Lengthy Economic Time Series - Their Use and Misuses.

by
Samuel H. Williamson
President of MeasuringWorth
and
Professor of Economics Emeritus at Miami University

Quotes from the masters to think about.

In the natural sciences, even the most abstract theorists are exceedingly well informed about the precise nature, circumstances, and limitations of experiments and measurements. Indeed, without such knowledge their work would be entirely impossible or meaningless.

In the social sciences the situation is quite different. It is not often feasible to be aware of the detailed nature of the data. ... Thus economic data are normally time series, i.e. numbers of the same kind of event, say the price of bread, strung out over time. When the series are long, as they ought to be, it is often exceedingly difficult to know how the data were obtained in the past as to what extent temporal comparability is assured. (Morgenstern, 1965, p.15)

The chief thing is to understand that there is a fundamental difference between mere data and observations . The latter are naturally also data, but there are more than that. They are selected. (Morgenstern, 1965, p.88)

*The problem of how to construct an index number is as much one of economic theory as of statistical technique. (*Frisch (1936), p. 1)

*The index-number problem arises whenever we want a quantitative expression for a complex that is made up of individual measurements for which no common physical unit exists. The desire to unite such measurements and the fact that this cannot be done by using physical or technical principles of comparison only, constitute the essence of the index-number problem and all the difficulties center here. . (*Frisch (1936), p. 1)

What is a time series?

Wikipedia's definition is: A time series is a series of data points indexed (or listed or graphed) in time order. This begs the question of what are data points?

Data points can be observations on anything. The number of snowflakes that landed on a glove in a minute last week, or the height of Mount Everest above sea level in meters. There is no reason to collect data points in themselves.

The reason to collect data is to create observations of a variable that is part of a hypothesis to be tested in the process of creating "proffered laws."[1] Data are not a variable.

Variables only exist if there is a theory that is hypothesizing a relationship between different observations of the world. This theory might be implicit.

Take the daily temperature outside. We have dozens of theories where these observations are a variable. What people will wear, will plants grow or die, how much energy will be used, the movement of a high pressure zone, etc.

So back to what is a time series? My definition is that it is consecutive observations of data that all satisfy the definition of a variable used in hypotheses.

Examples

Table 1

	Price	Quantity
Monday	$1.20	Bag of carrot
Tuesday	$1.14	Bag of carrot
Wednesday	$1.26	Bag of carrot
Thursday	$1.03	Bag of carrot
Friday	$0.99	Bag of carrot

Table 2

Monday	$1.20	Bag of carrot
Tuesday	$1.14	Three Bananas
Wednesday	$1.26	Two Onions
Thursday	$1.03	Head of lettuce
Friday	$0.99	Pound of beans

Table 3

Monday	$1.20	Bag of carrot
Tuesday	$1.14	Cup of coffee
Wednesday	$1.26	Bus ticket
Thursday	$1.03	Three pencils
Friday	$0.99	Smart phone app

[1] I was taught this by R.L. Bassmann as he explained in his article "The Role of the Economic Historian in Predictive Testing of Proffered 'Economic Laws'", EEH/ Second Series, Vol.2, No. 3, pp. 159-86, 1965.

Here are three tables of five observations of prices in a week. Are they a time series? That depends. The first one could be associated with the supply price of carrots at a vegetable stand, the second with the cost of vegetables bought by a consumer each day. The third?

Most of what economists usually call data, are much more complicated. They are observations that we use in our models, descriptions and constructs. At a simple level they are averages of many data points period after period. For example, the wage of bus drivers in all of Chicago.

Then there are the constructs that are combinations of different kinds of data points combined (sometimes observations themselves) to create an aggregate measure. For example, the consumption portion of GDP is durable, non-durable and services bought by the households in a year.

Finally, and perhaps most ubiquitous, are index numbers. In this case one observation has an arbitrary value and, unlike the wage of bus drivers, has no information in itself. As Ragnar Frisch (winner of the first Nobel Prize in Economics) puts it, a time series index is a quantitative expression for a complex that is made up of individual measurements for which no common physical unit exists[2]. The *only usefulness* of index numbers is how they change over time as we see from the press releases below.

In all these cases, there has to be a "theory" to how to create these observations. As discussed by Morgenstern over 50 years ago in economics, the "theories" use to construct these observations are (in most cases) not created by the theorists who are using these observations. It is my contention that this latter group who create complicated models and explanation sketches using these observations do not know what they think they are explaining.

The three time series that measures the economic performance of the US economy

For the United States there exist three types of well used continuous time series that measure output, compensation and price from the late 18 century to today. They are the GDP, the wage index of unskilled and the hourly pay of production workers, and the CPI (consumer price index). Economists and others use these series for measuring economic growth and improvements in standard of living.

Each of these series consist of over 220 observations and have been downloaded from the MeasuringWorth website between 2,000 to 10,000 times a year. They are time series. But they may not be series measuring what the users think they are. We will discuss the history of how each has been constructed and why I say this.

The fact that these series have grown at such different rates should alert us that we should be careful as to how we use them to describe the same thing – the growth of the US economy.

Press release November13th.

The Consumer Price Index for All Urban Consumers (CPI-U) rose 0.4 percent in October on a seasonally adjusted basis after being unchanged in September, the U.S. Bureau of Labor

[2] Reading the literature on index numbers gives a variety of definitions from Edgeworth to Keynes. R.G.D Allen would have us differentiate between index numbers where the quantity is identifiable and those where it is not, i.e. the index of unskilled wage and the CPI.

Statistics reported today. Over the last 12 months, the all items index increased 1.8 percent before seasonal adjustment.

Press release November13th.
Real average hourly earnings for all employees decreased 0.2 percent from September to October, seasonally adjusted, the U.S. Bureau of Labor Statistics reported today. This result stems from an increase of 0.2 percent in average hourly earnings combined with an increase of 0.4 percent in the Consumer Price Index for All Urban Consumers

Press release October 30th.
Real gross domestic product (GDP) increased at an annual rate of 1.9 percent in the third quarter of 2019, according to the "advance" estimate released by the Bureau of Economic Analysis. In the second quarter, real GDP increased 2.0 percent.

Issues with the measurement of GDP.

The only thing we tend to hear about GDP is the growth rate of its real value[3]. One observation of nominal GDP does provide information ($21,525.8 billion.). It is not an index number. It is useful as a total and as a catalog of where our output is going. But what it is? We seldom teach it much about it, beyond saying it is "a monetary measure of the market value of all final goods and services produced in a year."

There are too many issues about the difficult in measuring GDP to cover here, but I will mention three that have an important impact on the interpretation of what GDP tells us.

First is the growth rate of annual GDP or GDP per capita in the 19th century. In his famous book titled *The Stages of Economic Growth,* (1960) Walt Rostow stated that "the crucial stage was the 'take-off' – a period of roughly 20 years when a country's economy accelerated to a more rapid, self- sustaining growth."

Nobel laureate Simon Kuznets, perhaps the most assiduous and revered student of long term economic change, did not accept Rostow's hypothesis. Kuznets argued that we could not be sure a country was successful at economic development until its real output per person increased by one percent or more each year - for a period of at least 50 years. Better estimations of the early GDP debunked Rostow and supported Kuznets view.

The second is there has always been the issue of the lack of measuring of services in the nineteenth century because most of them were done at home and were not part of the market economy. As that changed, did the growth rate increase because there were more of them or becasue they were now being measured.

The third is how the government is treated. In the 1940s, Kuznets, argued that business taxes should be excluded from national product on the grounds that they served as a proxy for the value of government services to business. Taxes paid by individuals served as proxies for payments for services rendered by the government to those individuals and therefore should not be deducted.

[3] In the late 1960s when inflation became more long-run and not a wartime spike, real GDP became the number regularly reported so the distinction between the two did not have to be explained.

In other words, taxes paid by individuals were treated as though they represented purchases by them and therefore were classified as purchases for final use services, which are included in national product. Taxes paid by businesses should be treated as intermediate purchases, which are excluded from national product.

Under this scenario, there would be no G in the GDP equation and taxes paid by the households would be part of purchases of services. Note that this would mean that Government expenditures financed by deficits would not be counted as final output.

The idea was rejected by Milton Gilbert and others at the Bureau of Foreign and Domestic Commerce who were in charge of publishing the numbers. The grounds were that distinguishing between government services to individuals and those to business was not feasible.

Issues with the Wage Series.

The Hourly Pay of Production Workers.

Unlike most other series, the creator of this series is available to explain his "theory" construction. Lawrence Officer Published this series in 2009. He sent me this email this week.

> "I think that the most important feature of the series is the decision to use fixed rather than current weights. I deliberately allow for shifts of workers between occupations and industries. That is because I had a macro orientation.
>
> The series is not an index number in the statistical sense. But that decision fit my objective. So there are some purposes for which the series should not be applied: not just micro investigation of particular industries, but also for comparison of business cycles over time."

He did not look at the wages in a particular industry over time, but a particular type of worker in all industries. He then cautions users to use the series only for models that are consistent with these conditions.

The Index of the Unskilled Wage.

One of the problems with all early historic wage series is they seldom have the amount of work. How many days a year and how many hours a day? Add to that is the question of "benefits" i.e. room and board.

Most early entries for this series come from business ledgers and account books for Massachusetts 1774 to 1830 as reported in the *16th Annual Report* of the Bureau of Statistic of Labor (1885) They converted from other currencies to be consistent. So for the first half of the series it is the "common daily labor daily wage rate." We should remember that there is no control for the type of work. Farm or urban work is not known, but for sure there is a big shift to the latter. Starting in 1890 the data is for an hourly wage rate, thus getting around the problem of the hours in the day.

In 1948 the BLS stopped publishing wage series that pertained to "unskilled labor." Between then and now, first David and Solar and then I looked for alternatives. Since 2000 I have used the BLS series of the median usual weekly earnings (second quartile) of those wage and salary workers employed full time with less than a high school diploma, and are 25 years and over is used. These data are from the *Current Population Survey.*

I would really be happy if someone came up with another series.

Issues with the use of the Consumer Price Index (CPI)

There are many questions and problems with using the CPI as a good measure of the cost of living over time, however, economists often think it is the best we have. Here is a quote from a referee report about a paper suggesting that the MeasuringWorth approach was better.

> …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.

What is presented here is a short history of the creation of the CPI that help our understanding of why it is flawed. At the presentation I will give examples of how bad using the CPI can be.

The History of the CPI.

The first thing to know about the CPI is that it is not a "price" index, but a "cost of living index." From the start researchers, trade unions, government officials, etc. were trying to determine the minimum amount of money it took for the average family to survive. This is why the index can go back to 1774 even though there are no dollar prices then.

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 on 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."[4] 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. Those prices would have been in pound sterling for many years even after the end of the war. 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 19th 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

[4] 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.

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."[5] 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.

From 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 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. It 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

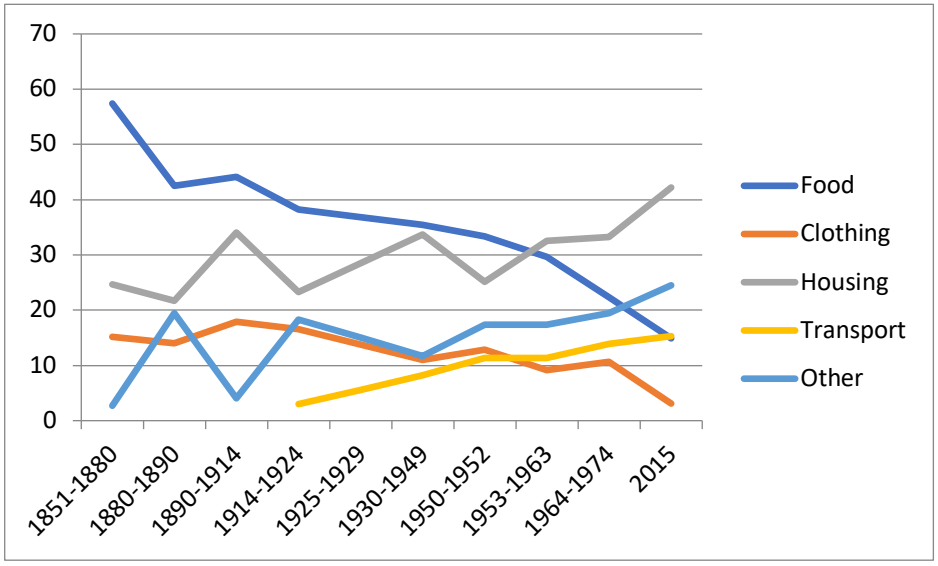
[5] Bureau agents surveyed 25,440 families that were headed by a wage earner or salaried worker earning no more than $1,200 annually in major industrial centers in 33 states; with inclusivity in mind, the Bureau included African American and foreign-born families in its survey."

for their own consumption."

In the 1970s the BLS wanted to replace the CPI based only on the surveys of urban wage earners and clerical workers (the CPI-W) with a broader CPI-U population. Some users resisted the change, so from 1978 both indexes have been published. Today, the CPI-W is used to calculate Social Security cost-of-living adjustments, most other cost of living adjustments, such as the indexation of federal income tax brackets, uses the CPI-U.

In 1985, 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), that series is not used to make adjustments to Social Security or any other federal program 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 appropriate that the content of the market basket used to construct the CPI changes over time to reflect the changes in household spending patterns. However, when using the CPI to inflate a price from the past, these changes create an incomparable bundle of which most users are unaware. In particular, 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 2017, those same items made up 15% and 3%.



Conclusions.

Most economic data are observations of human behavior. A simple market transaction has at least two participants, a supplier and a demander. While the price observed is what each is willing to pay or receive, each is dealing with a different of set of opportunity costs. A year from now, the identical participants may participate in a similar transaction perhaps even at the same

price, but they both will have a different set of opportunity costs then. To understand these two transactions we need to know more than just the two prices.

I am not a fan of long-run economic real value time series. I feel they give the impression that they are a measurement of the change in the size of a well-defined economic activity. This is often not the case as I have shown. Using the CPI to deflate over long periods often produces very unrealistic comparisons.

The main principle of MeasuringWorth is that when comparing the relative worth of "monetary amounts", one measure is not enough. Also, as we have shown in the Measuring Worth essay, it is possible to understand a great deal about relative worth without using a price index.

Time series have their uses, but it is important to know how they are measured and, more importantly, their limits. Much of how some of them are used currently is inconsistent with the intent of their creators.

.

Bibliography

Allen, R.G. D., *Index Numbers in Economic Theory and Practice,* Routledge, London, 1975

Bassmann, R.L.,The Role of the Economic Historian in Predictive Testing of Proffered 'Economic Laws'", EEH/ Second Series, Vol.2, No. 3, pp. 159-86, 1965

Bureau of Labor Statistics (2015). *The first hundred years of the Consumer Price Index: a methodological and political history*, Monthly Labor Review.

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

Frisch, Ragnar, 'The Problem of Index Numbers', *Econometrica*, 4 (1936) pp. 1-38.

Marcuss, Rosemary D. and Richard E. Kane "U.S. National Income and Product Statistics: Born of the Great Depression and World War II" *Survey of Current Business,* February 2007 pp. 32-46.

Morgenstern, Oskar, *On the Accuracy of Economic Observations*. 1965

Officer, Lawrence (2019) "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 to the Present*," MeasuringWorth, 2019.*

Samuel H. Williamson and Louis Cain, "Defining Measures of Worth --Most are Better than the CPI" *MeasuringWorth, 2019.*