer is that a 7.7¢ loaf of bread in 1931 has a relative *real value* of a \$2.75 in 2015. Notice this computation does not involve the price of

bread in 2015 nor even requires that bread exists in the current year. This is the answer found on the MeasuringWorth comparator for the relative worth of the US dollar.

The other definitions work the same way. Using the income measure to discuss the \$2,250 accountant's salary in 1931, we find that the relative 2015 *purchasing power* of his salary was \$80,000, his *Real Earnings* over \$100,000, and his *Economic Status*, \$200,000. His 2015 *economic power* was over half a million. Each of these is computed by multiplying the ratio of the observation of the measure in 2015 to the observation of the measure in 1931 times the salary of \$2,250.

INSERT TABLE 2

Table 2 adds the additional measure of a price index and we have the three *real* definitions.

(4,1) *Real Price* – The *real price* of a commodity in any year X is the price of that commodity “converted” to a base year price by multiplying it by the ratio of the price index in the base year to the price index in year X. So using the CPI, the real cost of a commodity in 2015 in 2000 year prices would be its current price times $(172.2/237.02)$ or 72.6% of the current price. The real price of a commodity in 2000 measured in 2015 prices would be a multiple of the inverse $(237.02/172.2)$ or 137.6%. If one preferred to use the GDP deflator, the values would be 74.4% and 134.3%.

Let us return to the story about John and his 5 ounces of gold in 1931. What would the *real value* of \$1,640 add to the story? What does it represent? The interpretation is that when John's sold his five ounces of gold and received \$206.70, that he could go to the store and buy a particular bundle of household goods that was 50% food and clothing and included a ride on a streetcar (though there might not been any around in Alaska.) The \$1,640 is the price of “that bundle” today. Though it is not that precise bundle but an analogue of that bundle that is only 18% food and clothing and includes the use of a smart phone.

(4,2) *Real Cost* – The *real cost* of a project in any year X is the cost of that project “converted” to a base year cost by multiplying it by the ratio of the price index in the base year to the price index in year X. Sometimes using the CPI makes sense. If the parishioners are wondering how much those donations of \$1,000 each made to build a new church 16 years ago “are worth today,” using the CPI, they would conclude it was \$1,376.¹⁴

For larger projects, it may make more sense to use the GDP deflator.

(4,3) *Real Wage & Real Wealth* – The *real wage* in any year X is the compensation (be that an hourly wage, yearly salary or a end of year bonus) received that year “converted” to a base year cost by multiplying it by the ratio of the price index in the base year by the ratio of the price index in year X. In most cases, the *real wage* is constructed using the CPI index. The idea is that recipient of this compensation is going to spend it on items in the household bundle, so the real wage has now been converted the purchasing power of a fixed bundle of consumer goods.

¹⁴ Whether they remember that there was no smart phone that year and expensive flat screen TVs were 30 inches wide is a separate question.

The story of the *real wealth* is measured the same way, but we are talking about comparing a stock to a flow. Some can have the same nominal wealth year after year, but the real wealth will change. It should be noted that when these compensation or wealth amounts are substantially different that the AHE, the computation provides less meaningful information. When comparing the wealth of Andrew Carnegie and the wealth of Bill Gates, the relative amount the AHE each could buy is an uninteresting question.

Selection of Measure

In general—and contrary to the almost-universal application of the CPI—there is no definitive answer to the question of worth over time. The questioner has first to decide on the context. Nevertheless, some guidance can be given. Most of the discussion for the point-of-time (single-period) schema is applicable when comparing over time and in many cases is preferable.

The *real price* (4,1) using a price ratio involves only pure-inflation; the bundle underlying the measure is unchanged from the base period. In contrast, *real value* (1,1) using the AHE ratio measures the share the item is of a period specific household bundle in period 1 as a share of what that bundle would cost in period 2. This definition incorporates both change in price and change in the size of the bundle itself. In fact, that property leads us generally to prefer the *real value* to the *real price* concept, as the difference found only from pure inflation cause substantial misimpressions over time, to be seen below. While one might consider that using the GDP Deflator to compute *real price* might alleviate this problem, in most cases it does not. Changes in the GDP deflator reflect changes in all prices and total output. There is no particular item being measured. When the item discussed is a commodity, a price index of both consumer and producer goods and services would be inappropriate.

The GDP Deflator is a much better measure to compute the *real cost* (4,2) particularly when the project is large, such as the construction of a highway system. The *real cost* could be measured against similar measures that would be appropriate for the particular item. For example, the BEA publishes 26 GDP Deflators for all the related components of the economy.¹⁵ In many cases, defining the *real cost* using a particular deflator will tell a more interesting story.

As discussed above, using *Real Wage & Real Wealth* (4,3) also has problems with the issue of what the price index measures. The intent of computing a real wage is so each dollar of compensation in both periods has the same purchasing power of groceries, housing, entertainment, etc. This is done by dividing each wage of a particular year by the CPI of that year. The greater the difference between the two years, the more incomparable the content of the bundle and the less it is real wage has the “same” denominator.

In certain situations, the appropriate measure of worth is clear. If the question is whether “Andrew Carnegie in 1900” was wealthier than “Bill Gates in 2015,” neither the CPI nor a

¹⁵ These 26 include deflators for durable and nondurable goods, services, fixed investment, exports, and federal and state and local government expenditures.

wage-rate index provides the appropriate comparison formula. Rather, Carnegie's wealth should be inflated by the ratio of GDP in the two years. "Power," as represented by share of GDP—not status or real earnings—is the criterion. In most contexts, the worth across time of large-scale, public-good projects (such as war or space exploration) is again obtained most meaningfully by the GDP ratio, not by the CPI or GDP deflator.

The important point of all this discussion is that in most cases using multiple definitions of worth is the best. They all describe the elephant.

Empirical Application – 1931 measured in 2015 prices

We now consider the relative worth of *the 1931 subjects* eight-four years later in 2015. As we have explained the technique is straightforward. We find the worth in 1931 using one of the nine definitions in table 1. These definitions are based on three types of measures. We then take the observation of the value of the item in 1931 as a share of the index number for that measured in 1931. That share is then multiplied times the observation of the measure in 2015. Now can also use a price index for the three additional definitions.

That loaf of bread in 1931 had a *real value* of 1.8 percent of the *daily AHE*, and an *income value* of 4.5 percent of *daily GDP* per capita. The *labor value* for a production worker was nine minutes of work. Applying those ratios to the 2015 values of the AHE, GDP and production worker's wage and we get that the *relative value* of that 1931 loaf of has a *real value* of \$2.74, an *income value* of \$6.93 and nine minutes of a production worker's wage would earn \$4.61 or *labor value*. Of course we now can also compute the *real price* and that would be \$1.20.

Applying this technique to the Accountant's \$2,250 salary in 1931, we see that this money had a relative 2015 *purchasing power* of \$80,200 and *real earnings & status* of \$202,000. Using the CPI to inflate this wage gives a *real wage* of \$35,000. By just looking at this relative *real wage* (that is 75% the average wage of all workers and a little over half the median wage of \$66,000 that accountants earn today), you would conclude that accountants were very poorly compensated. On the other hand the *relative earnings* and *status* it looks as if accountants were extremely well compensated.

Babe Ruth's 1931 income has a 2015 *real wage* of \$1,250,000, which does not sound very large when one considers the *average* salary for a major league player in 2015 was \$4 million! Even when we look at the Babe's *real earnings* at \$7.2 million, they do not compare with the \$32.8 million paid to Clayton Kershaw in 2016.

The *real cost* of Capone's fine is \$3.3 million. The 2015 measure of the *real earnings* lost by the fine is \$18 million. This seems quite small compared to the quarter of a billion dollar fines that have been passed out these days.¹⁶

The 2015 *real cost* of the Empire State Building is \$527 million (using the GDP deflator). The *opportunity cost* is \$1.46 billion, while the *labor cost* is \$1.87 billion or \$2.4 billion (using the unskilled and the production worker wage). The *economy cost* is an impressive

¹⁶ Walter Anderson was reported to owe \$248,962,929 six years ago and still has not paid up. <http://federaltaxcrimes.blogspot.com/2011/02/walter-anderson-fight-continues.html#more>

\$5.9 billion as measured by share of GDP. This can put in perspective the announcement that 2 World Trade Center will likely cost \$4 billion.

Finally, the worth in 2015 of the 1931 defense spending also, of course, has the same fourteen-fold range. The *real cost* (using the GDP deflator) is \$10.8 billion, whereas the AHE generates a worth of \$30 billion *opportunity cost*. The *labor cost* is \$38 billion or \$50 billion (using the unskilled and the production worker wage). The defense share of output is \$196 billion. As a comparison, the defense budget for fiscal year 2015 was \$388.9 billion. Of course, our methodology would emphasize that the subjects are not “the same” defense.

The Impact of an “Over indexed” CPI.

If the method of measuring the CPI “over indexes” the increased cost of a “fixed” bundle of consumer expenditures, then the *real price, real wage, etc.* computations overstate the impact of changing prices. This is another part of flaw in using the CPI to measure relative worth.

While the indexing was probably flawed from the beginning, systematic over indexing would most likely only happen when prices were continually rising. This would be after WWII.¹⁷ Tables 3 and 4 demonstrate the impact of over indexing.

INSERT TABLE 3

The first two columns of Table 3 show the values of the CPI index for 1931 and every ten years up to 2015, and the annualized growth rate between the earlier year and the present.¹⁸ The next three columns show what the CPI in the earlier year would have been if that annualized growth rate was “adjusted” to reduce the bias by .2%, .8% and 1.6%. The later two the amounts were the ones suggested by the Boskin Commission.

INSERT TABLE 4

Table 4 shows the multiple needed to increase an observation from a particular year to “correct” its real value in 2015 dollars. So if it had been reported that the real wage (in current dollars) for a worker in 1970 had been \$20, the correcting that amount for a .8% bias gives an amount of \$28.40. This would be an important difference in the story.

“Correcting” the 1931 measured in 2015 prices

Table 5 presents the *real* values that we reported for our examples from 1931 and what they would have been if we correct for the different level of biases.

INSERT TABLE 5

There are some interesting observations. The *real price* of bread with a .2% bias correction is almost exactly the current price of bread. A 1.6% bias correction gives a *real price* about equal to the *labor value* we computed.

¹⁷ The CPI for both 1794 and 1916 is 10.64. During that 125-year period it would go up in wars and trend back after. Then again the CPI for 1919 and 1943 are both 17.3. After the WWII there is a continuous upward trend to its current level.

¹⁸ The annualized growth rate is the hypothetical constant per-year rate that takes the beginning-date value of a series to the ending-date value of the series during the time span.

Using .8% bias correction to the accountant's *real wage* give a new value that is exactly equal to the median annual salary of an accountant today.

There is no bias correction to the Babe's wage that will make his relative compensation today comparable to the higher paid professional athletes today. That is because while he was the best-paid player in 1931, athletes were not as important to the economy as they are today.

No bias correction to Capone's fine will change the story. The fine and the income it is based on were very small compared to the billions that crooks are bilking people for today.

Any of the bias corrections of large projects such as the Empire State building and the Defense Budget demonstrate how large an impact they would have, but compared to the labor or economy cost are not as significant.

Conclusions

In this paper we present a discussion of the many ways to compute the relative worth of an item and show that any item that has an associated monetary amount can have its worth measured in many ways -- both at a moment in time and over time. The different definitions of relative worth presented in the paper show how important context is. The paper shows that statements of worth are meaningful only when the contexts are specified and that the almost uniform use of the CPI (particularly by itself) to measure worth over time is often at best misleading. There may be an implicit or explicit assumption that all these definitions will tell about the same story as we talk about the past, so that by using one we are implying the others. We have show here how wrong that is. Table 6 shows how much these measures differ, and how much more they differ the farther in the past we look.

INSERT TABLE 6

I will conclude with a list of rules for economic historians to use in their work and for journal editors to require of their authors. It is not inclusive and the profession should it discuss more.

1. Any statement of real price or real wage must define the denominator.
2. The term "in 2016 dollars" or "in today's dollars" should not be allowed by itself. At the minimum there should be a footnote declaring what index is being used to make the conversion.
3. The use of the CPI to generate the term "in 2016 dollars" or "in today's dollars" should not be allowed for comparisons where changes in the content of the AHE would impact the comparison.¹⁹ Usually *real value* and *income* value use better measures.
4. For the purpose of putting a value in current perspective, as a general rule, the CPI should not be used earlier than the time that most readers have a memory of what was in the consumer basket.

¹⁹ Take the observation that a rent payment in 1950 went up \$20 and that is a \$180 in today's dollars. Housing was 25% of the bundle in 1950 and 42% today. That \$20 was 2.14% of what the average household spent on housing, \$180 is a third of that today at .78%.

5. The terms “real prices” or “in today’s dollars” should not be used for computations involving the CPI unless they apply to a consumer good or service.
6. In time series data, the CPI should not be used to deflate a price or wage series without a statement of why it is the best comparator compared to other measures.²⁰
7. When comparing two or more series in the past, ask the question, does deflating them by the cost of a fixed consumer bundle (the CPI) add information? This is probably not a good idea, particularly if they are dissimilar items.²¹
8. If a model is being tested using “real derived variables,” is there any reason it could not be tested using the nominal ones instead.

Appendix B shows examples from the press and publications that would be improved by using these rules.

²⁰ For example from 1891 to 1906 per capita income is 50% larger, wages over 20% larger, but the CPI has not changed. If the series being deflated is the income of a particular job or a construction project, the “real series” would give a misleading impression.

²¹ If the study was of a farm that raised corn, the prices of corn and the cost of a hired farm hand are important, but it would probably add more information to measure the *real price* of corn as the prices received as a ratio wholesale farm products and the *labor cost* of the farm hand as a ratio of what he received to the unskilled wage.

Item Measure	Commodity	Project	Compensation or Wealth
Household-Expenditures	Real Value	Opportunity Cost	Purchasing Power
Output	Economy Share	Economy Cost	Economic Power
Income	Labor (or Income) Value	Labor Cost	Real Earnings & Status

Item Measure	Commodity	Project	Compensation or Wealth
Household-Expenditures	Real Value	Opportunity Cost	Purchasing Power
Output	Economy Share	Economy Cost	Economic Power
Income	Labor (or Income) Value	Labor Cost	Real Earnings & Status
Price Index	Real Price	Real Cost	Real Wage or Real Wealth

Year	CPI	Annualized growth between that year and 2015	"Corrected" CPI for .2 % bias.	"Corrected" CPI for .8 % bias.	"Corrected" CPI for 1.6 % bias.
1931	15.23	3.32%	17.95	29.30	56.58
1950	24.08	3.58%	27.32	39.88	66.27
1960	29.62	3.85%	33.00	45.41	69.71
1970	38.84	4.10%	42.37	54.99	78.02
1980	82.38	3.07%	88.04	108.04	142.22
1990	130.7	2.41%	137.23	158.99	193.73
2000	172.2	2.15%	177.41	193.83	218.30

2010	218.06	1.68%	220.23	226.86	236.07
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Table 4

Year	The multiple needed to "correct" the CPI for .2 % annual bias.	The multiple needed to "correct" the CPI for .8 % annual bias.	The multiple needed to "correct" the CPI for 1.6 % annual bias.
1931	1.18	1.92	3.71
1950	1.13	1.66	2.75
1960	1.11	1.53	2.35
1970	1.09	1.42	2.01
1980	1.07	1.31	1.73
1990	1.05	1.22	1.48
2000	1.03	1.13	1.27
2010	1.01	1.04	1.08

Table 5

Item	"Real Amounts"	.2% bias	.8 % bias	1.6% bias
Bread	\$1.20	\$1.42	\$2.30	\$4.45
Accountant	\$35,000	\$41,300	\$67,200	\$129,850
Babe Ruth	\$ 1.25 Million	\$ 1.48 Million	\$ 2.4 Million	\$ 4.64 Million
Copone's fine	\$ 3.35 Million	\$ 3.95 Million	\$ 6.43 Million	\$ 12.4 Million
The Empire State Building	\$ 527 Million	\$ 622 Million	\$ 1.01 Billion	\$ 1.96 Billion
Defense Budget	\$ 10.8 Billion	\$ 12.7 Billion	\$ 20.7 Billion	\$ 40.1 Billion

Table 6 The ratio of the measures used on MeasuringWorth between 2015 and earlier year observations.							
Ratio	CPI	GDP Deflator	VHE	Unskilled Labor	Production Workers Hourly Comp.	Nominal GDP per capita	Nominal GDP
2015/1790	26.75	25.29		502.24	1,527.50	1,160.54	94,957.67
2015/1830	28.28	27.04		285.89	509.17	703.94	17,059.89
2015/1860	29.41	22.18		185.83	381.88	400.74	4,090.95
2015/1900	29.12	24.13	73.67	132.73	218.21	204.42	864.25
2015/1930	14.19	11.51	29.54	43.83	57.64	74.58	194.65
2015/1950	9.84	7.98	14.44	15.69	19.71	28.19	59.78
2015/1990	1.81	1.64	1.9	1.88	2.12	2.33	3.0

Appendix A

The History of the Consumer Price Index (CPI).

MeasuringWorth publishes an annual CPI series from 1774 to the present. Before 1914, the series is based on various contemporary studies made in the 19th century and the work of many 20th century economic historians that was put together in the classic work by Peter Solar and Paul David in their study “A Bicentenary Contribution to the History of the Cost of Living in America.”²² The numbers reported since 1914 have been published by the Bureau of Labor Statistics.

The earliest numbers come from fitting a regression to Philadelphia wholesale prices. Then for the years from 1800 to 1851, six benchmark years of retail prices and budget collected by Dorothy Brady and the interpolated by an annual series of what Vermont farmers paid.

During the latter half of the nineteenth century, various economic events prompted Congress to ask the Bureau of Labor (later to be renamed the Bureau of Labor Statistics) to collect information on the “cost of living.” These data were needed to discuss such issues as tariffs and labor unrest. At the turn of the century “the Bureau endeavored to conduct a comprehensive study of the condition of working families throughout the country. A survey of family expenditures from 1901 to 1903 was the first step in constructing a comprehensive index of retail prices.”²³ More studies were made over the next two decades and then “Using a weighting structure based on the 1917–1919 expenditure survey, in 1919 the Bureau began semiannual publication of a retail price index. With the reference base period set to 1913 = 100, values of the index were estimated back to 1913 with the use of wholesale price movements.” (It did not get its current name until 1945 when it became the “Consumer’s Price Index for Moderate Income Families in Large Cities.”)

These studies were used extensively by the government for policy purposes such as to standardize and stabilize wage rates during U.S. involvement in World War I. A specific example of the use of the index during the depression was the passage by Congress of the Economy Act of 1933 requiring a 15-percent reduction in federal salaries on the basis of a more-than-20-percent decrease in the BLS cost-of-living index.

Since the beginning the indexes were met with much criticism for the lack of inclusiveness in the number of cities used and the diversity of the families surveyed, the

²² David, Paul A., and Solar, Peter. (1977). “A Bicentenary Contribution to the History of the Cost of Living in America.” In Paul Uselding, ed., *Research in Economic History*, vol. 2, pp. 1-80. Greenwich, CT: JAI

²³ Bureau agents surveyed 25,440 families that were headed by a wage earner or salaried worker earning no more than \$1,200 annually in major industrial centers in 33 states; with inclusivity in mind, the Bureau included African American and foreign-born families in its survey.”

slowness of updating the composition of the fixed basket of goods and services, and whether the technique of using a fixed basket was the best measure of the ideal “cost-of-living” index.

During the last 85 years, many commissions and studies have critiqued the index. In the 1940s there were the Mills and Mitchell Committees then, the Stigler Committee in 1960, and the Boskin Commission of 1995. Each made recommendations, some accepted and others not.

The conflict during WWII between organized labor and the Bureau demonstrates the main issue when “American Federation of Labor (AFL) Representative George Meany stated, ‘If the index is a retail price index and not actually a cost-of-living index, we have no particular interest in what the index has done in the past.... My attitude is...let’s go into partnership and see what we can do together—this committee and your department—to make the index do the thing that it has not done.’ Commissioner Hinrichs insisted that, by definition, cost-of-living indexes were constant-good, retail price indexes, and as the Mills Committee report explained, this type of index was limited in its ability to fully capture changes in all factors that affect an individual’s well-being.” The Mitchell Committee also agreed with the Bureau’s position that many were confusing the additional expense of attaining a higher standard of living for an increase in the cost of a fixed standard of living.

In 1960, the Stigler Committee was formed to address among other issues, the question if the CPI overestimated inflation. In the opening statement was critical when they say:

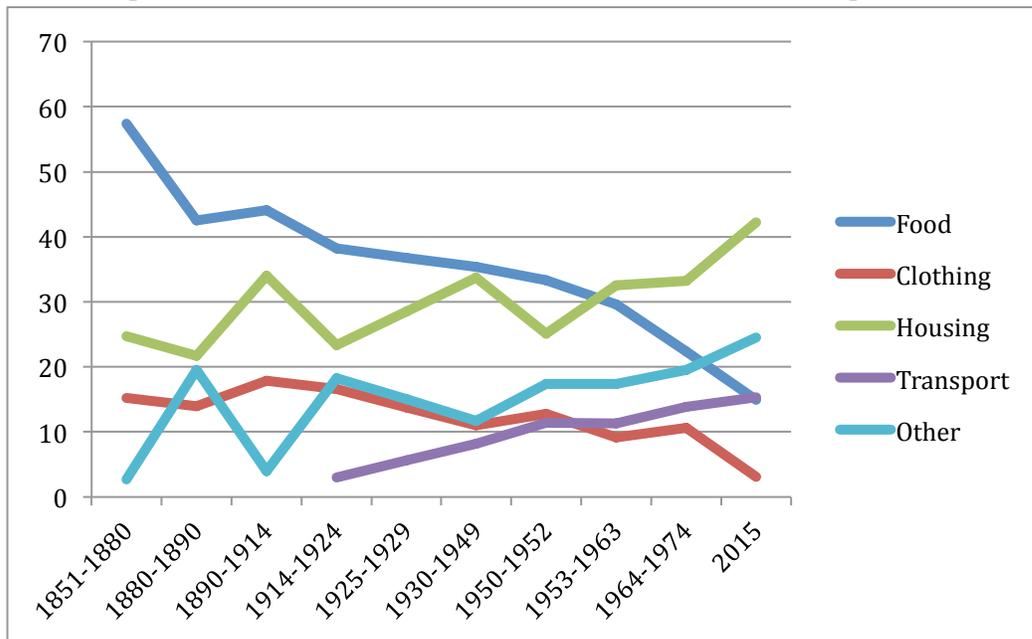
“But in the presence of the introduction of new products, and changes in product quality, consumer tastes, and relative prices, it is no longer true that the rigidly fixed market basket approach yields a realistic measure of how consumers are affected by prices.”

The committee recommended changing the CPI to a “constant-utility” index. But in the end a 1964 report stated that. “The revised CPI, continues to be what it has always been—a measure of price change, and of price change only, in items purchased by urban wage and clerical workers for their own consumption.”

Thirty years later, complaints about biases of the CPI were the reason for the creation of the Boskin Committee. Their final report stated because of two levels of substitution, new product or quality change, and new outlets, the CPI over indexed by .80 to 1.60 percent. While some of its recommendations were accepted and starting in 2002, the BLS began publishing the Chained Consumer Price Index for All Urban Consumers (C-CPI-U), however, that series is not used for any government indexing and the CPI-U is still the series that is reported on the 15th of the month.

While the CPI may be the best measure of inflation (and the only one we have before 1909), it is not always the best measure to use for relative worth. It is appropriate that the content of the market basket used to construct the CPI change over time to reflect the changes in household spending patterns. But when using the CPI to inflate a price from the past, these changes create an incomparable bundle that most users are not aware of. The longer the difference between the two periods the more incomparable the bundles are.

For example in the constructing of the CPI, for the antebellum period, purchases of food made up about 40% of the bundle and clothing 22%. As recently as the 1950s those same items made up 33% and 13% while in 2015, those same items made up 15% and 3%.



David, Paul A., and Solar, Peter. (1977). "A Bicentenary Contribution to the History of the Cost of Living in America." In Paul Uselding, ed., *Research in Economic History*, vol. 2, pp. 1-80. Greenwich, CT: JAI

Bureau of Labor Statistics (2014). *The first hundred years of the Consumer Price Index: a methodological and political history*, Monthly Labor Review.

<http://www.bls.gov/opub/mlr/2016/article/one-hundred-years-of-current-employment-statistics-busting-ces-myths.htm>

Officer, Lawrence (2006) *What Was the Consumer Price Index Then? A Data Study*. found on Lawrence H. Officer and Samuel H. Williamson, "The Annual Consumer Price Index for the United States, 1774-2015," *MeasuringWorth*, 2016.

URL: <http://www.measuringworth.com/usdpi/>

Appendix B

Two Examples from the New York Times

In the New York Times on February 12th of this year there was an article titled “George Washington, the Whiskey Baron of Mount Vernon” by Michael Beschloss. There were statements in the text that were intended to give the readers a sense of how much Washington’s expenses and income were.

One was: “When a nephew asked the ex-president for a loan of \$1,000 (about \$18,000 today), Washington gave in but admonished him, ‘You are under the same mistake that many others are in supposing that I have money always at command.’”

What would that \$1,000 the nephew receive buy? In 1800, an Ax cost \$.50, a gallon of gin \$1.11, sugar \$12.94 a hundred weight, and lumber \$28 a thousand feet. So with \$1,000 the nephew could have bought 2,000 axes, 900 gallons of gin, 7,800 pounds of sugar, or 36,000 feet of lumber. At current prices, \$18,000 can buy 500 axes, 350 gallons of gin, 28,000 pounds of sugar and 60,000 feet of lumber. So in terms of commodities available both then and now, the “about \$18,000 today” is not a bad guess.

But we can doubt that in the mind of the average reader when they see this amount, they are thinking about the axes or lumber they have just purchased. They might think that \$18,000 might buy a decent used car or pay the tuition for a year at a junior college.

In 1800, with \$1,000 that nephew could have bought 500 acres at the price of \$2 an acre most anywhere as that was the price set in the Land Ordinance of 1796. Unimproved land most places today, would value that at half a million or more. He could possibly could have bought a herd of 50 to 100 cattle. Current value about \$1,000 a head. And he could have bought three slaves or more that have a current labor or income value of over \$150,000 in current prices²⁴. The idea that this loan should be thought of as about \$18,000 today misrepresents its magnitude.

Here are the results from the MeasuringWorth US comparator:

In 2015, the relative price worth of \$1,000.00 from 1800 is:

\$19,500.00 using the Consumer Price Index

\$18,300.00 using the GDP deflator

In 2015, the relative wage or income worth of \$1,000.00 from 1800 is:

\$310,000.00 using the unskilled wage

\$764,000.00 using the Production Worker Compensation

\$619,000.00 using the nominal GDP per capita

In 2015, the relative output worth of \$1,000.00 from 1800 is:

\$37,600,000.00 using the relative share of GDP

²⁴ See “Measuring Slavery in 2011 Dollars” <https://www.measuringworth.com/slavery.php>

Again in the New York Times on April 16th, there was an article titled “272 Slaves Were Sold to Save Georgetown. What Does It Owe Their Descendants?” The article does not say how much they were sold for, but the author (or the Times editor) attempts to put the sale in current perspective with these two sentences: “And the 1838 sale — worth about \$3.3 million in today’s dollars — was organized by two of Georgetown’s early presidents, both Jesuit priests. Some of that money helped to pay off the debts of the struggling college.” The 2015 budget of Georgetown is \$1,147.9 million. So the story implies that Georgetown sold these slaves to cover one day of its expenses (by using a purchase power calculator.)

Is this what the author wanted to say? 3.3 million divided by 272 is about \$12,000. It is perhaps unintended consequence of the article is to say this is the average value of slaves from that year is \$12,000 in today’s prices. That is not much and that was a year when slave prices had reached a peak. The article *Measuring Slavery in 2011 Dollars* puts the Labor Income Value of the average slave at ten times that amount in 1838.²⁵

Another source puts the sale at the contemporary price they received for the slave was \$115,000. This would mean for this sale, the *labor cost* was as much \$65 million and the *economy cost* \$1.3 billion. It would have added considerable amount of information if the author had told us what the annual budget of Georgetown was in 1838.

Here are the results from the MeasuringWorth US comparator:

In 2015, the relative *price* worth of \$115,000.00 from 1838 is:

\$3,020,000.00 using the Consumer Price Index

\$2,620,000.00 using the GDP deflator

In 2015, the relative *wage or income* worth of \$115,000.00 from 1838 is:

\$27,500,000.00 using the unskilled wage

\$60,600,000.00 using the Production Worker Compensation

\$65,500,000.00 using the nominal GDP per capita

In 2015, the relative *output* worth of \$115,000.00 from 1838 is:

\$1,300,000,000.00 using the relative share of GDP

Example from the Monthly Labor Review

There is an excellent history of the CPI in the *Monthly Labor Review* in 2014.²⁶ It is not surprising that the article uses the concept “in current dollars” to describe the cost of creating the index when it was first started.

²⁵ See “Measuring Slavery in 2011 Dollars” <https://www.measuringworth.com/slavery.php>

²⁶ *The first hundred years of the Consumer Price Index: a methodological and political history*, Monthly Labor Review. in Bureau of Labor Statistics (2014). <http://www.bls.gov/opub/mlr/2016/article/one-hundred-years-of-current-employment-statistics-busting-ces-myths.htm>

It states that “Commissioner Meeker worked quickly and earnestly to secure funding to complete the study and ultimately received \$75,000 (approximately \$1.35 million in 2012 dollars) from President Wilson.” This was in 1917 and the \$1.35 million quoted here comes from using the BLS CPI Inflation Calculator.²⁷

Is that the story we want to know? In 1917 non-defense spending by the Federal Government was \$700 million (\$2,308 million minus \$1,608 million). The \$75,000 received to do this study was .011% of \$700 million.

In 2012, the non-defense spending was \$2,687 billion (\$3,537 billion minus \$850 billion.) and .011% of this amount is \$288 million. If we exclude off budget expenditures from the 2012 expenditures, then no-defense spending is \$2,179 and .011% of this amount is \$240 million.

So to understand the 2012 relative value of the \$75,000 that Commissioner Meeker secured, the choice is:

1. \$1.35 million measured by what the average urban household spends (which in 1917 was over 40% was food.)
2. \$7.14 million measured by the compensation of the average production worker representing the cost to hire the people to do the work.
3. Over \$200 million that represents the share of the federal budget that was allocated to this project.

Later in the article they use the concept of “in current dollars” to explain the magnitude of a change in the CPI will have on indexed Federal Expenditures.

By 1981, “almost a third of federal expenditure [was] directly linked to the CPI or related price measures, and over half of the federal budget [was] affected if indirectly indexed expenditures [were] added.” Small movements in the CPI could dramatically affect government outlays; for example, a 1-percent increase would “automatically trigger nearly \$2 billion of additional federal expenditures, at 1981 program levels [approximately \$5 billion in 2012 dollars].”

What are the authors trying to say is the meaning of this \$5 billion? The CPI had increased from 90 to 230 between 1981 and 2012 or a little over 2.5 times. On the other hand, Federal Expenditures, nominal GDP and social security payments had all increased over five times during that period. So if this number was inflated by the size of federal expenditures, it is probable that a 1-percent increase in the CPI would “automatically trigger over \$10 billion of additional federal expenditures, at 2012 program levels.”

But the amount Federal Expenditures in 2012 would increase from a 1-percent increase in the CPI could be even more than this, since more programs might be indexed by then. It is not clear what the authors are trying to say since it appears that this quote is from a 1981 article about indexing with the CPI. So the statement “approximately \$5 billion in 2012 dollars” adds confusion. It would have been better to have indexed the \$2 billion to the share of GDP or share of the federal budget.

²⁷ https://www.bls.gov/data/inflation_calculator.htm

Examples from Journals

Here are two examples where a version of the expression “in today’s prices” was used.

Any time an article uses the term “real cost” or real wage” there is an implicit or explicit denominator associated with the term. Some articles do better than others.

In the article titled “Do Patent Pools Encourage Innovation? Evidence from the Nineteenth-Century Sewing Machine Industry.” *The Journal of Economic History*, Vol. 70, No. 4 (DECEMBER 2010), pp. 898-920: There is the following quote: “The pool agreement ...was to be maintained above \$10,000, approximately a quarter million 2009 dollars, ... Then there is a footnote: “Using the Consumer Price Index, \$10,000 in 1856 was worth \$261,000 in 2009. Other indicators place the value of the litigation fund between \$198,000 and \$35,600,000 (Williamson, Six Ways).

It is nice that the authors know that there are other indicators, but what do the authors want to readers to do with this information. Why didn’t they pick one or more and explain why they chose it. Of course using the CPI violate rule one. But even if this was a study of pool agreements today, why want to know the value of the agreements measured in a multiple of consumer bundles? I think it would be more interesting to measure this against the output of the sewing machine industry. If they did not know that, then would the GDP be a better proxy than the AHE? It would be worth thinking about.

In the article titled “Flip the Switch: The Impact of the Rural Electrification Administration 1935–1940.” *The Journal of Economic History*, Vol. 75, No. 4 (DECEMBER 2015), pp. 1161-1195: there is this sentence: “In its first five years of operation from 1935 to 1939, the REA provided more than \$227 million in loans (\$3.6 billion in 2010 dollars) primarily to newly incorporated cooperative utilities, to survey areas, lay distribution lines, and wire homes.” The GDP in 1937 was \$93 billion, all government expenditures \$13.1 billion and nondefense federal expenditures \$3.8 billion. \$227 million is .024%, 1.73% and 5.97% of these three measures of output.

The GDP in 2010 was \$14.96 trillion, government expenditures \$3.174 trillion and the non-defense part \$833 billion. So by applying these output shares to these amounts, in today’s terms the \$227 million in loans would be a 36.5 billion share of the present GDP, its economy cost. It would be a \$55 billion share of all government expenditure today, and a \$49.8 billion share of the non-defense part of federal expenditures. These amounts are ten or more times the “real cost” reported. These numbers are the economy cost of the loans, not a bad application of the real cost that would have added to the story.

In the article “Biological Innovation and Productivity Growth in the Antebellum Cotton Economy.”, *The Journal of Economic History* Vol. 68, No. 4, (DECEMBER 2008), pp. 1123-1171 There is a statement: “From 1800 to 1860, the quantity of cotton produced increased by 6.6 percent per annum as the real price of cotton fell by 0.5 percent per annum. Over a slightly shorter period beginning in 1804, the U.S. slave population rose by 2.4

percent per year while the real price of prime-age male slaves rose by 1.9 percent per year.” Slaves were a major input in the production of cotton, yet their real prices were soaring at a time when real cotton prices were declining.

The authors do explain they are deflating slave and cotton prices by the series Cc113 from the Historical Statistics. This series is a wholesale price index. So what they are saying is the price of cotton relative to other wholesale items is going down and the price of slaves relative to the same wholesale items was going up.

What does the “conversion to real price add to the story that the cost of a slave per bale of cotton is rising? They could have deflated the slave price by the unskilled wage and compared the *labor value* of slaves to the *real price* of cotton. That would have been a different story.

In the article “On the divergence between fuel and service prices: The importance of technological change and diffusion in an American frontier economy”, *Explorations in Economic History* Vol. 60, April 2016

This is the introduction and it does it right. It starts with an explanation of why not to use “conventional price indexes” and what will be used instead.

“In their most basic form, price indices are weighted- averages used to summarize price changes and to convert nominal to real values. Such indices assume that, for a given good, the consumption weights are comparable across time; i.e. the same good of the same quality is being consumed. However, consumption is more appropriately defined in terms of services. This distinction is crucial for energy fuels. These are inputs used in the production of services upon which welfare ultimately depends. As technology that transforms inputs to services matures, fuel prices and service prices may change to different degrees and in different directions. In such contexts, conventional price indices are likely biased.”