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Inflation

# How is inflation measured?

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Of all the different official statistics, few have such a direct impact on the life of citizens than the consumer price index (CPI). Wages, state pensions, specific duties and taxes and rental contracts, just to give a few of the more significant examples, can all be modified to some extent according to variations in the CPI. And it is also relatively important in the area of economic policy. For example, the goal pursued by central banks is to maintain price stability and, consequently, accurately and explicitly measuring the evolution of inflation is fundamental to formulating monetary policy. However, on numerous occasions economists have warned of measurement problems associated with price indices. In this Dossier we describe how inflation is calculated and highlight the main problems in its measurement. As we will see, issues that, a priori, seem to be mere methodological curiosities may actually have a significant impact on economic policy decisions.

Microeconomic theory related to consumer decisions provides the features a price index should contain to accurately reflect trends in the cost of living. Specifically it should measure the minimum expenditure required by a household to obtain the same level of well-being (or utility, in economics jargon) over time.<sup>1</sup> It should therefore take into account the fact that consumers may substitute the goods they consume in response to a relative change in the prices of goods. It should also consider new goods at the time they begin to be consumed and reflect any changes in purchasing habits, such as an increase in online shopping, for instance.

However, there are considerable limitations to calculating a price index of this nature, both due to the availability of data and also the methodological challenges posed by measuring consumer utility. By way of example, a cost of living index (CLI) should reflect any improvements in quality of life due to the appearance of new medical treatments or changes in the quality of public goods, such as the air we breathe. Such goods are totally excluded from the CPI calculation as it only includes goods that incur expenditure by households. So although the CPI is frequently referred to as a CLI, it is important to note that this is far from the case.<sup>2</sup>

In practice the CPI, the most widely used price index to measure inflation,<sup>3</sup> is calculated using two basic inputs: a shopping basket of the goods and services a representative household consumes, and their prices. With these data the expenditure required to acquire the basket is calculated with a specific frequency, in general each month. The simplicity of this computation contrasts with the methodological difficulties encountered when putting it into practice: which goods should be included in the basket? How frequently should these goods be updated? Which establishments should provide the prices? And, the question which perhaps has caused most headaches, how can we distinguish the part in a change in price that is due to a change in the good's quality?

Establishing a methodology to calculate the CPI that satisfactorily answers these questions is of the utmost importance to ensure the index reflects as far as possible the trend in the cost of living. Academic literature has identified three important biases. Firstly, the goods in the shopping basket are not updated

immediately when changes occur in the relative prices of the goods.<sup>4</sup> In this respect, when the relative price of a good increases, the expenditure made to buy the CPI's basket of goods is overestimating the expenditure that must be made by a household to acquire a basket that provides it with the same utility. For example, when the price of apples goes up, consumers may substitute them with pears and obtain similar utility. This is known as the substitution bias.

Secondly, given that the quality of goods tends to improve over time, it is necessary to separate the part of the variation in the price that can be attributed to the change in the good's quality from any pure change in price. Not doing so, or only doing so partially, will tend to overstate the CPI compared with the CLI. Lastly, new goods are not included in the CPI basket until after some time has passed, generally a few years after they appear on the market. As the fall in a good's price tends to be concentrated in the first few years (for example in the case of electronic products), taking time to include them in the CPI basket implies that the initial fall in price is not covered by official statistics.

Suspecting that such biases could be considerable, in 1996 the Boskin

Commission, made up of five prominent academics,<sup>5</sup> was asked to quantify the measurement error of the CPI in the United States. The findings of their report caused great commotion: although people already realised that the increase in the cost of living was overstated, their estimates established that the bias had actually been 1.1 pps annually in 1995 and 1996. Approximately half the bias, 0.6 pps, was attributed to the quality change bias.

It should be noted that, since the report was published, important methodological changes have been introduced in the CPI computation which have more than likely reduced these biases. Specifically, substitution between goods within the same category is now permitted (Golden Wonder apples for Fuji, for example) but not substitution between categories (cinema for an online film). New goods are included more quickly in the basket and important methodological advances have been made to adjust for improvements in quality by using, for example, using hedonic regression methods.<sup>6</sup>

In addition to the traditional problems in measuring inflation, we must also add the new challenges brought by new technologies and digitalisation. As innovation is increasing in speed, the bias due to new products on the market and the quality bias may have also increased. Another additional issue is how free goods, so common in the new digital era, should be treated as they are totally excluded from official statistics. This can lead to the CPI being overstated, for instance if the free goods replace goods that previously entailed expenditure (such as a free call via Skype instead of using the telephone).

Although digitalisation represents a considerable challenge for official statistics, the solution could lie in the application of these new technologies themselves. For example, the increasingly widespread use of barcode scanners in shops means that a huge amount of data can be gathered. In this respect, new initiatives related to big data are emerging in academia and business to exploit this information, as is the case of the digital price index developed by Adobe together with the economists Peter Klenow and Austan Goolsbee. Based on online transactions, the trend in consumers' purchasing habits can be recorded in accordance with the price changes of more than 1.4 million goods (compared with the 80,000 included in the CPI). Logically this index excludes all offline purchases so it is far from being representative and cannot replace the CPI but, nevertheless, it may be more reliable for analysing the trend in the price of some electronic goods.<sup>7</sup>

All these methodological questions regarding the potential bias in calculating inflation would not be very relevant if they did not have such huge implications for economic policy. The price index is used to deflate macroeconomic aggregates. Consequently, real GDP growth could be higher than the figure estimated by official statistics if inflation is overstated, as noted by renowned economists such as Martin Feldstein.<sup>8</sup> Differences in calculating inflation between different countries also make international comparisons difficult: if a country tends to overstate its inflation, compared internationally it would seem to have a worse performance in real terms. By way of example, if we exclude the component of owners' equivalent rent from the US CPI, as the European harmonised index of consumer prices (HICP) does, we might conclude that the economic performance of the US in real terms is even greater than that of the euro area.<sup>9</sup>

Errors in measuring inflation can also have a significant effect on monetary policy: if real inflation is lower than the published figure, the margin to increase monetary stimuli is greater. And also for public accounts, given that state pensions and tax deductions in many countries are indexed to the CPI. In this respect, a study by the research unit of the US Congress estimates that adopting a chain-weighted CPI<sup>10</sup> instead of the traditional CPI would reduce the public deficit by 69.3 trillion dollars in 2023.

In summary, measuring inflation properly is no easy task but its importance means that we must try our best. In this respect new technologies offer a unique opportunity to improve the reliability of official statistics that should not be wasted.

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1. From a theoretical point of view, the index containing these properties is known as the cost of living index (CLI).
2. In the US, the inclusion of the cost of living concept in calculating the CPI was one of the main recommendations of the Boskin Commission in 1996.
3. In addition to the CPI, inflation can also be measured via other price indices that are normally published by national statistics institutes, such as production prices, export and import prices, etc. Another frequently used resource to measure inflation is the GDP deflator. In the US, the Fed does not use the CPI as its main benchmark index but the index of Personal Consumption Expenditure (PCE).
4. Specifically a Laspeyres index is used that fixes quantities in the base period.
5. The five members the Commission were Michael Boskin, Ellen Dulberger, Robert Gordon, Zvi Griliches and Dale Jorgenson.

6. This method is based on the hypothesis that the price of an article can be expressed in terms of a series of characteristics via a regression model that estimates the value of each of the characteristics that make up the good. However, a large number of observations are required to adjust the regression model, as well as highly specialised knowledge of the product so, in practice, it is only used for a limited number of goods. In Spain, for example, the INE employs hedonic regression models to adjust for quality in two articles: washing machines and television sets.

7. According to the digital price index, the price of computers fell by 13.1% year-on-year in January 2016 compared with a drop of 7.1% according to the CPI.

8. «The U.S. Underestimates Growth», Wall Street Journal, 18 May 2015.

9. The main difference in calculating the CPI between the United States and Europe lies in how the services received by households for owned property are treated. While the US uses the concept of owners' equivalent rent, this is excluded from Europe's HICP (harmonised index of consumer prices).

10. The chain-weighted CPI allows goods to be substituted when there are changes in relative prices or in consumer habits.



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