

# Price Indices Suitable for the Monetary Policy: A Measurement in Economics Perspective

Carlos Guerrero de Lizardi [Universidad Nacional Autónoma de México]

Copyright: Carlos Guerrero de Lizardi, 2021

You may post comments on this paper at

<https://rwer.wordpress.com/comments-on-rwer-issue-no-98/>

## Abstract

Although the consumer price index (CPI) has constituted the first choice as the monetary policy target, currently central banks might examine a “second-generation approach” based on other indicators. Founded on an extensive literature review into the subdiscipline called “measurement in economics”, we will outline some suggestions to upgrade the monetary policy framework applied by central banks. Firstly, we elaborate on a methodological guideline. Next, we review the theoretical foundation of the CPI, that is, the notion of the purchasing power of consumers. Later on, taking as a starting point some theoretical insufficiencies and practical concerns relative to the CPI compilation, we offer some considerations about the unsuitability of using CPI growth rate as the monetary policy target. We then submit our proposals.

## Introduction

The consumer price index (CPI) has constituted the first choice as the monetary policy target, to the extent is widely known by the general public and is available on a timely basis. Without ruling out the above, currently, central banks might examine a “second-generation approach” based on other indicators, such as the producer price index (PPI) or the gross domestic product (GDP) deflator (Bloem, Armknecht, and Zieschang, 2002, p. 173).

The aforementioned authors, officials of the International Monetary Fund, argued in the following terms (2002, p. 180):

“The conclusion of the foregoing discussion of the scope and valuation dimensions of inflation indices is that such and index should satisfy several criteria. An inflation index should include all types of monetary transactions; exclude nonmonetary transactions; exclude taxes and subsidies on products in the valuation of market transactions; and permit transparent analysis of the contributions to change in the inflation index arising from the prices of exported and imported goods and services.”

Founded on an extensive literature review into the subdiscipline called “measurement in economics” (among others, Haavelmo, 1944; Solow, 1957; Arrow, 1958; Nordhaus, 1996, 1998; and Deaton, 1998), we will outline some suggestions to upgrade the monetary policy framework applied by central banks in nowadays.

Firstly, we elaborate on a methodological guideline. Next, we review the theoretical foundation of the CPI, that is, the notion of the purchasing power of consumers. Later on, taking as a starting point some theoretical insufficiencies and practical concerns relative to the CPI

compilation, we offer some considerations about the unsuitability of using CPI growth rate as the monetary policy target. We then submit our proposals, among others the following:

- 1) We recommend that monetary authorities ask the statistical agencies to compile *additional* consumer price indices, to dispose of better information on the dynamics of the purchasing power of citizens throughout the expenditure distribution.
- 2) When conducting their monetary policy, including the determination of the inflation target, central banks have to take into account the measurement biases of the CPI and not to overlook that measured inflation, and its volatility, are the result of the application of an instrument that numerically *resizes* the available price information.
- 3) It would be convenient that central banks add, as a monetary policy target, at least one of the other two major price indices of an economy, the GDP deflator –which would require the change of its frequency from quarterly to monthly– or the PPI. Under this scenario, monetary authorities: 3.1) would have as a target a broader price index growth rate, with its matching instrument, the interest rate; and 3.2) would have an intermediate target in terms of the CPI growth rate –which is a subset of the prices of an economy–, with the intention of taking care of the purchasing power of consumers. To the extent that the link between the PPI and CPI growth rates is, firstly, a theoretical matter –for example in terms of its scope–, and secondly, an empirical one, central banks would have to analyze it carefully in order to determine the target –in terms of the PPI growth rate–, and as its byproduct, the *intermediate* target –in terms of the CPI growth rate. Once again, the PPI growth rate would be the policy target –with the aim of maintaining the current transparency and accountability of central banks– and the CPI growth rate would be merely an intermediate target.

### **Methodological guideline**

Scientists should make a distinction between the theoretical definition of a variable, its measured value, and its true value (Haavelmo, 1944). An applied economist, for example, should be aware of the weak or strong correspondence between a theoretical definition and its observed value, and of the difference between the true value and its measured one –known as the measurement bias. With sharpness, Morgan (2001, pp. 236-7) illustrated Haavelmo’s concerns:

“Whereas some might suppose that economic measurement is merely counting ‘what is there’, a similarly naïve view would have us think that x-ray machines merely look through our flesh to reveal bones. We don’t see a macroeconomy, nor a consumer price index... hence fashioning measuring instruments in economics has been, in part, a matter of developing ways of observing the economy... Economic observations must not only be registered but also converted into measurements, and converted in ways which serve particular theoretical or empirical or bureaucratic purposes.”

Extending Haavelmo (1944), Koopmans (1947) labeled Burns and Mitchell’s efforts to analyze the business cycle empirically as “measurement without theory”. Although Mitchell was regarded, initially, as one of the main exponents of quantitative economics in the early twentieth century, for Hendry and Morgan (1996, p. 8) “he cannot be said to have adopted statistical ways

of thinking... Instead, he is an empiricist who adopted quantification as a natural tool for gleaning evidence in economics.”

And Mitchell participated in the decision to rename the Cost of Living Index (COLI) as a CPI, which implied, as will become clear later, narrowing its microeconomic foundations. Although it seemed that it was a theoretical discussion, strictly speaking, the debate at stake was about the *precision* of the measurement. On that Persky (1998, p. 204) wrote the following: “However, the Mitchell committee did recommend that the name of the ‘Cost of Living Index’ be changed, arguing that an index of prices couldn’t fully reflect changes in welfare (Davis, 1944, p. 23), and as a result, the Bureau of Labor Statistics renamed its series as a ‘Consumer Price Index’.”

So data are theoretical constructions, or in other words, scientific objects, in the sense that they constitute the measured values of theoretical definitions and because of the manipulation of measuring instruments for its compilation. In particular, the subdiscipline known as measurement in economics strongly advises not to lose sight of the precision of the observed values. Lequiller and Blades (2014, p. 44) addressed the case of the emblematic variable of the System of National Accounts:

“National accounts could better be called ‘national accounts statistics’ because without this qualifier users may think they are as reliable as the business accounts of a company. This is not true. In particular, while GDP for technical reasons is often expressed in millions of units of the National currency, users should be aware that they are very, very far from being accurate at the level of millions... It is not even possible to give a summary figure of the accuracy of the GDP. Indeed, national accounts, and in particular GDP, are not the result of a single big survey for which one might compile a confidence interval. They are the result of combining a complex mix of data from many sources, many of which require adjustment to put them into a national accounts database and which are further adjusted to improve coherence, often using non-scientific methods.”

A recent point of reference is a paper written by Moulton (2018, p. 31 and p. 33), a former official who worked for 32 years at the US statistical system. He estimated a pair of mismeasurements linked each other, that is, the upward bias of the inflation rate of 0.85 percentage points per year, and the underestimation of the economic growth around -0.65 percentage points per year during the post-Boskin Commission years. To size the mismeasurements it is worth to remember that, according to the Bureau of Labor Statistics (BLS) and to the Bureau of Economic Analysis (BEA), the US annual average inflation rate was 2.14% between 1997 and 2017, and its economic growth was 2.27% in the same period. According to Feldstein (2017, p. 2), mismeasurement in economics not only distort public and private decisions but may erode social cohesion, among other collaterals:

“The resulting widespread references to slow economic growth reduce the public’s faith in the political and economic system. The low measured growth of incomes exacerbates concerns about mobility with people worrying that they and their children are ‘stuck’ at low income levels. I think it creates a pessimism that contributes to political attitudes that are against free trade and critical of our market economy more generally... The underestimation of growth also distorts Federal Reserve policy. The perception of slow real growth now supports a Federal Reserve policy of exceptionally low interest rates that is contributing to potential financial instability. Back in 1996, Fed chairman Alan Greenspan persuaded members of the Federal Open Market Committee in 1996 that the

official data underestimated productivity growth so that maintaining strong demand would not cause a rise in inflation.”

With great insight, the guru of measurement in economics warned us that (Boumans, 2005, p. 121), a “relevant problem of instruments used to make unobservables visible is how to distinguish between the facts about the phenomenon and the artifacts created by the instrument.” The heart of the matter is that, in economics, measuring instruments functioned initially as “artifacts of measurement” but rapidly turned into “analytical devices” (Klein, 2001; and Morgan, 2001). Therefore, it is always necessary to keep in mind that measuring instruments shape our subject matter, and we would better use them with extreme caution all the time.

In short, measurement in general, and measurement in economics in particular, is full of risks and obstacles. Muller (2018, pp. 3-4) summarized them as follows:

“Used properly, measurement, as we’ll see, can be a good thing... (But measurement) can also distort, divert, displace, distract, and discourage. While we are bound to live in an age of measurement, we live in an age of mismeasurement, over-measurement, misleading measurement, and counter-productive measurement... There are things that can be measured. There are things that are worth measuring. But what can be measured is not always what is worth measuring; what gets measured may have no relationship to what we really want to know. The costs of measuring may be greater than the benefits. The things that get measured may draw effort away from the things we really care about. And measurement may provide us with distorted knowledge –knowledge that seems solid but is actually deceptive.”

The main measuring instruments used in economics are index numbers. This paper deals with a relevant one, the well-known CPI.<sup>1</sup> The implementation of this methodological guideline will allow us to put forward an upgrade of the current monetary policy framework.

### **On the theoretical foundations of the Consumer Price Index**

The purchasing power, as a theoretical concern, is one of the oldest and persistent in what we call economics nowadays. Fleetwood (1707, 1745, [1969], p. 49), the “real father of index numbers” (Balk, 2008, p. 6), compared the purchasing power of an Oxford student from 1460 to 1707 using a basket with the following content, “5 quarters of wheat, 4 hogsheads of beer, and 6 yards of cloth”. In the same direction, according to Edgeworth (1925, p. 381) “the earliest treatise on index numbers and one of the best” is Fleetwood’s *Chronicon Preciosum*.

---

<sup>1</sup> Long time ago Foster (1922, p. vii) wrote: “All sciences are characterized by a close approach to exact measurement. How many of them could have made much progress without units of measurement, generally understood and accepted, it is difficult to image... In economics, however, as in education, though the need for quantitative measurement is as great as in physics or in medicine, we have been guided in the past by opinions and guesses... In the future, we must substitute measurement for guesswork. Toward this end, we must first agree upon instruments of measurement. To the Pollak Foundation for Economic Research, it seems fitting, therefore, that its first publication should be *The Making of Index Numbers*.”

The other two founders are C. F. Dutot and G. R. Carli. About the methods proposed by Dudot (1738) and by Carli (1764), Walsh (1901, p. 553 and p. 554) wrote the following:

“(Dudot)... compares the total sums made up, at two periods (times of Louis XII and Louis XIV), of the prices of the customary mass-units of various articles (including wages). [Uses the arithmetic average of prices with haphazard weighting. See Appendix C, I.]... (Carli)... averaging the prices of grain, wine and oil, in the periods about 1500 and 1750, he compares them by taking the earlier as units and reducing the later to the proper figures in proportion, thereby representing the variations, and draws the arithmetic average”.

Fleetwood's *un-weighted* price index constitutes the first registered attempt “to solve” what is currently named “the problem of index numbers”. Afriat (2005, pp. 21-2), “the guru of the price index” (Deaton, 2005, p. xvii), defined the problem we are dealing with as follows:

“In the other extreme, the only authority for the present is the past. In early economics, the correct price or wage is simply the price or wage that has been settled by custom and has the value which, so far as anybody can remember, it has always had... Price indices express respect for that authority. They offer a kind of exchange rate between £s in different periods... A force acting on what a wage should be this year is what it was in some former year converted into this year's £s. Sums today are measured by a yardstick which has reference to the past. The ‘index number problem’ can be understood as the problem of fashioning such a yardstick.”

The *Consumer Price Index Manual: Theory and Practice* (ILO et al., 2004, Chapter 15, corrected, p. 1) transformed our theoretical problem into a practical one: “How exactly should the microeconomic information involving possibly millions of prices and quantities be aggregated into a smaller number of price and quantity variables? This is the basic problem of index numbers.” Various “calibrating instruments” have been proposed in order to establish a common metric (Afriat, 2005, p. 22), among others, the fixed basket approach; the statistical approach; the test approach, also known as axiomatic or instrumental; the Divisia approach; the economic approach or constant utility; and the factorial approach.

Nevertheless, in reality, there are only two competing approaches to support the compilation of the CPI. The first one, known as the COGI approach, is based on a sort of a pragmatic point of view. From this perspective, the CPI (Schultze and Mackie, 2002, pp. 1-2) “measures the change in expenditures required by a household to purchase a fixed weight basket of goods and services when prices change between some initial reference period and a subsequent comparison period.” One example is the HICP, which is compiled by the European Statistical System and the National Statistical Institutes with harmonized methods, and is the index used in the European Central Bank's definition of price stability (ECB, 2014).

The second one, the so-called (Konüs) conditional COLI approach, provides a foundation of the fact that, when prices change, consumers do not continue to purchase the same fixed basket, but shift their purchases toward goods whose relative prices have fallen. The COLI quantifies the effect of this *substitution behavior* in reducing the expenditure required by a consumer to maintain a given standard of living when prices change. In this regard, from the trenches, Groshen et al. (2017, p. 188) highlighted that the BLS uses the COLI approach “as a unifying framework and is the standard by which BLS defines any bias.” Triplett (2001, p. F315),

chief economist at the BEA from 1985 to 1997, explained the full meaning of the adoption of the economic approach to base a CPI program:

“Constructing a CPI is not just a matter of choosing a formula that combines the detailed component indexes—price indexes for coats and carrots and computers and cars, indexes that are sometimes called ‘elementary aggregates’. Hundreds and perhaps thousands of decisions must be made in measuring those detailed component indexes. Those decisions are not solely statistical or sampling or collection and processing decisions. Many of them involve economic questions – they are ‘what do we want to measure?’ questions. Applying the theory of the COL index to the CPI means that those ‘What do we want to measure?’ decisions are guided by a consistent, overall decision-making framework, which is the economic theory of consumption.”

From our perspective, to conceptualize the CPI as a COLI means recuperate its original purpose, that is, the measurement of the purchasing power of a target population. As a consequence, we would be able to highlight the closeness between the theoretical object and its empirical counterpart, and we could call the compilation of prices and its conversion into a CPI as an exercise of “measurement with theory”.

The foundation of the CPI as a COGI or as a COLI has subtle implications. For example, US authorities not only acknowledge that their statistical measures have potential errors and biases, but for a long time, they have been trying to estimate them and reduce them. Ulmer (1946), an official at the Department of Commerce, written the first guesstimate of the substitution bias. He estimated a maximum bias of 1.5 percent per year over the period 1929-1940 in the CPI. On the opposite side, ILO et al. (2004, chapter 11, point 11.66) proposed a mixed balance, which may be useful to understand the generalized adoption of a COGI instead of a COLI approach: “Statistical agencies have been reluctant to provide their own estimates of CPI bias. In some cases, they have accepted the existence of substitution bias... Statistical agencies have, however, been reluctant to draw even qualitative conclusions from fragmentary and speculative evidence on quality change, new products and new outlet bias.” To the extent measurement errors in the CPI might lead to inadequate monetary policy actions (Smets, 2006, p. 9), it is central bank officials who have researched on biases typically (among others, Lebow and Rudd, 2003 and 2006; Rossiter, 2005; Shiratsuka, 2006; and Sabourin, 2012).<sup>2</sup>

### **On the notion of purchasing power**

The primary objective of a central bank is to procure the stability of the purchasing power of the national currency. It sounds correct and substantial. Nonetheless, we think that here lays a subtle misunderstanding. The purchasing power is not a characteristic of a coin. Only to the extent that a consumer’s spending pattern is known, it is plausible to define her purchasing power, or making an abusive use of the language, the purchasing power of her earnings.<sup>3</sup>

---

<sup>2</sup> In the annex we present a summary table about the measurements of the CPI biases.

<sup>3</sup> Retrieving the analysis of money’s functions, Afrait (2005, p. 59) endorses our point of view: “The distinction made between exchange value and use-value for goods produces the idea that money, or—what is more specific and understandable—any income, has a purchasing power which is variable depending on prices. The distinction is recognized, but at the same time there is need to avoid the

As a scientific community, we believe, we all share this subtle misunderstanding, and possibly it has its root in a literal reading of Fisher's *The Purchasing Power of Money, its Determination and Relation to Credit, Interest, and Crises*. Perhaps some quotations, necessarily long, may be useful to improve our understanding of Fisher's ideas. At the beginning of his book, Fisher (1922, p. 25) clarified that we are dealing with a microeconomics issue related to consumer's decisions: "The equation of exchange may therefore be written:  $MV = \sum pQ$ . That is, the magnitudes M, V, the p's and the Q's relate to the entire community and an entire year; but they are based on and related to corresponding magnitudes for the individual persons of which the community is composed and for the individual moments of time of which the year is composed."

In page 106, Fisher proposed shortlists of Q's and P's –and reviewing them, we found the description of a model of the entire economy and its *intrinsic price heterogeneity*:

"The chief subclasses under these three groups, which occur in actual sales, may be indicated as follows: wealth (real estate and commodities), property (bonds, mortgages, private notes, and time bills of exchange), and services (of rented real state, of rented commodities, of hired workers, and of some or all these agencies combined)... The prices of these various classes of goods cannot all move up and down in perfect unison. Some are far more easily adjustable than others. Only by extremely violent hypotheses could we imagine perfect adjustability in all. The order of adjustability from the least to the most adjustable may be roughly indicated as follows: 1. Contract prices of properties and services, especially where the contracts, are for a long time; these include bonds, mortgage notes, use of real estate by leases. 2. Contract prices of properties and services, where the contracts are for a shorter time; these include bills of exchange, use of rented real estate and commodities, services of workmen, etc. 3. Prices of commodities made of the money metal. 4. Prices of substitutes for said commodities. 5. Prices fixed by law, as court fees, postage, tolls, use of public utilities, salaries, etc. 6. Prices fixed by custom, as medical fees, teachers' salaries, etc., and to some extent wages. 7. Prices of real estate. 8. Prices of most commodities at retail. 9. Prices of most commodities at wholesale. 10. Prices of stocks."

Finally, in page 105 Fisher summarized the condition, based on an "extremely violent hypotheses", that enabled him to integrate the notion of a single price level in the context of the quantity theory of money: "We have found that the general level of prices is determined by the other magnitudes in the equation of exchange. But we have not hitherto defined exactly what a 'general level' may mean. There was no need for such a definition so long as we assumed, as we have usually done hitherto, that all prices move in perfect unison. But practically prices never do move in perfect unison."

Our interpretation is that Fisher was perfectly aware that, in his analysis, he juxtaposed the spheres of production and consumption, that is, on the one hand, the monetary label for Q's, on the other hand, the purchasing power of individual persons. Fisher chose as the title of his

---

awkwardness of maintaining it fully. The need must be understood, because otherwise there can be bewilderment at consequences of it."

book what he thought was a correct mixture of words in the context of the *equation* of exchange founded on the quantity theory of money.

### **Unsuitability of using the CPI growth rate as the monetary policy target**

According to Schumpeter (1954, p. 14): “We need statistics not only for explaining things, but also in order to know precisely what there is to explain... It is impossible to understand statistical figures without understanding how they have been compiled.” His perspective is relevant to the following discussion.

Founded on our measuring in economics approach, we want to propose four considerations about the unsuitability of using the CPI growth rate as the monetary policy target. Firstly, we have a pair of theoretical definitions –which obey two distinct purposes– and its measured values. In this sense, it is a confusion to identify the CPI –an observed value– with the price level of an economy –a theoretical variable. We have, on the one hand, the purchasing power of a target population, typically the urban consumers, and its measurement, or from a COGI approach, without more ado, a CPI –that serves to “measure the change in expenditure necessary to maintain a certain consumption pattern.” On the other hand, the price level of an economy, which, to say it briefly, synthesizes the supply and demand forces of markets, and its observed values, the GDP (Paasche index) deflator or the Producer Price (Laspeyres) Index (PPI). On this first consideration, we propose a couple of examples. To show empirical evidence on money, prices, and output, Walsh (2003, pp. 13-4) utilized the detrended GDP deflator. In his seminal paper Taylor (1993, pp. 201-1) highlighted the following: “The Council of Economic Advisers published a consensus estimate that a one-year temporary increase in oil prices of 50 percent could temporarily raise the overall price level (GDP deflator) by about 1 percent and with a longer lag, cause real output to fall by about the same amount.” Therefore, it should be clear that the scope, or domain –as it is called in the specialized literature (Diewert, 2002)– of the CPI and the GDP deflator, or the PPI, does not match, implying that these measurements correspond to different theoretical definitions.

Secondly, the aggregate index numbers are not “neutral” statistical indicators (Muellbauer, 1976, p. 32). By construction, the CPI depends on the weights structure; specifically speaking, in the plutocratic method, the CPI relies on the spending pattern of the highest expenditure deciles (Ley, 2005). In this regard, according to Deaton (1998, p. 43), the household for which the American CPI weights are correct lies at the 75th percentile of the expenditure distribution. In the case of Spain, the applicable percentile is the 61st (Izquierdo, Ley, and Ruiz-Castillo, 2003, p. 149), and for the Mexican CPI, the percentile in question is the 86th (Guerrero, 2010, p. 2). To the extent the measured value of the CPI depends on the selected aggregation method, Arrow (1958), Prais (1959), and Pollak (1998), proposed different aggregation methods, that is to say, alternative weights to approximate the purchasing power of a population and its groups.<sup>4</sup> For its part, in the case of the GDP deflator, its weights are the value aggregated shares of each one of the activities that structure the economy. For example, in the case of Mexico, the CPI aggregates price indices of 299 items strata, and according to the North American Industry Classification System (NAICS), the GDP deflator aggregates price indexes of 796 economic activities.

---

<sup>4</sup> Ball (2019) has just solved the “puzzle” regarding the loss of validity of the Phillips curve after the Great Recession, using the *median* as a weight to determine the core inflation. Taking account that weighting information is not available at the elementary level, an extreme proposal would be the use of un-weighted formulae, such as the Dutot, the Carli or the Jevons indices (Ralph, O’Neill, and Winton, 2015, p. 125).



Thirdly, the numerical difference between the inflations measured using the CPI or the GDP deflator, the CPI or the PPI, or the differences between the inflation in each one of the items contained in a basket of goods and services and the one measured using the entirely CPI, may seem “negligible”, and to some extent they are, but solely by construction! Such a reduction –or “compromise” that is, the adjustment, as it was repeatedly written by Fisher (1922)– is the result of the selected measuring instrument, that is, a weighted average index number.<sup>5</sup>

As an illustration of the *resizing effect* of the Laspeyres formula, or said metaphorically the “funnel” effect, we prepare three examples. The selected period was due to the availability of information after the Great Recession. The US CPI-U (for all urban consumers) divides the population into 38 geographic areas called index areas and divides all goods and services purchased by consumers into 211 categories called item strata. In its hierarchical approach, we find major groups, expenditure classes, item strata, and entry-level items, which are the ultimate sampling units for items and represent the level of item definition from which data collectors begin item sampling within each sample outlet. The first example displays the growth rate of the first item strata –other bakery products (FB04)– that shows three entry-level items –fresh sweet rolls, coffeecakes, and doughnuts (S02063), crackers, bread, and cracker products (S0206A), and frozen and refrigerated bakery products, pies, tarts, and turnovers (S0206B)– of the CPI.

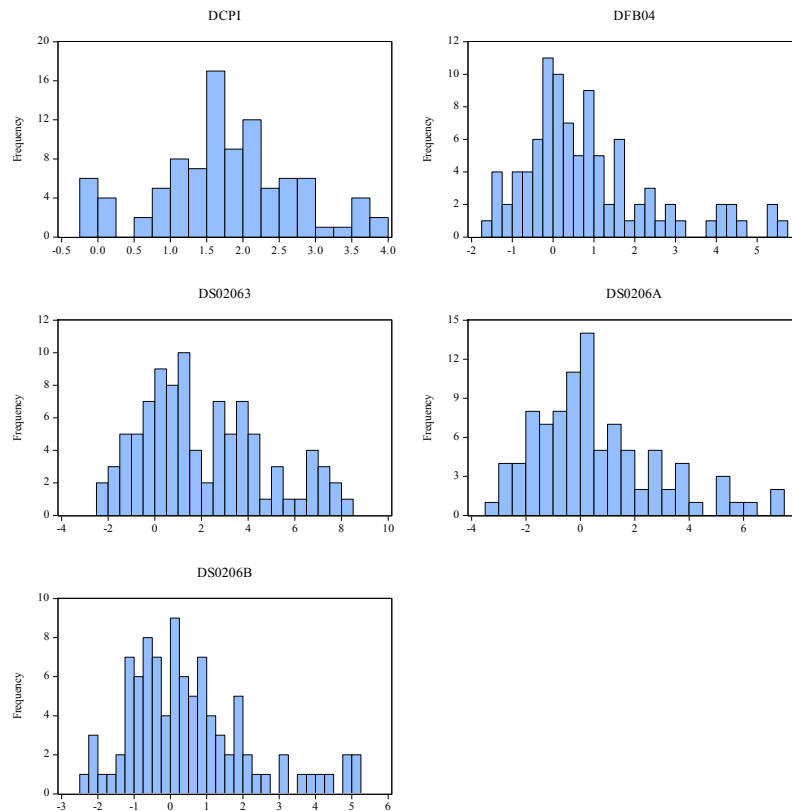
**Table 1.** Descriptives of (item strata and its entry-level items) price indexes growth rates, in percentage, from 2010.10 to 2018.10.

	Mean	Median	Maximum	Minimum	Standard deviation
Consumer price index	1.78	1.73	3.87	-0.20	0.95
Other bakery products	0.84	0.44	5.58	-1.60	1.63
Fresh sweet rolls, coffeecakes, and doughnuts	2.11	1.48	8.34	-2.40	2.64
Crackers, bread, and cracker products	0.60	0.14	7.31	-3.15	2.32
Frozen and refrigerated bakery products, etc.	0.51	0.22	5.23	-2.47	1.71

**Source:** Author’s calculations based on BLS monthly data.

<sup>5</sup> With the intention of not being repetitive, we selected the following quotation (Fisher, 1922, p. 2): “There would be no difficulty in such measurement and hence no need of index numbers, if all prices moved up in perfect unison or down in perfect unison. But since, in actual fact, the prices of different articles move very differently, we must employ some sort of compromise or average of their divergent movements.”

**Figure 1.** Histogram of (item strata and its entry-level items) price indexes growth rates, in percentage, from 2010.10 to 2018.10, based on BLS monthly data.



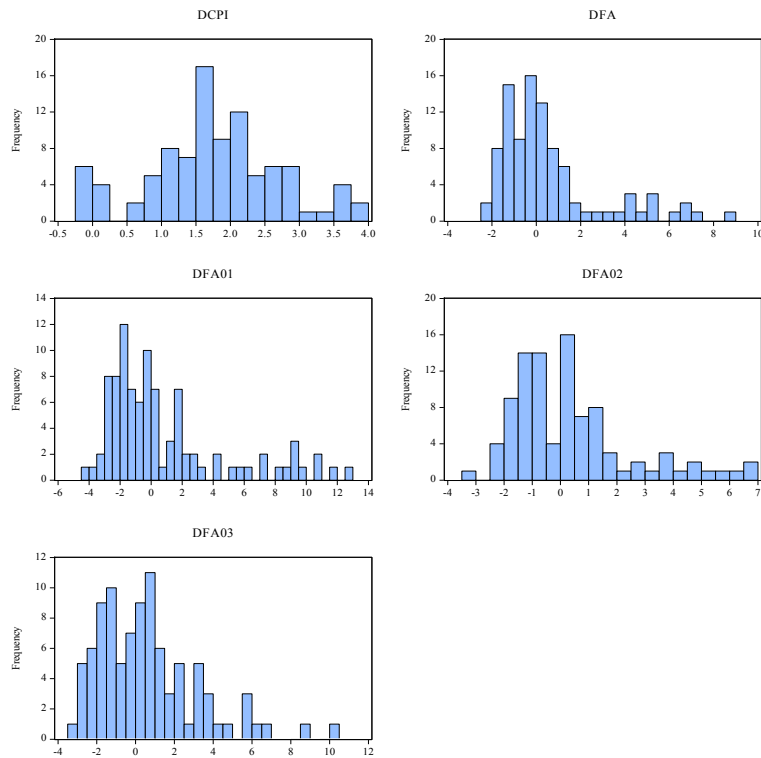
It is sufficient to compare the axes of the x in the panels of Figure 1 to find out how the dispersion of prices for the entry-level items was resized in the price index of the item strata (FB04) that groups them. It should be noted that this exercise was conducted at the highest available level of disaggregation. If we compare the scale of the changes of the item strata (FB04) and the CPI, the resizing effect generated by the measuring instrument is confirmed. The second example displays the growth rate of the first three item strata –flour and prepared flour mixes (FA01), breakfast cereal (FA02), and rice, pasta, and cornmeal (FA03)– of the CPI that compound the “cereals and cereals products” (FA) expenditure class.

**Table 2.** Descriptives of (expenditure class and its items strata) price indexes growth rates, in percentage, from 2010.10 to 2018.10.

	Mean	Median	Maximum	Minimum	Standard deviation
Consumer price index	1.78	1.73	3.87	-0.20	0.95
Cereals and cereals products	0.53	-0.07	8.55	-2.19	2.30
Flour and prepared flour mixes	0.84	-0.46	12.57	-4.08	3.97
Breakfast cereal	0.36	0.03	6.60	-3.08	2.12
Rice, pasta, and cornmeal	0.65	0.22	10.48	-3.01	2.63

**Source:** Author’s calculations based on BLS monthly data.

**Figure 2.** Histogram of (expenditure class and its items strata) price indexes growth rates, in percentage, from 2010.10 to 2018.10, based on BLS monthly data.



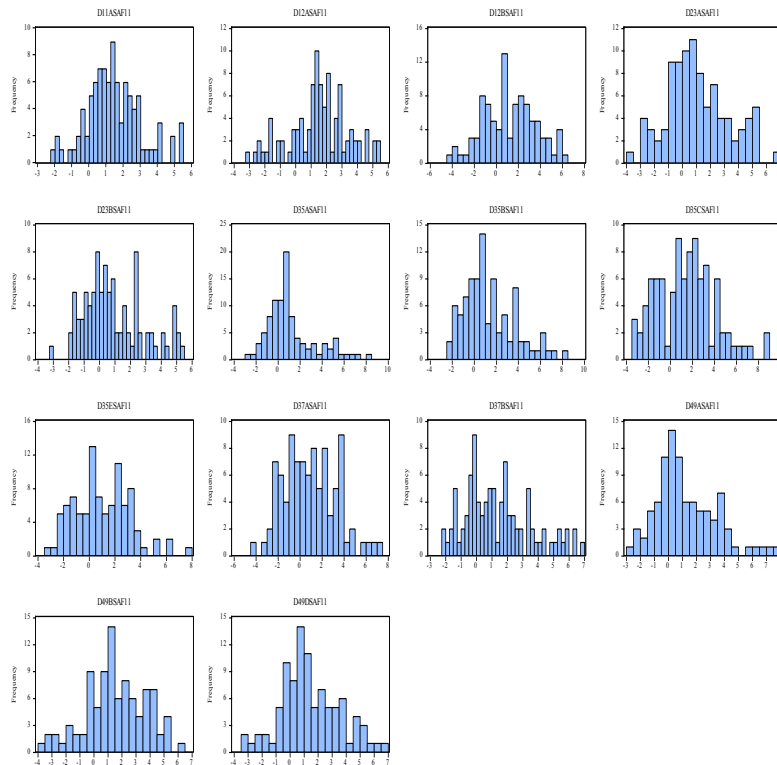
In Table 2, statistics of the price indexes that compose the “cereals and cereal products” are different, but the histograms evidence of how the price of the expenditure class compromised the prices of its item strata. The third example displays the growth rate of food at home price indexes by metropolitan areas. For the selected period and frequency, the urban regions available data were Boston-Cambridge-Newton, MA-NH (D11ASAF11); New York-Newark-Jersey City, NY-NJ-PA (D12ASAF11); Philadelphia-Camden-Wilmington, PA-NJ-DE-MD (D12BSAF11); Chicago-Naperville-Elgin, IL-IN-WI (D23ASAF11); Detroit-Warren-Dearborn, MI (D23BSAF11); Washington-Arlington-Alexandria, DC-VA-MD-WV (D35ASAF11); Miami-Fort Lauderdale-West Palm Beach, FL (D35BSAF11); Atlanta-Sandy Springs-Roswell, GA (D35CSAF11); Baltimore-Columbia-Towson, MD (D35ESAF11); Dallas-Fort Worth-Arlington, TX (D37ASAF11); Houston-The Woodlands-Sugar Land, TX (D37BSAF11); Los Angeles-Long Beach-Anaheim, CA (D49ASAF11); San Francisco-Oakland-Hayward, CA (D49BSAF11); and Seattle-Tacoma-Bellevue, WA (D49DSAF11).

**Table 3.** Descriptives of food at home price indexes growth rates by metropolitan area, in percentage, from 2010.10 to 2018. 10.

	Mean	Median	Maximum	Minimum	Standard deviation
Boston-Cambridge-Newton	1.44	1.36	5.40	-2.17	1.59
New York-Newark-Jersey City	1.50	1.55	5.49	-3.02	1.90
Philadelphia-Camden-Wilmington	1.18	0.98	6.33	-4.27	2.41
Chicago-Naperville-Elgin	1.08	0.84	6.76	-3.70	2.20
Detroit-Warren-Dearborn	0.89	0.45	5.30	-3.01	1.92
Washington-Arlington-Alexandria	1.20	0.68	8.47	-2.52	2.21
Miami-Fort Lauderdale-West Palm Beach	1.39	0.87	8.16	-2.25	2.33
Atlanta-Sandy Springs-Roswell	1.42	1.41	8.66	-3.40	2.65
Baltimore-Columbia-Towson	1.05	0.88	7.99	-3.28	2.19
Dallas-Fort Worth-Arlington	0.94	0.77	7.05	-4.36	2.38
Houston-The Woodlands-Sugar Land	1.42	1.02	6.96	-2.17	2.16
Los Angeles-Long Beach-Anaheim	1.26	0.75	7.53	-2.87	2.15
San Francisco-Oakland-Hayward	1.54	1.37	6.09	-3.78	2.17
Seattle-Tacoma-Bellevue	1.41	1.09	6.76	-3.49	2.12

**Source:** Author's calculations based on BLS monthly data.

**Figure 3.** Histogram of food at home price indexes growth rates by metropolitan area, in percentage, from 2010.10 to 2018.10, based on BLS monthly data.



The resizing effect of weights on prices is also observed when we use spatial information, that is to say, the above information evidences the *idiosyncratic character of prices*, at an aggregated level and by metropolitan areas, whether it is measured by its mean, its maximum or minimum values, or its dispersion.

Before moving on to the next section, we stress that the equalization of the price level of an economy with the purchasing power of a group of consumers, would imply that the list of biases of the GDP deflator, of the PPI, and the CPI, are similar, or at least we would expect some degree of correspondence between them. But it is not like that because its theoretical senses and practical purposes are distinct, regarding, for example, the outlet substitution bias –and its statistical framework, the Point-of-Purchase Survey– which it may be defined exclusively for the CPI.

### **The problem of quality changes: theoretical insufficiencies and practical concerns**

We borrowed the first part of the title above from Arrow (1958, p. 84). Although the original version has a few paragraphs, the messages are significant. To the extent he acknowledged that the perspective used was theoretical, we want to highlight the following three fundamental insights. The first one is that “at this level of abstraction”, there is no “logical difference” between an improvement in the quality of a product and the introduction of a new one (Arrow, 1958, p. 85). The second one, Arrow (1958, p. 86) underlined that to compile a CPI based on a COLI approach is necessary to assume “an unchanged want structure between one period and the next”. In this sense, no more no less, “We have gone so far as to impute tastes for commodities not available in one time period or the other in order to preserve the theoretical foundation.” The third fundamental insight, Arrow (1958, p. 86) emphatically pointed out that “the only true measure of quality is the satisfaction yielded to the consumer.” In short, even from a COLI perspective, we face theoretical difficulties hard to overcome. Having said all of the above, Arrow warned us all that the compilation of the CPI requires the excellent judgment of its makers.

From the theoretical ground, we would like to add a consideration to those proposed by Arrow (1958). To put it briefly, the analytical breakdown caused by the transfer from an individual-true cost of living index to a social one, that is, the difficulty of jumping from Konüs (1939) to Pollak (1981). Konüs (1939) defined the individual-true cost of living index as the ratio of the minimum costs of achieving a certain reference utility level in a base period, given the prices prevailing at that time, and at a later current period, given whatever changes in prices had occurred in the interval. And Pollak (1981) defined the social-true cost of living index as the ratio of the expenditure required to enable each of the households present in the two periods to attain their reference utility levels in both periods. Here we face a theoretical insufficiency regarding the comparison and aggregation of utility levels, which requires further analysis beyond this paper and may provoke hard-to-answer questions, such as those implied by Deaton (1998, p. 44):

“Not everyone will benefit from advances in heart or cataract surgery, which means that the reduction in the cost of living associated with such advances is different for different people, so that once again it makes no sense to talk about ‘the’ cost-of-living index (Griliches and Cockburn, 1994). It is all very well to suggest that the CPI should move closer to a true cost-of-living index, but it would be wise to discuss whose cost of living we are talking about.”

Similarly, Nordhaus (1996, 1998) made clear that the linking method used by statistical agencies misses the impact of “radical new products” on living standards; in other words, the “tectonic shifts in technologies” are not captured in the official figures. For Nordhaus (1996, p. 30), the task faced by statistical makers is a science-fiction mission to the extent it is necessary to compare “the services of horse with automobile, of Pony Express with facsimile machine, of carbon paper with photocopier, of dark and lonely nights with nights spent watching television, and of brain surgery with magnetic resonance imaging.” From his point of view, statistical agencies might require numerous teams of economists and plenty of time to account for changes in the quality and range of goods and services that we consume. We would add adequate financing because statistical institutions are under-funded all around the world.<sup>6</sup> Although his suggestion may not be attractive for some professionals, Nordhaus (1998, p. 68) is an enthusiast of this measurement in economics perspective to the extent that, for him, “it is hard to think of a more exciting and worthwhile topic in applied economics.”

### **Proposals for an upgrade of the monetary policy framework**

We listed an inventory regarding the unsuitability of using the CPI growth rate as the monetary policy target. Afriat (2005, p. xxiv) wrote: “It should no longer be plausible, even to convinced ‘price level’ believers, that the whole situation can be effectively summarized by a single number.” Afriat is right –the price level exists only in the imaginary of models builders. Keeping in mind the information requirements to design the monetary policy, the selection of index numbers as measuring instruments –in both senses, as “artifacts” and as “analytical devices”– falls short. Thus, possibly, as a scientific community, we erred in selecting index numbers as measuring instruments. Suffice it to say that it was a decision made a century ago. How quickly time passes!

Albeit we are not able to thoroughly analyze its consequences for the theory and practice of monetary policy and, in general, for the making of macroeconomics, we are in a position to submit the following:

- The use of an index number –that is, of a weighted average–, resizes the available price information. Fisher (1922, p. 291) wrote: “These weights are, of course, merely matters of opinion, but, as is well known, wide differences in systems of weighting make only slight differences in the final averages.” We recommend that central banks ask the statistical authorities to compile the following *additional* indices: a democratic one in which each household’s index is averaged to obtain the CPI (Prais, 1959); a second one base on the median of the expenditure distribution (Pollak, 1998); and ten other price indexes corresponding to the ten deciles of the income distribution (Arrow, 1958).<sup>7</sup>

---

<sup>6</sup> Griliches elaborated the following diagnosis a long time ago which, we believe, continues in force until our days (1994, p. 14): “Why are the data not better? I don’t really have good answers to this question, but at least three observations come to mind: (i) The measurement problems are really hard. (ii) Economists have little clout in Washington, especially as far as data-collection activities are concerned. Moreover, the governmental agencies in these areas are balkanized and underfund. (iii) We ourselves do not put enough emphasis on the value of data and data collection in our training of graduate students and in the reward structure of our profession.”

<sup>7</sup> Here an extract of a pair of resolutions of *The Second International Conference of Labour Statisticians* held in April 1925 (ILO, pp. 69-70): “(1) In each country statistics should be published showing changes in the cost of living... Separate index numbers should be published for each of the groups... (2) A series

All the above with the intention that monetary authorities dispose of better information on the dynamics of the purchasing power of citizens throughout the expenditure distribution. These new measurement exercises should be based on the well-known expenditure surveys and less-known point of purchase surveys by expenditure group levels (Guerrero, 2014, p. 151).

- When conducting their monetary policy, including the determination of the inflation target, central banks have to take into account the measurement biases of the CPI, and not to overlook that measured inflation, and its volatility, are the result of the application of an instrument that numerically resizes the available price information. All the above requires strong efforts by both the statistical agencies and the central banks to research on these topics.
- The objectives of central banks are complex. Noticeably, monetary authorities look out for the inflation of an economy. In this regard, it would be convenient that central banks add, as a monetary policy target, at least one of the other two major price indexes of an economy, the GDP deflator –without losing sight of its drawbacks–, or the PPI –suggested by Bloem, Armknecht, and Zieschang (2002) from the International Monetary Fund. Under this scenario, monetary authorities: 1) would have as a target a broader price index growth rate, with its matching instrument, the interest rate; and 2) would have an intermediate target in terms of the CPI growth rate –which is a subset of the prices of an economy–, with the intention of taking care of the purchasing power of consumers. To the extent that the link between the PPI and CPI growth rates is, firstly, a theoretical matter –for example in terms of its scope–, and secondly, an empirical one, central banks would have to analyze it carefully in order to determine the target –in terms of the PPI growth rate–, and as its byproduct, the intermediate target –in terms of the CPI growth rate. Once again, the PPI growth rate would be the policy target –with the aim of maintaining the current transparency and accountability of central banks– and the CPI growth rate would be merely an intermediate target.<sup>8</sup>

Last but not least, we firmly believe that the feasibility of adopting our suggestions depends on the following prerequisites. 1) Robust coordination among central banks, founded on common points of view. 2) The construction of a joint research agenda between monetary authorities and statistical institutes. And 3) The implementation of a successful educational crusade that allows citizens an adequate understanding of the measurement decisions suggested here.

---

of national index numbers, calculated by using weights based on the consumption of industrial workers generally, should be published...”.

<sup>8</sup> According to Lombardozzi and Kelley (2013, p. 2), “PPI data most often are used as a general indicator of inflation, for price trend analysis and forecasting, for contract escalation, and for price comparisons of a company’s products with those of its competitors. According to the user survey results, the value of the average contract escalated by the PPI is \$115 million dollars. This outcome illustrates the importance of the proper use of the PPI as a contract escalator, because a 1-percent error in the escalation of a \$115 million contract would result in more than a \$1-million adjustment.” In its web, the Bureau highlights the following: “BLS estimates that agreements with a lifetime worth in the trillions of dollars are currently adjusted using the Producer Price Index (PPI) family of indexes, either alone or in conjunction with other sources of economic data”; and also makes available the *Escalation Guide for Contracting Parties* (<http://www.bls.gov/ppi/ppiescalation.htm>).

## Final thoughts

Morgan (2007) has already shown that it is unsuitable to measure a variable using an equation –in her case, the income velocity of money using the equation of exchange. One obvious problem is the lack of independence between the velocity and the money stock. We want to propose the residuals of the aggregate production function as the emblematic example of the use of an equation as a measuring instrument.

There is an acknowledged continuity between Solow (1956) and Solow (1957). The first one founded the neoclassical theory of economic growth, and the second one constitutes its practical extension (1957, p. 312): “The new wrinkle I want to describe is an elementary way of segregating variations in output per head due to technical change from those due to changes in the availability of capital per head.” With his second effort, Solow met the modern most demanding requirements for the complete exposition of a theory proposed by Boumans (1999, p. 410), that is to say, “a measurement formula” and its “standardization”.

A quick re-reading of the masterly document reveals that Solow (1957) himself was aware of the complexity of his methodological proposal. Among other examples, he mentioned, as theoretical challenges, the doubts about the precise meaning of the “quantity of capital” and of the “technical change”; and the need for a problematic assumption –the factors are paid according to their marginal products. As empirical challenges, the author analyzed, among other issues, the weak correspondence between the theoretical definition of “output” and its empirical counterpart, the GNP; the problem of measure aggregates; the poor quality of data; and the difficulty to approximate a non-observable variable, that is, the idle capacity of the capital stock, and its implausible solution. In his own words (p. 314): “Lacking any reliable year-by-year measure of the utilization of capital I have simply reduced the Goldsmith figures by the fraction of the labor force unemployed in each year, thus assuming that labor and capital always suffer unemployment to the same percentage.”

In the case we are dealing with, the weighted average Laspeyres price index, the problem is not that an equation was used as a measuring instrument but that the equation required a single representation of the prices of an economy. In other words, the equation of exchange played the role of “straitjacket”. Therefore, we believe that it is time for us to recognize that a single measurement of prices, originated in an equation, does not constitute an adequate representation of the real economic phenomena that we have to understand to design the monetary policy.

## References

- Afriat, S. N. *The Price Index and its Extension: A Chapter in Economic Measurement*, New York, Routledge, 2005.
- Arrow, K. J. The measurement of price changes, 77–87, in *Relationship of Prices to Economic Stability and Growth: Hearings before the Joint Economic Committee Congress of the United States*, Washington DC, U. S. Government Printing Office, 1958.
- Balk, B. M. *Price and Quantity Index Numbers: Models for Measuring Aggregate Change and Difference*, Cambridge, Cambridge University Press, 2008.
- Ball, L. M. The nonpuzzling behavior of median inflation, *Working Paper 25512*, National Bureau of Economic Research, 2019.



Bloem, A. M., Armknecht P. A. and Zieschang K. D. Price indices for inflation, 172-98, in Carson, C. S., Enoch, C., and Dziobek, C. (eds), *Statistical Implications of Inflation Targeting: Getting the Right Numbers and Getting the Numbers Right*, Washington DC: International Monetary Fund, 2002.

Boumans, M. Representation and stability in testing and measuring rational expectations, *Journal of Economic Methodology*, 6(3), 381-402, 1999.

Boumans, M. *How Economists Model the World into Numbers*, London, and New York, Routledge, 2005.

Boumans, M. Introduction, 3-18, in Boumans M. (ed), *Measurement in Economics: A Handbook*, Amsterdam, Academic Press, 2007.

Carli, G. R. Del valore e della proporzione del metalli monetati con i geueri in Italia prima delle scoperte dell' Indie col confronto del valore e della proporzione de' tempi nostri, Ed. Custodi, quoted by Walsh (1901, p. 554), (1764).

Carson, C. S., Enoch, C. and Dziobek, C. (eds). *Statistical Implications of Inflation Targeting: Getting the Right Numbers and Getting the Numbers Right*, Washington DC: International Monetary Fund, 2002.

Deaton, A. Getting prices right: What should be done?, *Journal of Economic Perspectives*, 12(1), 37-46, 1998.

Deaton, A. Foreword, xvii, in Afriat, S. N., *The Price Index and its Extension: A Chapter in Economic Measurement*, New York, Routledge, 2005.

Diewert, E. Harmonized indexes of consumer prices: Their conceptual foundations, European Central Bank, Working Paper no. 130, 2002.

Dutot, C. F. *Réflexions politiques sur les finances et le commerce*, The Hague 1738, quoted by Walsh (1901, p. 553), (1738).

European Central Bank. *Prices and Costs*, Monthly Bulletin, April, 40-2, 2014.

Feldstein, M. S. Underestimating the real growth of GDP, personal income and productivity, National Bureau of Economic Research, *Working Paper* 23306, 2017.

Fisher, I. *The Purchasing Power of Money, its Determination and Relation to Credit, Interest, and Crises*, assisted by Harry G. Brown, new and revised edition, New York, Macmillan. First edition: 1911. (<https://oll.libertyfund.org/titles/1165>), 1922.

Fleetwood, W. *Chronicon Preciosum, or, an Account of English Money, the Price of Corn, and Other Commodities for the last 600 years: in a Letter to a Student in the University of Oxford*, New York, Augustus M. Kelley Publishers, [1707, 1745] 1969.

Foster, W. T. Prefatory Note, vii-ix, in Fisher, I., *The Making of Index Numbers: A Study of Their Varieties, Tests, and Reliability*, Cambridge, The Riverside Press, 1922.

Griliches, Z. Productivity, R&D, and the data constraint, *American Economic Review*, 84(1), 1-23, 1994.

Groshen, E. L., Moyer, B. C., Aizcorbe, A. M., Bradley, R. and Friedman, D. M. How government statistics adjust for potential biases from quality change and new goods in an age of digital technologies: A view from the trenches, *Journal of Economic Perspectives*, 31(2), 187-210, 2017.

Guerrero, C. Alternative consumer price indexes for Mexico, *Center for International Development Working Paper* no. 42, John F. Kennedy School of Government, Harvard University, 2010.

Guerrero, C. A case of 'No man's land' in economics: the theory of price indexes and its applications, *International Journal of Pluralism and Economics Education*, 5(2): 144-56, 2014.

Guerrero, C. A number of concerns arising from a closer look at the estimation of the Consumer Price Index, *Realidad, datos y Espacio. Revista internacional de Estadística y geografía*, INEGI, 8(1): 64-77, 2017.

Haavelmo, T. The probability approach in Econometrics, *Econometrica*, 12(supplement), iii-vi + 1-115, 1944.

- Hendry, D. F. and Morgan, S. M. *The Foundations of Econometric Analysis*, editors, CUP, 1996.
- ILO/IMF/OECD/UNECE/Eurostat/The World Bank. *Consumer Price Index Manual: Theory and Practice*, Geneva, 2004.
- International Labour Office. *The Second International Conference of Labour Statisticians, Studies and Reports Series N (Statistics)* no. 8, Geneva, 1925.
- Izquierdo, M., Ley, E. and Ruiz-Castillo, J. The plutocratic gap in the CPI: Evidence from Spain, *IMF Staff Papers*, 50(1), 2003.
- Klein, J. L. Reflections from the age of economic measurement, 111-36, in Klein, J. L., and Morgan, M. M. (eds), *The Age of Economic Measurement*, Durham, Duke University Press, 2001.
- Klein, J. L., and Morgan, M. M. (eds), *The Age of Economic Measurement*, Durham, Duke University Press, 2001.
- Konüs, A. A. The problem of the true index of the cost of living, *Econometrica*, 7(1), 10-29, 1939.
- Koopmans, T. C. Measurement without theory, *The Review of Economics and Statistics*, 26(3), 161-72, 1947.
- Lebow, D. E., and Rudd, J. B. Measurement error in the consumer price index: where do we stand?, *Journal of Economic Literature*, XLI(1), 159-201, 2003.
- Lebow, D. E., and Rudd, J. B. Inflation measurement, *Finance and Economics Discussion Series*, No. 43, Federal Reserve Board, 2006.
- Lequiller, F. and Blades, D. *Understanding National Accounts*, second edition, revised and expanded, OECD Publishing, 2014.
- Ley, E. Whose inflation? A characterization of the CPI plutocratic gap, *Oxford Economic Papers*, 57, 634-46, 2005.
- Lombardozzi, A. and Kelley, J. Highlights of the 2013 PPI User Survey, *Beyond the Numbers: Prices and Spending*, 2(20), U.S. Bureau of Labor Statistics, August, 2013.
- Morgan, M. S. Making measuring instruments, 235-51, in Klein, J. L., and Morgan, M. M. (eds), *The Age of Economic Measurement*, Durham, Duke University Press, 2001.
- Morgan, M. S. An analytical history of measuring practices: The case of velocities of money, 105-32, in Boumans M. (ed), *Measurement in Economics: A Handbook*, Amsterdam, Academic Press, 2007.
- Moulton, B. R. *The Measurement of Output, Prices, and Productivity: What's Changed Since the Boskin Commission?*, <https://www.brookings.edu/wp-content/uploads/2018/07/Moulton-report-v2.pdf> (accessed November 12, 2018), 2018.
- Muellbauer, J. The political economy of price indices, *Birbeck Discussion Paper* no. 22, 1976.
- Muller, J.Z. *The Tyranny of Metrics*, Princeton University Press, 2018.
- Nordhaus, W. D. Do real-output and real-wage measures capture reality? The history of lighting suggests not, 29-66, in Bresnahan, T. F., and Gordon, R. J. (eds), *The Economics of New Goods*, Chicago, Chicago University Press, 1996.
- Nordhaus, W. D. Quality change in price indexes, *Journal of Economic Perspectives*, 12(1), 59-68, 1998.
- Persky, J. Price indexes and general exchange, *Journal of Economic Perspectives*, 12(1), 197-205, 1998.
- Pollak, R. A. The social cost of living index, *Journal of Public Economics*, 15(3), 311-36, 1981.
- Pollak, R. A. The consumer price index: a research agenda and three proposals, *Journal of Economic Perspectives*, 12(1), 69-78, 1998.
- Prais, S. J. Whose cost of living?, *The Review of Economic Studies*, 26(2), 126-34, 1959.
- Ralph, J., O'Neill, R. and Winton J. *A Practical Introduction to Index Numbers*, Wiley, 2015.

Rossiter, J. "Measurement bias in the Canadian consumer price index", *Working Paper* no. 2005-39, Bank of Canada, 2005.

Rudd, J. Measurement error in the US CPI, *IFC Bulletin* no. 24, 152-55, 2006.

Sabourin, P. Measurement bias in the Canadian consumer price index: an update, *Bank of Canada Review*, summer, 1-11, 2012.

Schultze, C. L., and Mackie, C. Executive summary, 2-12, in Schultze, C. L., and Mackie, C. (eds), *At What Price? Conceptualizing and Measuring Cost-of-Living and Prices Indexes*, Washington DC, National Academy Press, 2002.

Schumpeter, J. A. *History of Economic Analysis*, London, Allen & Unwin Publishers, 1954.

Shiratsuka, S. Measurement errors in the Japanese CPI, *IFC Bulletin*, no. 24, 36-43, 2006.

Smets, J. Overview of the workshop, *Proceedings of the Irving Fisher Committee Workshop on "CPI Measures: Central Bank Views and Concerns"*, *IFC Bulletin*, no. 24, 9-11, 2006.

Solow, R. M. A contribution to the theory of economic growth, *The Quarterly Journal of Economics*, 70(1), 65-94, 1956.

Solow, R. M. Technical change and the aggregate production function, *Review of Economics and Statistics*, 39(3), 312-20, 1957.

Taylor, J. B. Discretion versus policy rules in practice, *Carnegie-Rochester Conferences Series on Public Policy* 39 (December), 195-220, 1993.

Triplett, J. E. Should the cost-of-living index provide the conceptual framework for a consumer price index?, *The Economic Journal*, 111(472), F311-34, 2001.

Ulmer, M. J. On the economic theory of cost of living index numbers, *Journal of the American Statistical Association*, 41(236), 530-42, 1946.

Walsh, C. E. *Monetary Theory and Policy*, second edition, Cambridge, MIT Press, 2003.

Walsh, C. M. *The Measurement of General Exchange-Value*, The Macmillan Company, available at <http://archive.org>, 1901.

## Annex

The following table summarizes some recent empirical findings on the biases of the CPI.

**Table 1A.** Estimates of biases in the CPI-based measure of the cost of living (percentage points per annum)

Sources of bias	United States	Japan	Canada	Mexico
Commodity substitution	0.35	0.10	0.22	0.198
New products + Quality change	0.37	0.70	0.19	0.215
New outlets	0.05	0.10	0.04	0.100
Total	0.77	0.90	0.45	0.513

**Source:** Lebow and Rudd (2003), Shiratsuka (2006), Sabourin (2012), and Guerrero (2017).

**Author contact:** [cgdl@unam.mx](mailto:cgdl@unam.mx)

SUGGESTED CITATION:

Guerrero de Lizardi, Carlos (2021) "Price Indices Suitable for the Monetary Policy: A Measurement in Economics Perspective." *real-world economics review*, issue no. 98, 14 December, pp. 150-169, <http://www.paecon.net/PAEReview/issue98/GuerreroDeLizardi98.pdf>

You may post and read comments on this paper at <https://rwer.wordpress.com/comments-on-rwer-issue-no-98/>