Do core inflation measures help forecast inflation?

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Abstract

We conduct cointegration and Granger causality tests for traditional and new measures of core inflation. We find that both measures are consistent with desired properties of measures of underlying inflation, but neither is very useful for forecasting purposes. © 1998 Elsevier Science S.A.

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1. Introduction

Monetary policymakers are confronted with some price changes that are permanent and some that are temporary. Since measures of inflation may be especially vulnerable to the volatility of a few key components, economists have developed alternative measures, called “core” inflation rates, that attempt to identify permanent trends in inflation by eliminating temporary price fluctuations. A number of observers argue that core inflation is a better measure of the “underlying trend” of inflation, which may be important in the formation of inflation expectations. This paper examines how well alternative measures of core inflation forecast future inflation rates.

The standard approach to segmenting core and transitory components of inflation is to remove, in a more or less arbitrary way, “noisy” elements from, say, the Consumer Price Index. The Bureau of Labor Statistics (BLS) subtracts food and energy components from CPI to obtain core inflation (Brauer and Wu, 1991). Other techniques, based on the time series properties of the CPI, have included smoothing the index via moving averages or processing it via a Kalman Filter.

An alternative measure of core inflation, suggested by Bryan and Pike (1991) and further developed by Bryan and Cecchetti (1993), is motivated by the observation that the distributions of prices are characterized by skewness caused by the asymmetric reaction of price-setting agents. Since only those agents who have relatively low adjustment costs and relatively large price shocks may choose to respond immediately with price increases, using the mean of the distribution of initial price changes may overstate the response to shocks. Bryan and Cecchetti (BC) propose truncating the distribution of

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price changes to eliminate outlying observations and provide a more representative measure of central tendency, or core inflation. They examine two measures, a trimmed mean (with the 7.5% tails removed), and the weighted median of the distribution of price changes. Because BC find that the median fares best in their statistical tests, and because the Federal Reserve Bank of Cleveland has begun publishing monthly estimates of the median CPI, we focus on BC’s weighted median as the alternative to the BLS measure of core inflation.

This study is motivated by two concerns: 1) to examine the time series properties of two measures of core inflation, change in CPI less food and energy (CPILFE), the BLS measure, and change in median CPI (CPIMED), the BC measure, for consistency with the time series properties of total inflation; 2) to test, using cointegration and error-correction techniques, the usefulness of these measures as forecasts of inflation. We will also test the hypothesis that CPIMED is clearly superior to CPILFE as a measure of core inflation.

2. Stationarity and cointegration tests of core inflation measures

For any interval, total inflation can be decomposed into core and transitory components:

\[ p_t = p_t^c + p_t^e, \] (1)

where small letters denote differences in logs. Temporary perturbations to inflation, \( p_t^e \), are caused by events, e, such as weather, supply/demand disturbances, etc. The transitory component does not have the characteristics of usual disturbance terms, since each event will be unique, so concepts like weak stationarity may be overly stringent. Nevertheless, we expect any realization of \( p_t^e \) to have zero mean and finite variance, so that nonstationarity in the unit root sense is ruled out.

The stationarity of inflation is a matter of some debate in the literature, with conclusions varying with time periods and frequency of observation. If total inflation is nonstationary and integrated of order \( d \), or \( I(d) \), meaning that it must be differenced \( d \) times to achieve stationarity, then core inflation must also be \( I(d) \), given the assumptions on \( p_t^e \) (Box and Jenkins, 1976, p. 122). Furthermore, in the case that inflation is \( I(1) \), a meaningful definition requires core inflation also to be \( I(1) \) and cointegrated with total inflation such that \( \pi_t = \beta \pi_t^e \) for some (unique) \( \beta \) is stationary. Given the assumption of zero mean for transitory elements of inflation, \( \mathbb{E}[\beta] = 1 \).

BC conduct stationarity tests for CPI inflation, CPILFE and CPIMED, but draw incorrect conclusions from their results. In the text of their working paper (but not in the note to their Table 2, p. 11) they state that the Dickey–Fuller test “fails to reject stationarity in all of the series”. A correct interpretation of their findings, however, is that the Dickey–Fuller statistics (which are all greater than the 10% critical value for BC’s tests) fail to reject nonstationarity (the null hypothesis of the Dickey–Fuller tests) in all of the series. BC’s evaluation of inflation series using least squares on inflation levels is an inappropriate procedure for nonstationary variables.

1 See, for example, “Median CPI up 0.3% in February”, news release from the Federal Reserve Bank of Cleveland (1997) March 19.
2 Mishkin (1984) and Schwert (1987) provide evidence of unit roots in various measures of inflation.
3 See, for example, Enders (1995), p. 213.
In Table 1 we replicate the BC Dickey–Fuller tests of CPI, CPILFE and CPIMED inflations for the period 1967:01 to 1996:10. Data for CPI and CPILFE are from the Bureau of Labor Statistics; CPIMED data are from the World Wide Web site of the Federal Reserve Bank of Cleveland (1996).

It is clear from Table 1 that we cannot reject the null hypothesis of nonstationarity for any of the inflation series. The first differences of the inflation series do appear to be stationary, however, so tests for cointegrating vectors among the inflation levels are the next step.

Table 2 reports the results of Engle–Granger tests of cointegration between total inflation and the alternative measures of core inflation. Both measures of core inflation are cointegrated (at the 10% level of significance) with total inflation, and both have coefficients relatively close to unity. With the larger coefficient, CPIMED would appear to be more closely related to total inflation than CPILFE.

Closeness of the relationship is not sufficient, however, if the objective is to use core inflation to forecast total inflation. In their tests of forecast accuracy of core inflation measures, BC do not take...
into account the nonstationarity of the series being estimated, nor do they test for Granger causality using the standard VAR methodology. The appropriate test for Granger causality between cointegrated variables employs the error correction representation:

\[
\nabla p_t = a_{10} + \alpha_p (p_{t-1} - \beta \nabla p_{t-1}) + \sum a_{11}(i) \nabla p_{t-i} + \sum a_{12}(i) \nabla \nabla p_{t-i} + \epsilon_{1t},
\]

(2)

\[
\nabla p_t^c = a_{20} + \alpha_p^c (p_{t-1} - \beta \nabla p_{t-1}) + \sum a_{21}(i) \nabla p_{t-i} + \sum a_{22}(i) \nabla \nabla p_{t-i} + \epsilon_{2t},
\]

where \( \alpha_p \) and \( \alpha_p^c \) are speed of adjustment coefficients relating departures from long-run equilibrium in the cointegrating relationship to changes in the respective rates of inflation and the \( a_{jk}, j, k = (1, 2), \) are the parameters of the lagged dependent variables. If, say, \( \alpha_p \) and all \( a_{12}(i) \) are zero, then it can be said that \( \nabla p_t^c \) does not Granger-cause \( \nabla p_t \) (Enders, p. 377). Innovation accounting via impulse response functions and variance decompositions can be used to measure the interactions among the variables.

3. Granger-causality tests

Table 3 reports the results of an error-correction VAR of CPI inflation with the alternative measures of core inflation. Lag-length tests (using the Swartz Bayes Information Criterion [SBIC]) indicate that one lag of the dependent variables is optimal\(^4\).

The results of the error-correction model conform to expectations for both measures of core inflation. In each case, a rate of total inflation above core in one period will produce downward pressure on total inflation in the subsequent period. The effect on core inflation in the next period is

<table>
<thead>
<tr>
<th>Equation</th>
<th>( R^2 )</th>
<th>CPI</th>
<th>CPILEFE</th>
<th>CPIMED</th>
<th>( p_{t-1} - \beta \nabla p_{t-1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPI</td>
<td>0.27</td>
<td>–</td>
<td>0.093</td>
<td>–</td>
<td>–0.471</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(1.462)</td>
<td></td>
<td>(6.390)***</td>
</tr>
<tr>
<td>CPILEFE</td>
<td>0.25</td>
<td>–0.056</td>
<td>–</td>
<td>–</td>
<td>0.196</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.025)</td>
<td></td>
<td></td>
<td>(2.978)**</td>
</tr>
<tr>
<td>CPI</td>
<td>0.29</td>
<td>–</td>
<td>–</td>
<td>–0.209</td>
<td>–0.550</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(2.699)***</td>
<td>(7.413)***</td>
</tr>
<tr>
<td>CPIMED</td>
<td>0.22</td>
<td>–0.138</td>
<td>–</td>
<td>–</td>
<td>0.195</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.024)**</td>
<td></td>
<td></td>
<td>(3.530)***</td>
</tr>
</tbody>
</table>

\(^a\)All variables except the error correction term are second differences of log price levels, or first differences of inflation rates.\(^b\)Absolute values of \( t \)-statistics in parentheses.\(^**\)Significant at the 0.01 level.\(^***\)Significant at the 0.001 level.

\(^4\)Lags of 3, 6 and 12 months were tested with no appreciable change in results for the error-correction terms, but all causality tests involving lagged values of right-hand side variables produced insignificant values.
positive, reflecting the subsequent transmission of transitory shocks to core price components. Convergence is direct, with the opposite signs of the coefficients on the error-correction terms insuring stability in the system, but the difference in relative sizes of the coefficients indicate some persistence of the transitory shock over time.

The near equality of the coefficients of the error correction terms for each measure of core inflation is remarkable, and the almost purely contemporaneous correlation indicates that core inflation does not “lead” total inflation in any meaningful sense. Granger tests, significant in lagged variables only for CPIMED, imply bivariate causality at lags of only one month. It may well be that CPIMED is better than CPILFE at forecasting total inflation, but the evidence in this paper suggests that one would do just as well to use total inflation to forecast either measure of core inflation.

4. Conclusion

We have examined the time series properties of total CPI inflation and two alternative measures of core inflation. We conclude that all measures of inflation herein are I(1) and that both measures of core inflation are cointegrated with total inflation. We find that median CPI, recently suggested as a superior measure of core inflation, more closely meets the criteria for core inflation in cointegration tests, but that the differences between median CPI and CPI less food and energy, the traditional measure of core inflation, are small. Granger causality tests using error correction methodology indicate that divergence of total inflation from either measure of core inflation is quickly reversed, rendering the potential for using core inflation for long-term forecasts of total inflation practically nil.

References