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Inferring Prices from Quantities

Based on BFI Working Paper No. 2026-26, "Inferring Prices from Quantities," by David Argente, Yale University; Chang-Tai Hsieh, University of Chicago; and Munseob Lee, University of California-San Diego

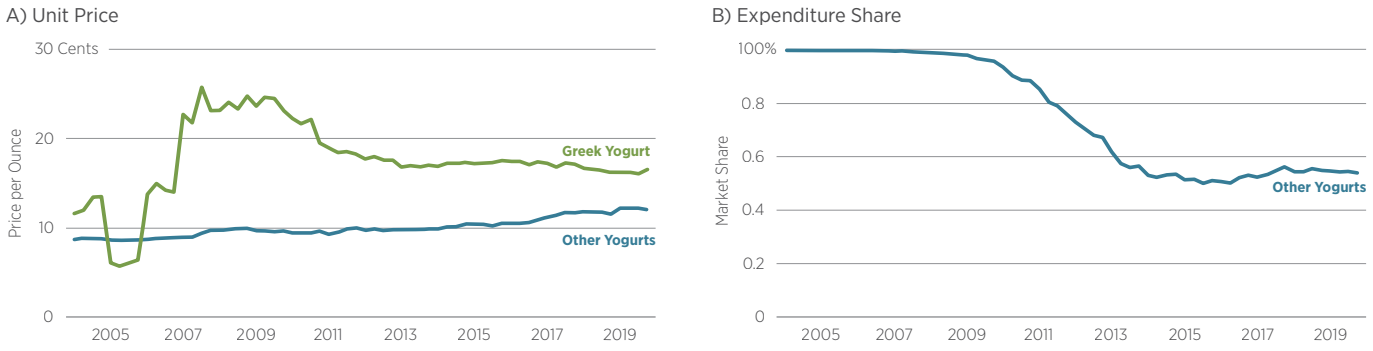
A new methodology for constructing an aggregate price index that corrects for two pervasive measurement problems reveals that an inflation measure preferred by many US policymakers understates the annual inflation rate by 0.3-1.0 percentage points on average between 1959 and 2019.

Measuring price indices is notoriously challenging because the mix and quality of products change over time. To address this problem, researchers have tried to collect increasingly granular data on product quality and new products. The challenge is not only how to incorporate new products (the first mobile phone, for example) and changing quality (each ensuing new version) into prices of individual products, but also how to classify new products. Is the iPad a new television, a new computer, a new smartphone, or simply as its own product? Although there is no obvious answer, analysts at the Bureau of Economic Analysis (BEA) are charged with making these classifications.

This paper offers a novel approach to this challenge. Rather than assembling detailed product-level data, the authors use **demand theory** to infer the aggregate price index directly from expenditure shares. They offer the improvement in Greek yogurt as a helpful illustration. Over the decade between 2007 and 2017, the quality of Greek yogurt improved, including higher protein content, lower sugar, changes in texture, and the

demand theory: the theoretical framework that analyzes the factors shaping consumer demand for goods and services, typically focusing on the effects of income, prices, and preferences

Figure 1 · Yogurt Expenditure Shares and Prices



Note: Panel A plots the unit-value price per ounce for Greek yogurt and for regular yogurts separately. Panel B plots the expenditure share of regular yogurt within the yogurt category over time. The authors use the NielsenIQ Consumer Panel data for this calculation.

inclusion of probiotics. At the same time, prices remained steady (see Panel A in accompanying figure). However, the effect on expenditure shares is dramatic: the market share of regular yogurt fell by almost 50 percentage points (Panel B).

Given a set of products with accurate price measurements, the authors can infer a weighted average of prices for the other products solely from data on expenditure shares. That is because the authors do not need direct information on the quality of products, in this case Greek yogurt. Any quality change in Greek yogurt appears in the expenditure share of regular yogurt, after controlling for the price of regular yogurt. The same holds for other products.

The authors then identify a set of products for which measured prices are reasonably immune to measurement issues that plague many products, after which the change in the aggregate price index is determined by the product of two terms: (1) the weighted average change in prices of the products in the chosen bundle, and (2) the change in the bundle's market share, adjusted by the **price elasticity of demand**. This formula yields an aggregate price index that the authors term the CES Chosen Price Index (CCPI).

The authors' methodology corrects for the two opposing biases that occur when measuring aggregate inflation: unobserved quality and variety growth, and the use of incorrect weights when new varieties are misclassified. The authors implement their methodology using publicly available price and expenditure data from the BEA for roughly 200 product categories in the **Personal Consumption Expenditures (PCE) Price Index**. The authors approximate the official PCE Price Index with a CES aggregate of prices of 200 product categories in the BEA, which they call the CES-BEA price index. In sum, the authors estimate that *the CES-BEA price index understates the annual inflation rate by 0.3-1.0 percentage points on average between 1959 and 2019*.

Two immediate lessons for policy arise from this finding:

- Partial bias corrections, whether for quality or for new varieties alone, can inadvertently worsen overall measurement error if the remaining biases are left unaddressed.
- And because these two sources of bias pull the aggregate index in opposite directions, they must be corrected jointly.

This work offers a practical roadmap for statistical agencies to make these corrections and to improve inflation measurement using readily available price and expenditure data, even in the absence of detailed product-level attributes or exhaustive variety tracking.

price elasticity of demand: a concept that describes the relationship between a product's change in quantity demanded and a price change, expressed as a ratio. If elasticity is greater than 1, demand is elastic; if less than 1, it is inelastic. Necessities and products with few substitutes tend to be inelastic, while goods with many substitutes tend to be more elastic. Businesses use elasticity to guide pricing decisions.

Personal Consumption Expenditures (PCE) Price Index: a measure of the prices that people living in the United States, or those buying on their behalf, pay for goods and services. The PCE price index is known for capturing inflation (or deflation) across a wide range of consumer expenses and reflecting changes in consumer behavior. A variation is the core PCE price index, which excludes often volatile food and energy prices, which makes it easier to see the underlying inflation trend. The core PCE price index is closely watched by the Federal Reserve as it conducts monetary policy.

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ABOUT OUR SCHOLAR

Chang-Tai Hsieh

Phyllis and Irwin Winkelried Distinguished Service Professor of Economics and PCL Faculty Scholar, Chicago Booth

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Written by David Fettig • Designed by Maia Rabenold