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A NEW APPROACH TO CONSTRUCT CORE INFLATION

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Abstract

We propose a new methodology to construct core inflation which is, unlike other conventional methods, not based on ad hoc elimination/trimming of prices. The underlying inflation derived from our method is found to be a powerful leading indicator of headline inflation while other conventional measures do not seem to reflect such fundamental property of core inflation.

Keywords: *Core inflation, Skewness, Leading indicator*
JEL Codes: *C43, E31, E52*

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INTRODUCTION

Three alternative methods have been widely used to construct core inflation: (i) exclusion method; (ii) limited influence method; and (iii) model-based method. The exclusion method involves arbitrary elimination of certain prices which are, in researchers' perception, considered to be noise. Under limited influence method proposed by Bryan and Cecchetti (1993) certain percentage of prices on both extremes are either symmetrically or asymmetrically eliminated to arrive at a measure of core inflation. Asymmetric trimming is suggested when cross sectional distribution of price changes is skewed. In this context, Roger (1997) proposed a method that decides the percentage of trimming based on the sign and size of skewness. However, this method gives rise to the question of what is the optimal percentage to be considered for trimming.[1] The underlying inflation obtained from macro econometric models (Bagliano and Morana, 2003) tends to alter the estimates of past core inflation when new observations are added to estimate the model; hence, it is less useful for communication purpose.

In this study, we propose a measure of core inflation which is defined as weighted average of those commodity prices whose distribution has minimum-skewness. The measure of underlying inflation derived from such method is found to be a powerful leading indicator of headline inflation while other conventional measures do not seem to reflect such fundamental property of core inflation. The theoretical foundation and methodology to construct core inflation is presented in section 2. A numerical simulation is given in section 3. The predictive power of core inflation is examined in section 4 and concluding remarks are produced in section 5.

[1] Kearns (1998) and Meyler (1999) define optimal size of trimming that ensures measured core inflation lying closer to a reference trend component of inflation. However, core inflation so obtained is conditional upon the choice of reference trend inflation.

THE METHODOLOGY

In general, core inflation is obtained by subtracting transitory elements from measured inflation; hence, researchers invent methodologies to identify the transitory component of measured inflation. In this context, Ball and Mankiw (1995) provide theoretical rationale for a temporary deviation of inflation (π) from its underlying trend (π^c). They consider an economy that contains a gamut of industries, each with a set of imperfectly competitive firms. The desired price change of an industry equals $\pi^c + \theta_t$ where π^c is common across industries and θ is idiosyncratic shocks which follow skew-normal distribution *f(θ)* with zero mean. In the presence of menu cost with distribution *G*, the actual price change for each industry is $\pi^c + \{(\theta)\,\mathrm{G}(|\,\theta\,|)\}$ and the realized aggregate inflation is:

$$\pi = \pi^c + \int_{-\infty}^{\infty} (\theta)\, G(|\,\theta\,|)\, f(\theta) d(\theta)$$

Thus, if the density of shocks $f(\theta)$ is symmetric $\{f(\theta)=f(-\theta)\}$then inflation is π^c. On the contrary, if the distribution of $f(\theta)$ is skewed $\{f(\theta) \neq f(-\theta)\}$ then inflation equals to π. Based on this premise, we minimize the skewness of actual price change $\pi^c + \{(\theta)\,\mathrm{G}(|\,\theta\,|)\}$ as it would minimize the influence of θ on π and uncover π^c; a common component across all commodity price changes. We propose a method to minimize the skewness which involves the following steps:

1. Measure change in price of k^{th} commodity (π_{kt}) as $\ln(p_{kt} / p_{kt-1})$; hence, inflation can be defined as

$$\pi_t = \sum_{k=1}^{n} \omega_k \pi_{kt}$$

where n denotes the number of commodities in the sample and ω_k represents the weight of k^{th} commodity.

2. Arrange commodity inflation (π_{ht}) with their associated weights in ascending or descending order for each time period.

3. Search for the range of commodity price changes $\{i^*, j^*\}$ which minimizes the skewness $|S_h|$. The search is conducted as follows:

$$s_h = \left(\sum_{h=i}^{j} \omega_h (\pi_h - \pi')^3 \right) \times \left(\sum_{h=i}^{j} \omega_h (\pi_h - \pi')^2 \right)^{\frac{-3}{2}} \times \left(\sum_{h=i}^{j} \omega_h \right)^{\frac{1}{2}}$$

For each $j = \{n, n\text{-}1, n\text{-}2 \ldots. T\}$, $i = \{1, 2, 3 \ldots. j\text{-}T\text{+}1\}$; where T is minimum data required for the calculation of skewness and π' is the sample mean for each range.

4. Then the core inflation (π_t^c) for time period t, defined as the weighted average of commodity price changes within the range i^* to j^*, is calculated as:

$$\pi_t^c = \sum_{h=i^*}^{j^*} w_h \pi_h / \sum_{h=i^*}^{j^*} w_h$$

The advantage of this method is that the trimming range is endogenously and uniquely determined based on the size and sign of skewness. Above all, it is easy to compute, communicate and free from revision.

NUMERICAL SIMULATION

A simulation exercise has been carried out to confirm whether the methodology presented in section 2 is capable of minimizing skewness to uncover the common component (π^c) of inflation. In this regard, we generate θ from skew-normal distribution with different shape parameters (S_θ) and an exponential function G, as in Ball and Mankiw (1995), to compute both actual distribution of price changes

$\left[\pi^{c} + \{(\theta)\,\mathrm{G}(|\theta|)\}\right]$ and aggregate inflation (π) for different assumed values of π^{c}. The values given in the first column of the Table 1 are shape parameters used in generating *θ*. The corresponding mean (π) and skewness (k_p) estimates of realized price changes are respectively presented in the second and third columns of the Table 1. Note that the estimates of both mean and skewness move in the direction consistent with the sign and magnitude of chosen S_θ.

Table 1: Simulation Results

S_θ	π	k_p	π^c	k_m
		π^c **=0.00**		
1.00	0.010	1.431	0.000	0.000
3.00	0.012	1.591	0.001	0.000
5.00	0.013	1.925	0.001	0.000
-1.00	-0.010	-1.334	0.000	0.000
-3.00	-0.012	-1.646	-0.003	0.000
-5.00	-0.014	-1.965	-0.003	0.000
		π^c **=0. 01**		
1.00	0.020	1.549	0.011	0.000
3.00	0.022	1.625	0.012	0.000
5.00	0.024	1.949	0.012	0.000
-1.00	-0.001	-1.571	0.008	0.000
-3.00	-0.002	-1.601	0.009	0.000
-5.00	-0.004	-1.980	0.008	0.000
		π^c **=0. 02**		
1.00	0.030	1.538	0.021	0.000
3.00	0.032	1.790	0.021	0.000
5.00	0.035	1.902	0.022	0.000
-1.00	0.008	-1.421	0.019	0.000
-3.00	0.006	-1.806	0.017	0.000
-5.00	0.005	-2.011	0.017	0.000

Note: The estimates are obtained using a scale parameter of 0.05 for a sample of 1000.

Further, an exhaustive search is conducted using our methodology to identify the distribution of price changes having minimum skewness. The mean (π^{c}) and skewness (k_m) of the distribution so obtained is presented in the fourth and fifth columns of the Table. It is more striking to note that estimated π^{c} approaches assumed π^{c} (i.e., 0.00, 0.01 and 0.02), as k_m approaches zero. These results suggest that minimizing the skewness of the distribution of actual price changes uncovers the measure of inflation (π^{c}) which is common across industries. Thus, the evidence obtained from the simulation exercise confirm that the proposed methodology is effectively minimizing the noise in measured inflation arising out of relative price shocks and traces the core component of price changes.

EVALUATION OF CORE INFLATION

We construct three measures of core inflation for the sample period April 1993–August 2010 using prices of 418 commodities, which constitutes 98 percent of commodity prices used in the construction of Wholesale Price Index (WPI) in India.[2] The core inflation measures were constructed using our methodology (π^{c}) and the traditional exclusion (π^{cex}) and trimmed mean (π^{c}) methods.[3] While evaluating the performance of core inflation, we consider how best core inflation serves as predictor of measured inflation.[4] In this context, we follow the methodology of Ribba (2003) which proposes two conditions: (i) core inflation (π^{c}) and headline inflation (π) must be cointegrated with a cointegrating vector (1,-1); and (ii) there should be an error correction representation:

$$\begin{aligned} \Delta\pi_t^c &= b_{11}(L)\Delta\pi_{t-1}^c + b_{12}(L)\Delta\pi_{t-1} + \varepsilon_{\pi ct} \\ \Delta\pi_t &= b_{21}(L)\Delta\pi_{t-1}^c + b_{22}(L)\Delta\pi_{t-1} - \alpha_{21}\left(\pi_{t-1}^c - \pi_{t-1}\right) + \varepsilon_{\pi t} \end{aligned} \qquad (1)$$

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[2] The widely used official measure of inflation in India is based on whole sale price index.

[3] For 418 commodity prices, our methodology generates 87153 skewness estimates for each month. We obtain π^{cex} by excluding food and energy items and π^{ctm} using 15% trimming.

[4] See Marques *et.al,* (2000) for various empirical criteria.

where L is lag operator; $\Delta = 1 - L$; and $\varepsilon_t = (\varepsilon_{ct}, \varepsilon_{\pi t})'$ such that $E(\varepsilon_t) = 0$ and $E\left(\varepsilon_t \varepsilon_t'\right) = \sum \varepsilon$.

The equation (1) implies that π_t adjusts to long-run equilibrium whereas π_t^c does not, i.e. the coefficient on error correction term in core inflation equation is restricted to be zero. Hence, condition (ii) implies that shocks in core inflation can influence the long-run forecast of headline inflation and not vice versa. It means that there is one-way causality from core-to-headline inflation at zero frequency. If so,

$$\lim_{h \to \alpha} \frac{\partial E(\pi_{t+h})}{\partial \varepsilon_{\pi ct}} \neq 0 \text{ and } \lim_{h \to \alpha} \frac{\partial E(\pi_{t+h})}{\partial \varepsilon_{\pi t}} = 0$$

The above conditions imply that the conditional forecast of headline inflation *h* period ahead depends only on core inflation. We adopt this method to examine the reliability of core inflation as predictor of headline inflation.

The maximum likelihood method of Johansen (1991) suggested one cointegrating relationship between headline and alternative measures of core inflation (results are not presented).[5] The estimates of cointegrating vectors presented in Table 2 indicate that the cointegrating parameter in the model wherein π^c is used lies much closer to -1 and turned out to be statistically significant. On the contrary, in the models wherein π^{ctm} and π^{cex} are used the cointegrating parameters are not closer to -1.

[5]A set of unit root tests indicated that π, π^c, π^{ctm} and π^{cex} follow I (1) process.

Table 2: Results of Cointegration Space

Variables	Normalized Cointegrating Vector	χ^2
π^c, π	1.00; -0.98[-36.1]	0.20(0.90)
π^{ctm}, π	1.00; -0.94[-57.9]	5.87(0.05)
π^{cex}, π	1.00; -1.63[-10.7]	11.0(0.00)

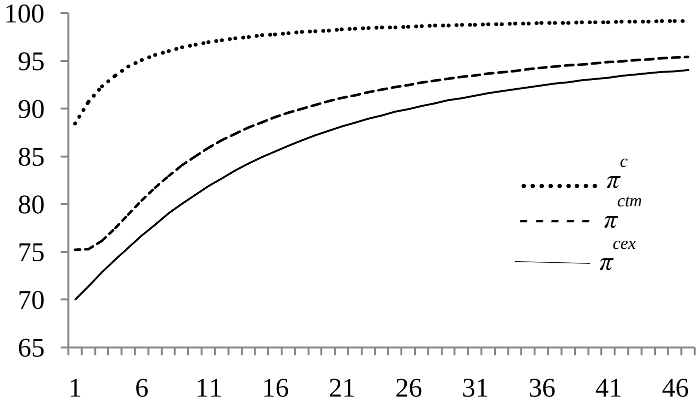
Note: Figures in (#) and [#] are p-values and t-statistics, respectively.

Moreover, we test the joint restriction that core inflation is cointegrated with headline inflation with cointegrating vector (1, -1) and that the loading coefficient in core equation is zero. The χ^2 statistics in Table 2 suggest that the joint restriction is rejected when π^{ctm} and π^{cex} are used as core measures whereas the restriction is binding in the model wherein π^c is used. This is the striking feature of evidence from error correction model that π^c is a powerful predictor of headline inflation[6].

Also, we present complementary evidence on the dynamic relationship between the alternative measures of core inflation and headline inflation using forecast error variance. The plots of forecast error variance given in Fig.1 show that shocks in π^c dominate the variability of headline inflation at all horizons as compared to shocks in π^{ctm} and π^{cex}.

[6] Crone et.al, (2013) present evidence for the US not in favour of conventional measures of core inflation as predictor of headline.

Fig.1: Decomposition of forecast error variance of π



CONCLUSION

This study proposes a methodology to construct core inflation which is free from ad hoc elimination of prices. Under this method, core inflation is constructed using those commodity prices whose distribution has the minimum skewness. The core inflation measure obtained from this methodology turned out to be a leading indicator of headline inflation whereas the conventional measures of core inflation do not seem to have such fundamental property.

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