E C O N O M I C S B U L L E T I N

On Plutocratic and Democratic CPIs

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Abstract

Prais (1958) showed that the standard CPI computed by most statistical agencies can be interpreted as a plutocratic weighted average of household price indexes because the weight of each household in the official CPI is determined by its total expenditures. In this paper, we decompose the difference between the standard CPI and a democratically weighted index as the product of a measure of income inequality and the sample covariance between the elementary individual price indexes and a parameter which is a function of the income elasticity of each good.

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1. Introduction

It is known since Prais (1958) that the CPI computed by statistical agencies can be interpreted as a weighted average of household price indexes. The weight of each household is given by its total expenditure, hence the term 'plutocratic index.' Alternatively, we could construct a democratically-weighted index, where each household weights the same. We shall define the CPI *plutocratic-democratic gap* as the difference between the plutocratic index and the democratic one. Whether price behavior in a given period hurts relatively more the better-off or the worse-off households can be expressed in terms of this single scalar (Fry and Pashardes, 1985). Various studies have computed the plutocratic-democratic gap for different countries.[1]

This paper investigates the sources of possible discrepancies between plutocratic and democratic indexes. We show that the plutocratic-democratic gap can be expressed as the product of mean income, a measure of variation of household expenditures, and the sample covariance between the elementary individual price indexes and the corresponding good's expenditure-share regression coefficient on household income. This coefficient, in turn, is a function of the total expenditures elasticity of each good (Ley, 2001).

2. Plutocratic and Democratic CPI budget shares

Define the *plutocratic* budget shares for good i in the aggregate CPI by

$$\tilde{s}_i^P = \frac{1}{X} \sum_h x^h s_i^h, \tag{1}$$

where x^h denotes household h total expenditures, x_i^h is the expenditure on good i, so that household h budget share for good i is given by $s_i^h = x_i^h / x^h$. Total aggregate expenditure is given by $X = \sum x^h$. The CPI (at time t) is given by $CPI^P = \sum_i \tilde{s}_i^P \mathcal{I}_i$, where $\mathcal{I}_i = (p_{it}/p_{i0})$ are elementary price indexes. Noting that household h individual index is given by $cpi^h = \sum_i s_i^h \mathcal{I}_i$, the CPI^P may be interpreted as a 'representative' CPI. It is natural to ask then what is the household better represented by the CPI^P. Muellbauer (1974) searched for the household whose budget shares were closest to the $\tilde{s}_i^P$ aggregate weights in the U.K. CPI, and found it to be at the 71 percentile in the household expenditures distribution. For the U.S. in 1990, Deaton (1998) estimates that this consumer occupies the 75 percentile. Thus, the 'representative' consumer embedded in the CPI^P is biased towards upper-income households.

Alternatively, we could use *democratic* budget shares,

$$\tilde{s}_i^D = \frac{1}{H} \sum_h s_i^h, \tag{2}$$

[1] See, e.g., Carruthers *et al.* (1980), Fry and Pashardes (1985), Deaton and Muellbauer (1980), Crawford (1996), Newberry (1994), Kokoski (1987, 2000), Erbas and Sayers (1998), Garner *et al.* (1999), Lódola *et al.* (2000), Yahav and Yitzhaki (1991), Ruiz-Castillo *et al.* (1999). See also Ley (2001) for a summary of findings.

where H denotes the number of households, to construct a democratically-weighted index, $CPI^D = \sum_i \tilde{s}_i^D \mathcal{I}_i$.

From equations (1) and (2), the difference between good i plutocratic and democratic shares in the CPI is given by

$$(\tilde{s}_i^P - \tilde{s}_i^D) = \frac{1}{\bar{x}H} \sum_h (x^h - \bar{x}) s_i^h = \frac{1}{\bar{x}} \hat{\sigma}(x, s_i)\,, \tag{3}$$

where $\bar{x} = X/H$ is the sample mean of total expenditures, and $\hat{\sigma}(x, s_i)$ is the sample covariance, across households, of the budget share of good i, s_i^h, and total expenditure. Multiplying and dividing the right-hand side of expression (3) by the sample variance of household total expenditures, $\hat{\sigma}^2 = \hat{\sigma}(x, x)$, we obtain:

$$(\tilde{s}_i^P - \tilde{s}_i^D) = \hat{\zeta}\, \hat{\beta}_i, \tag{4}$$

where $\hat{\zeta} = \hat{\sigma}^2/\bar{x}$ is a measure of variation of household total expenditures, and $\hat{\beta}_i = \hat{\sigma}(x, s_i)/\hat{\sigma}^2$ (see Ley (2001) for an interpretation of $\hat{\beta}_i$ as a regression coefficient and its relation the income elasticity of good i).

Equation (4) indicates that the difference in good i's plutocratic and democratic CPI shares depends on the product of: *(i)* a measure of inequality of household total expenditures,[2] $\hat{\zeta}$; and *(ii)* a measure of how good i's budget share varies with total expenditure in the household sample, $\hat{\beta}_i$. Since the decomposition is multiplicative, the shares must coincide when there is no inequality or when expenditure shares are not affected by differences in total expenditures.

3. The CPI plutocratic-democratic gap

As discussed before, we shall define the plutocratic-democratic gap, $\mathcal{G}$, as: $\mathcal{G} \equiv (\Pi^P - \Pi^D)/100 = \left(CPI^P - CPI^D\right)$, where $\Pi = (CPI - 1) \times 100$ is the inflation rate between 0 and t (in percent); using (3) we find:

$$\mathcal{G} = \sum_i (\tilde{s}_i^P - \tilde{s}_i^D)\mathcal{I}_i = \hat{\zeta} \sum_i \hat{\beta}_i \mathcal{I}_i = \hat{\zeta} \sum_i \hat{\beta}_i (\mathcal{I}_i - \bar{\mathcal{I}}), \tag{5}$$

where $\bar{\mathcal{I}}$ is a simple average, *i.e.*, $\bar{\mathcal{I}} = \frac{1}{N} \sum \mathcal{I}_i$, and N is the number of goods. Equation (5) may be rewritten as:

$$\mathcal{G} = \hat{\zeta}\, N\, \hat{\sigma}(\hat{\beta}, \mathcal{I})\,, \tag{6}$$

where $\hat{\sigma}(\hat{\beta}, \mathcal{I})$ refers to the sample covariance of $\hat{\beta}_i$ and $\mathcal{I}_i$, this time over goods instead that over households.

[2] Note that $\hat{\zeta} = 2\bar{x} I_2(\mathbf{x})$, where $I_2(\mathbf{x})$ corresponds to the Generalized Entropy inequality measure, $I_c(\mathbf{x})$, for $c = 2$ (Cowell and Kuga, 1981).

Equation (6) is our fundamental result. It shows that the plutocratic-democratic gap is determined by the dispersion of household total expenditures, measured by $\hat{\zeta}$, and the sample covariance between $\hat{\beta}_i$ and $\mathcal{I}_i$. The sign of the plutocratic-democratic gap is determined by the covariance term. A positive covariance term means that the goods favored by the richer households experience higher than average inflation and necessities a lower than average inflation. Similarly, a negative covariance implies that necessities experience higher than average inflation while superior or luxury goods experience lower than average inflation. These effects are also scaled by the magnitude of the inequality of household expenditures, as measured by $\hat{\zeta}$.

Inspection of equation (6) indicates that three elements are required for the plutocratic-democratic gap to be different from zero: *(a)* there must be some dispersion in the distribution of household expenditures (reflected by $\hat{\zeta} \neq 0$); *(b)* there must be some observed behavioral differences among households with different total expenditures (reflected by $\hat{\beta}_i \neq 0$ for some i); and *(c)* there must be some differences in price behavior across some goods which display behavioral differences across households (reflected by $\mathcal{I}_i \neq \bar{\mathcal{I}}$ for some i which has $\hat{\beta}_i \neq 0$).

Given a household survey, $\hat{\zeta}$ and the $\hat{\beta}_i$'s are then fixed, and any source of variation in the sign and size of the gap for, *e.g.*, each year must be solely explained by the price behavior reflected by the $\mathcal{I}_i$'s. The movements in the $\mathcal{I}_i$'s may cause $\hat{\sigma}(\hat{\beta}, \mathcal{I})$ to change sign from one year to another. Thus, as noted in Ley (2001), looking at the overall $\mathcal{G}$, simply averaging over a long period may be misleading. Moreover, because of data limitations, most of the empirical results are based on a smaller number of goods than the number for which prices were collected by the statistical agencies. In these instances, working with highly aggregated goods causes an underestimation of the true plutocratic-democratic gap for two reasons. First, price aggregates already embody a plutocratic-democratic gap. Second, income elasticities revert to the mean (*i.e.*, to one) as we aggregate goods. As a result, the true size of the plutocratic-democratic gap is typically underestimated. Finally, Ley (2001) extends this approach by considering explicitly the number of members in each household using an equivalence-scale approach.

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