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Peter L. D'Antonio Ph.D.
Molloy College, pdantonio@molloy.edu

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Peter L. D'Antonio, Ph.D.

Molloy College
Division of Business
1000 Hempstead Avenue
Rockville Centre, NY 11571
USA

(516) 993-5990
pdantonio@molloy.edu

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Abstract

It is generally accepted in the economics literature that there is an underlying inflation rate that raises the general price level and simultaneously degrades the value of money. This common force purportedly influences prices of all goods and services in the economy. Price changes of individual items can vary based on short-term, idiosyncratic fluctuations, but they are assumed to gravitate to the dominant underlying inflation rate over time. All government and private inflation measurements are based on this concept of inflation.

This paper takes a sectoral approach to assess this basic assumption of a common force pulling all individual prices. How strong is this underlying force relative to short-term volatility? What proportion of prices are represented by measures of inflation? This paper finds that price changes are widely diffused across sectors, and that only a small portion of price changes are approximated by standard inflation measures. This suggests that the gravitational pull from underlying inflation is weak in the short term, calling into question the accuracy of standard inflation measures. One important implication of this analysis is that monetary policymakers should aim for measured inflation to be in a target band, rather than an explicit value of 2 percent.

Keywords: inflation, consumer price index, inflation measurement, Fed inflation target

Section 1: Inflation modeling

The *concept* of inflation is fundamentally different from *measures* of inflation, such as the consumer price index (CPI) and the personal consumption expenditure (PCE) deflator.[1]

[1] McCully, Moyer, and Stewart (2007) offer a thorough analysis of the differences between the CPI and the PCE deflator. These differences are based mainly on the weighting, scope, and formulas when combining the component price changes into the two indexes. Since this study examines individual component price changes and not the combined indexes, there is little difference between the data in

> Conceptually, inflation is a rise in the general price level, which is tantamount to a decline in the value of money. This decline in value affects all prices in common and is expected to persist over the medium- to long-term.
>
> In contrast, measured inflation captures all price movements regardless of whether they are common to all prices. These price movements often are short-term in nature.

Economists have recognized for decades that standard measures of inflation, which take weighted averages of actual price changes, do not capture the true definition of underlying inflation. As a result, there have been myriad attempts to find alternative measures that come closer to the mark. These so-called core measures take out especially volatile components of inflation measures, such as food and energy. Others hone in on the central tendency of price changes by taking the median or the trimmed mean measures (Bryan & Cecchetti, 1994) (Cecchetti, 1996). All these inflation measures tend to be less volatile than the headline figures. Rich and Steindel (2007) review several of these alternatives, but are unable to find a single best version of core or underlying inflation.

These alternative approaches, as well as the factor model approach to inflation measurement,[2] all make the basic assumption that inflation can be modeled by a common underlying force driving up the general price level and driving down the purchasing power of money. In the model, any deviations are due to temporary noise. The model can be written as

$$(1) \quad \pi_i = \pi^* + \mu_i$$

where π_i is the actual price change of product i, π^* is the underlying inflation rate, and μ_i represents short-term price fluctuations. The implicit assumption is that the idiosyncratic short-term movements (μ_i) are independent random shocks.

CPI and the PCE deflator. In fact, the CPI surveys provide the main source data for the PCE deflator. As a result, the data used in this study are components of the CPI.

[2] See Amstad and Potter (2017) and Khan, Morel, and Sabourin (2013) for examples of factor models of inflation.

Section 2: Dispersion of price changes

This paper studied the distribution of a cross-section of price changes across sectors in the CPI to gauge if the common force (or gravitational pull) driving inflation (π^*) is weak or strong relative to random short-term noise (μ_i). Specifically, the study analyzed year-to-year percent changes for 49 categories (accounting for 100 percent of the total CPI) for October 2017.

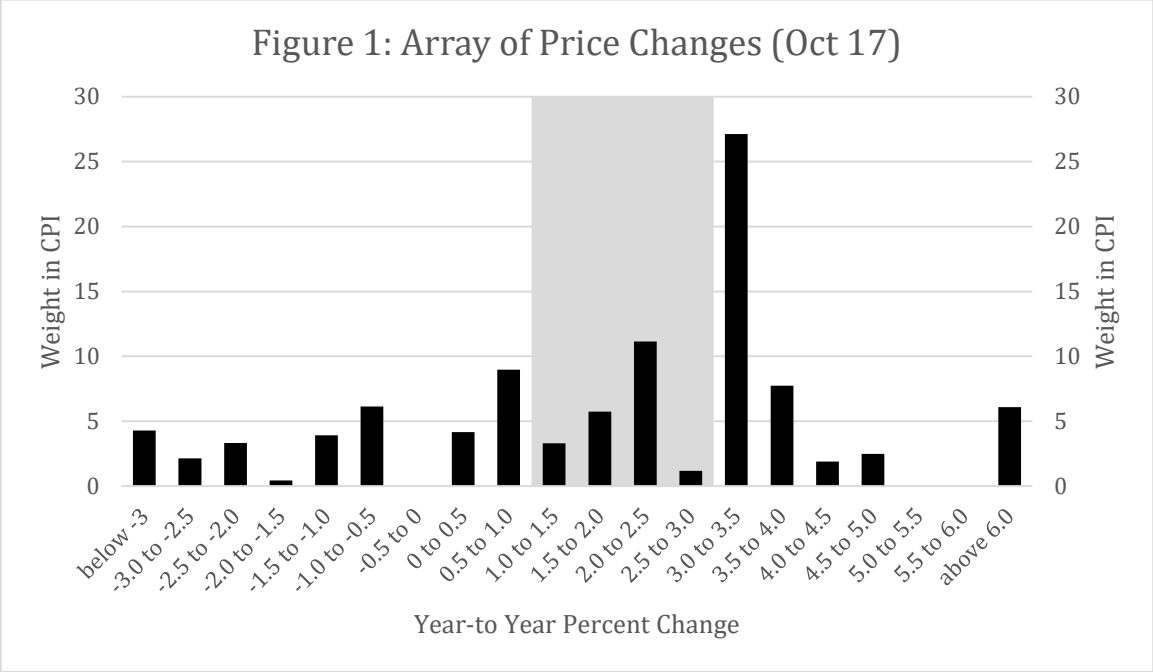
The actual distribution of price changes turned out to be remarkably dispersed.[3] The array of price changes did not appear to gravitate to a single common inflation rate. In fact, price increases of individual sectors rarely approximated the inflation rates measured by the CPI, the PCE deflator, and their core measures.

For example, over the past 12 months, headline CPI increased by 2.1 percent, CPI excluding food and energy increased by 1.8 percent, the PCE deflator increased by 1.6 percent and core PCE increased by 1.3 percent. Yet, looking at sector changes, only 21 percent of the total CPI (using sector weights) posted price increases of between 1 percent and 3 percent (inside the gray area in the frequency histogram in Figure 1 below).[4] [5] Meanwhile, 45 percent of prices in the CPI rose by 3 percent or more, and 33 percent of prices either increased by less than 1 percent or fell outright.

[3] Source data for the analysis and charts in this study are from the Bureau of Labor Statistics and Haver Analytics.

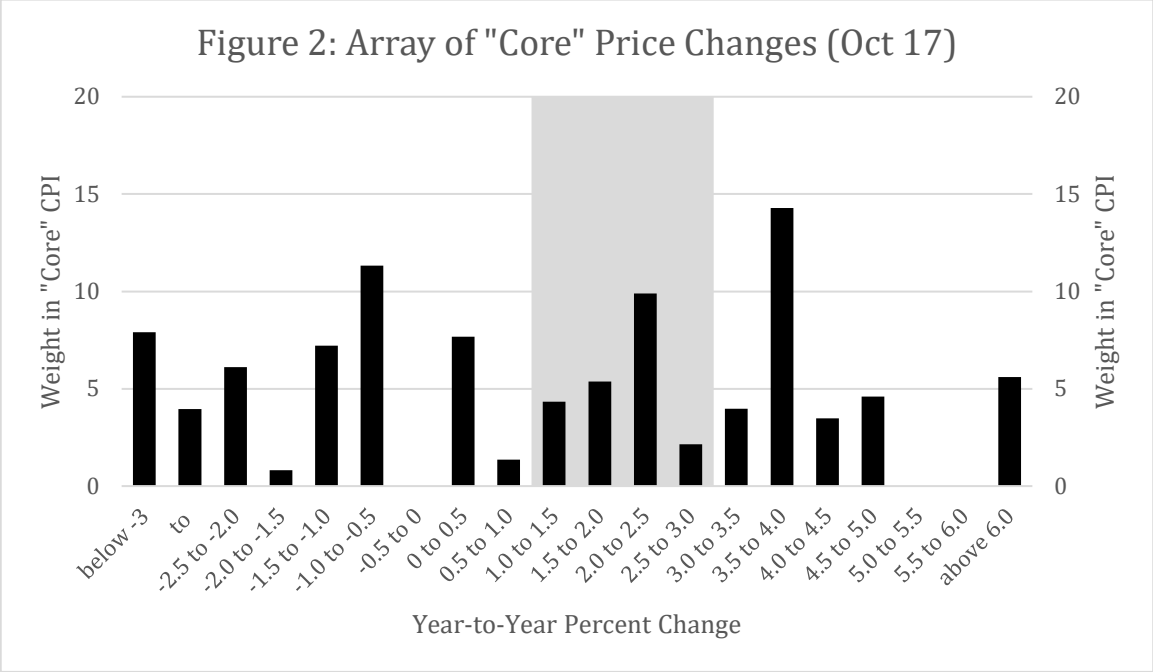
[4] The chart displays a frequency histogram of price changes for all items in the CPI. The chart can be read as follows: The values across the horizontal axis show the full array of possible price changes. The vertical axis shows the proportion of the individual price changes that fell in those ranges. The bars give the total weight in the CPI of those price changes.

[5] The big spike at 3-3.5 percent reflects the homeowners' equivalent rent (OER) price change. OER alone represents over 24 percent of the CPI by weight. Because this one item is such a large share of the CPI, there will always be a spike in the histogram wherever the OER price change appears.



This paper also conducted the same analysis for an alternative "core" subset of CPI, which excludes food products, energy, and the outsize OER, representing 54 percent of total CPI. Energy and food product prices were removed because those prices can have outsize effects on US *measured* inflation even though they rarely reflect *underlying* inflation, as they are set mainly in global markets. Likewise, OER was not included because no one actually pays this "equivalent rent" even though it exerts such a large influence on overall CPI.

A wide distribution of price changes occurred when these obvious sources of short-term price fluctuations were eliminated. A large subset of prices rose much faster than the inflation gauges and another large subset rose much more slowly (or actually declined). Very few prices increased at a pace near the inflation gauges – just 22 percent of all price changes in this "core" group rose between 1 percent and 3 percent. Instead, 32 percent of prices rose by more than 3 percent, and 46 percent increased at a pace less than 1 percent or fell outright (see Figure 2 below).



The current distribution of price changes is not unusual. Distributions of price changes showed similar patterns going back 20 years. There typically was a very wide dispersion of price increases or declines. Often, the distribution was bimodal.

Recent work by D'Antonio [2017] showed that divergences between individual sector price changes and standard inflation measures often persist for decades rather than representing short-term fluctuations – the differences were caused by idiosyncratic sectoral forces unrelated to underlying inflation. This paper shows that wide divergences are extremely prevalent and in fact are the norm. Together, these two papers cast doubt on the underlying assumption in Equation 1 that all prices are driven mainly by the common underlying inflation rate.

Section 3: Conclusion

The purpose of this paper was to develop a fuller understanding of the pull of the common underlying force driving inflation and its connection to the idiosyncratic price changes that are used to construct measures of inflation. By examining inflation data across sectors, this study finds that most standard inflation measures represent only a small fraction of price movements.

The wide distribution of prices raises an important question for financial markets and policymakers, which view differences of 0.5 percent or more from the Federal Reserve's explicit 2 percent inflation target as serious misses. If nearly half of the prices in the CPI (by weight) increase by more than 3 percent, and a third of the prices do not even rise by 1 percent, how sure can they be that inflation measures have identified the true underlying inflation rate common to all prices? Following that line of thinking, how sure can they be that their 2 percent target fulfills their policy objectives? This is especially problematic for policymakers if there are long-term sector-specific forces competing with the pull from underlying inflation.

The precision implied by the narrow range of inflation expectations in financial markets and policy circles seems unrealistic when individual price changes are so widely dispersed. As a result, policymakers should aim for an inflation band rather than a target of exactly 2 percent.

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