Do underlying measures of inflation outperform headline rates? Evidence from Australian data

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Motivation

RBA (1994), 'Measuring 'Underlying' Inflation':

"The *'underlying' rate of inflation* – rather than the conventional CPI – is the primary focus for monetary policy purposes; it is this concept which the Bank has in mind when it talks of limiting inflation to around 2 to 3 per cent a year on average."

- Long-term trend in inflation
  - persistent changes and movements in the fundamentals
  - abstract from short-run volatility
  - also known as underlying or core inflation

- Timely estimates: underlying measures
  - exclusion: the CPI excluding volatile items (fruit, vegs. & petrol)
  - statistical: trimmed mean, weighted median (100% trimmed mean)
- Question: Does underlying measures of inflation outperform headline rates in predicting the long-term trend in inflation?
- Today's presentation
  - Analytical framework
  - Data and methods
  - Results
  - Conclusion

Analytical framework

- Individual price

$$\dot{p}_{i,t} = \Pi_t + x_{i,t} \tag{1}$$

where

$\dot{p}_{i,t}$: rate of change of an individual price i

$\Pi_t = \ln(P_t/P_{t-1})$

P: common trend in all prices and is therefore the target of monetary policy

$x_{i,t}$: relative price change

- 'Headline' rate: weighted average of individual price changes

$$\pi_t = \sum_i w_{i,t} \dot{p}_{i,t} \tag{2}$$

  where $\sum_i w_{i,t} = 1$

- Implying

$$\pi_t - \Pi_t = \sum_i w_{i,t} x_{i,t} \tag{3}$$

  - $\sum_i w_{i,t} x_{i,t} = n_t + b_t$
  - noise (n_t):
    - transitory and mean zero: $\lim_{k \to \infty} \frac{1}{k} \sum_{j=1}^{k} n_{t+j} = 0$
    - can be eliminated by lengthening the observation interval

- bias (b_t):
  - permanent and non zero mean: $b_t = \mu_b + \varepsilon_t$
  - resulting from weighting patterns, sampling techniques and quality adjustment
  - lengthening the observation interval may eliminate the transitory part
- Lengthening the observation interval

$$
\begin{aligned}
p_{i,t}^{k} &= \frac{1}{k}\ln(\frac{p_{i,t+k}}{p_{i,t}}) \\
\pi_{t}^{k} &= \Pi_{t}^{k} + \mu_b + \frac{1}{k}\sum_{j=1}^{k}(n_{t+j} + \varepsilon_{t+j})
\end{aligned}
$$

* Moving averages reduce the usefulness: you have to wait
* Underlying measures: timely estimates of the movements in the long-term trend
  - provide as much information on the trend as possible from timely released price indexes
  - minimise the transitory noise by using different information in the calculation

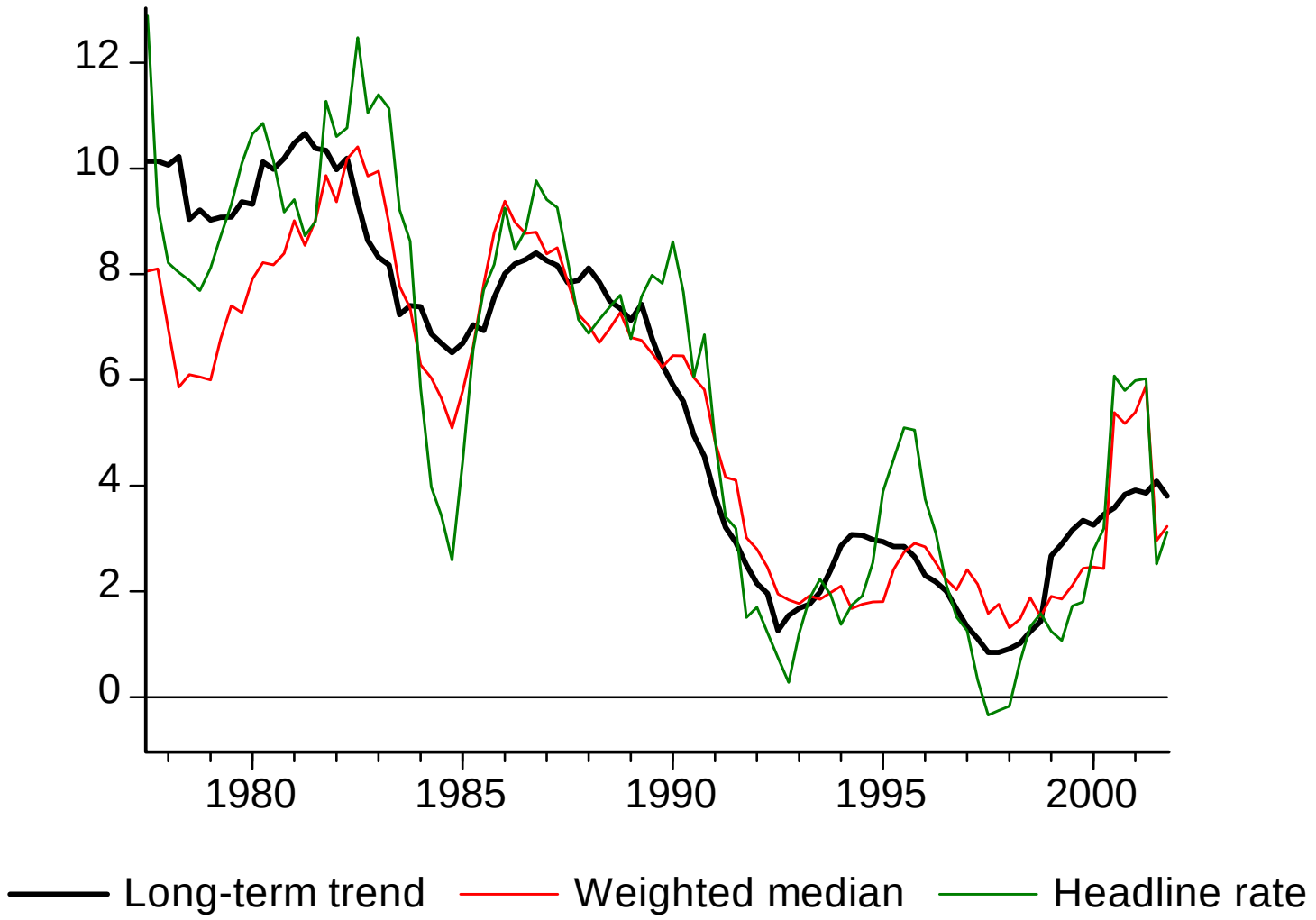
Data

- Long-term trend in inflation (Π_t): approximated by the 13-quarter centred moving average of actual inflation (quarterly headline rates)

- Australian data: 1976-2003 from RBA

  - year-ended and quarterly percentage changes
  - CPI All group (headline rates)
  - CPI excluding volatile items
  - Market prices excluding volatile items
  - Weighted median
  - Trimmed mean (30% trim)

Figure 1: Selected inflation measures and long-term trend



Methods

- Pair comparison: underlying measures and headline rates
  - Quarterly and year-ended rates, respectively
  - Relative accuracy of indicators: predictive and directional

- Predictive accuracy: Diebold-Mariano (1995) test and its modified version
  - Whether the prediction errors are the same
  - $\widehat{y_{1t}}$ and $\widehat{y_{2t}}$: two predictions of the long-term trend in inflation y_t
  - e_{1t} and e_{2t}: the associated predictive errors.
  - $g(e_{it})$: a direct function of the predictive errors and $d_t = g(e_{1t}) - g(e_{2t})$

– DM test statistic

$$S_1 = \frac{\bar{d}}{\sqrt{V(\bar{d})}} \tag{4}$$

$\bar{d}$: mean of d

$V(\bar{d})$ is the variance of $\bar{d}$

$$V(\bar{d}) \approx \frac{\gamma_0 + 2\sum_{k=1}^{h} \gamma_k}{T} \tag{5}$$

γ_k is the kth autocovariance of d_t

$$\gamma_k = \frac{\sum_{t=k+1}^{T} (d_t - \bar{d})(d_{t-k} - \bar{d})}{T} \tag{6}$$

where h: the truncation lag

* optimal $(h+1)$ step ahead prediction errors: at most h-dependent
* all the sample autocovariances beyond h are zero

– Modified version (Harvey, et al, 1997)

* As h increases, DM test could be seriously over-sized
* Modified DM

$$S_1^* = S_1 \sqrt{\frac{T+1-2(h+1)+h(h+1)/T}{T}} \tag{7}$$

* use critical values from Student's t distribution

- Directional accuracy
  - Probability of correctly predicting the moving direction of the underlying trend
  - Contingency table: correct and incorrect predictions of two indicators
  - Statistical tests for differences in probabilities
    - Chi-squared test, and
    - Yates test statistic: more conservative

Results

- Predictive accuracy (p.7-8)

  - Standards of predictive quality: MAE and RMSE
  - Relative to the headline rates
  - Tables 1 & 2

- Directional accuracy (p.9)

  Tables 3 & 4

Table 1: Predictive accuracy relative to the headline rate: the quarterly rates

	$g(e) = \|e\|$			$g(e) = e^2$		
	MAE	S_1	S_1^*	RMSE	S_1	S_1^*
1977Q3-2001Q4						
Weighted median	0.70	2.60*	2.59*	0.72	2.37*	2.36*
Trimmed mean	0.70	3.24*	3.22*	0.73	2.45*	2.44*
CPI ex. volatile items[a]	0.71	3.53*	3.50*	0.79	3.01*	2.99*
Market prices ex. volatile items[a]	0.72	3.21*	3.19*	0.79	2.60*	2.58*
1993Q1-2001Q4						
Weighted median	0.76	2.69*	2.66*	0.84	3.46*	3.42*
Trimmed mean	0.75	2.90*	2.86*	0.92	1.22	1.21
CPI ex. volatile items	0.81	2.61*	2.58*	0.88	3.01*	2.98*
Market prices ex. volatile items	0.80	2.32*	2.29*	0.90	3.65*	3.60*

Note: [a] the sample period for the CPI ex. volatile items and the Market prices ex. volatile items is 1988Q3-2001Q4.

MAE and RMSE are mean absolute errors and root mean squared errors, relative to those of the headline rate, respectively.

S_1 and S_1^* are absolute values of the Diebold-Mariano test and its modified version. The critical values at the 5 per cent significance level are 2.03 and 1.98 with 97 and 35 degrees of freedom, respectively. * significant at the 5 per cent level.

Table 2: Predictive accuracy relative to the headline rate: the year-ended rates

	$g(e) = \|e\|$			$g(e) = e^2$		
	MAE	S_1	S_1^*	RMSE	S_1	S_1^*
1977Q3-2001Q4						
Weighted median	0.84	0.98	0.98	0.87	0.78	0.78
Trimmed mean	0.84	1.28	1.27	0.80	1.60	1.59
CPI ex. volatile items[a]	0.90	0.65	0.64	0.85	1.23	1.22
Market prices ex. volatile items[a]	0.76	2.35*	2.33*	0.73	2.76*	2.74*
1993Q1-2001Q4						
Weighted median	0.74	1.68	1.66	0.72	2.15*	2.12*
Trimmed mean	0.81	1.24	1.22	0.81	1.59	1.58
CPI ex. volatile items	0.93	0.48	0.47	0.86	1.15	1.13
Market prices ex. volatile items	0.83	1.63	1.61	0.79	2.48*	2.45*

Note: [a] the sample period for the CPI ex. volatile items and the Market prices ex. volatile items is 1988Q3-2001Q4.

MAE and RMSE are mean absolute errors and root mean squared errors, relative to those of the headline rate, respectively.

S_1 and S_1^* are absolute values of the Diebold-Mariano test and its modified version. The critical values at the 5 per cent significance level are 2.03 and 1.98 with 97 and 35 degrees of freedom, respectively. * significant at the 5 per cent level.

Table 3: Directional accuracy relative to the headline rate: quarterly rates

Indicator and sample	Correct	Incorrect	Percent correct	Chi-Squared	Yates
1977Q3-2001Q4					
Headline rate	63	34	65		
Weighted median	55	42	57	1.38	1.06
Trimmed mean	59	38	61	0.35	0.20
CPI ex. volatile items[a]	27	32	46	2.18	1.67
Market prices ex. volatile items[a]	31	28	53	0.55	0.31
1993Q1-2001Q4					
Headline rate	20	15	57		
Weighted median	16	19	46	0.92	0.51
Trimmed mean	16	19	46	0.92	0.51
CPI ex. volatile items	14	21	40	2.06	1.43
Market prices ex. volatile items	17	18	49	0.52	0.23

Note: [a] the sample period for the CPI ex. volatile items and the Market prices ex. volatile items is 1988Q3-2001Q4.

The critical value at the 5 per cent significance level is 3.84. * significant at the 5 per cent level.

The description of the tests can be found in Conover(1980,pp.144-151).

Table 4: Directional accuracy relative to the headline rate: year-ended rates

Indicator and sample	Correct	Incorrect	Percent correct	Chi-Squared	Yates
1977Q3-2001Q4					
Headline rate	58	39	60		
Weighted median	55	42	57	0.19	0.08
Trimmed mean	59	38	61	0.02	0.00
CPI ex. volatile items[a]	30	26	54	0.14	0.04
Market prices ex. volatile items[a]	31	25	55	0.04	0.00
1993Q1-2001Q4					
Headline rate	20	15	57		
Weighted median	16	19	46	0.92	0.51
Trimmed mean	19	16	54	0.06	0.00
CPI ex. volatile items	17	18	49	0.52	0.23
Market prices ex. volatile items	20	15	57	0.00	0.00

Note: [a] the sample period for the CPI ex. volatile items and the Market prices ex. volatile items is 1988Q3-2001Q4.

The critical value at the 5 per cent significance level is 3.84. * significant at the 5 per cent level.

The description of the tests can be found in Conover(1980,pp.144-151).

Conclusion

- Predicting the long-term trend in inflation: underlying measures and headline rates
- Tests
  - Long-term trend in inflation: 13-quarter centred moving average
  - Compare underlying measures with the headline rates
  - Predictive accuracy
    - quarterly rates: the underlying measures outperform the headline rate (not surprising)
    - year-ended rates: weak evidence for the underlying measures
      - the measure of market prices ex. volatile items: reject the null in both sample periods;

    - the weighted mean: significant in the inflation targeting period
  - Directional accuracy: no differences

- Future research on underlying measures
  - Dynamic factor index measures, eg in Bryan & Cecchetti (1993), or
  - SVAR measures, eg Quah & Vahey (1995) and Stock & Watson (1999).