Hong Kong Monetary Authority

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ALTERNATIVE MEASURES OF CORE INFLATION ON THE MAINLAND

Key points:

- *Concerns have recently risen about the pace with which inflationary pressures have been building up on the Mainland. An examination of sectoral price movements reveals that upward pressures largely come from food prices.*

- *The question has been raised as to whether the headline inflation is a good indicator of "underlying" inflation – also referred to as "core" inflation. An adequate core inflation measure removes the impact of transient shocks, and permits the analysis to be focused on more persistent developments that are of greater relevance to monetary policy.*

- *This paper constructs several measures of core inflation with a view to providing an indicator of underlying inflationary pressures on the Mainland. Of the different measures, an Edgeworth index, which assigns smaller weights to the more volatile CPI components, is more informative for forecasting future inflation.*

- *This preferred core measure suggests that inflation pressures have been more subdued than signalled by the headline inflation rate. Nevertheless, these results need to be interpreted with caution as even this preferred core inflation measure contains limited information useful for forecasting the headline inflation.*

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I. Introduction

Monetary conditions and economic developments more broadly in the Mainland are of central importance for Hong Kong's economic outlook. Given the close economic ties between the two regions, a return of inflation and accelerated growth on the Mainland may help lift Hong Kong out of deflation. On the other hand, sharp swings in macroeconomic conditions on the Mainland could deter economic growth in Hong Kong.

Price developments on the Mainland are clearly at a turning point. In early 2003, it was considered to be positive that the Mainland seemed to experience modest rises in prices. However, the pace of price increases has accelerated since last August to a headline inflation rate of 3.0% in March, 2004 (Chart 1). Concerns have been raised about the pace with which inflationary pressures have been building up, and over whether the economy is overheating.

A close examination of price changes in different sectors reveals that inflationary pressures have largely come from increases in food prices, which have been rising at a rate of more than 5% since last October. Closely related to higher food prices, inflation has also been higher in rural than urban areas, in part reflecting a larger weight of food in rural areas' consumption basket (Chart 1).

These observations raise the question of whether the headline rate accurately reflects the underlying trend in inflation. It is widely recognised that headline inflation contains a great deal of short-term noise, and various economic developments beyond the control of the central bank may cause transitory changes in the inflation rate.[1] Since it takes time for inflation to respond to monetary policy, central banks need to take a view on the future evolution of inflation. Thus, what is more useful from a policy point of view is to decompose headline inflation into a transient component on the one hand, and a trend component – referred to as "core" inflation – reflecting persisting sources of inflation pressures on the other.

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[1] Transitory shocks to prices may be caused by factors such as changes in administratively set prices, taxes, weather and oil supply.

It is the latter component that contains the most relevant information from a central bank's perspective. If price fluctuations from non-monetary sources are effectively removed from the headline inflation, the resulting core inflation can be regarded as the outcome of monetary policy.

A useful core inflation measure can be calculated in real time, that is, using contemporaneously available data. It contains information useful for forecasting changes in inflation in coming periods, while minimising misleading signals about current and future trends in inflation. It should also be easily understood by the general public.

Many different core measures have been applied to study underlying inflation in industrial economies. There are, however, few studies that have investigated core inflation in Hong Kong and the Mainland. Fan (2001) compares a number of core measures for Hong Kong, and concludes that the headline inflation rate is a good indicator of underlying pressures. Gerlach and Yiu (2004) use a statistical method to derive a core inflation measure for Hong Kong and the Mainland.

This paper calculates a number of core inflation measures for the Mainland using alternative approaches, and evaluates their performance in gauging inflationary pressures. The rest of the paper is organised as follows. Section II reviews the price development in the Mainland in the last ten years, particularly the current inflation episode. Section III discusses different approaches in estimating core inflation, focusing on the measures that will be applied in this study. Section IV derives a number of core inflation measures for the Mainland, while Section V considers whether these are good indictors of underlying inflation. The analysis suggests that an Edgeworth index, which assigns smaller weights to more volatile CPI components, contains more information useful for forecasting future inflation. According to this indicator, inflation pressures have been more subdued than signalled by the headline rate. Applying the same measures, Section VI finds that core inflation in rural areas is around two percentage points higher than in urban areas. Finally, Section VII assesses the inflation outlook for the Mainland.

II. Price Developments on the Mainland

Price developments on the Mainland in the last decade can be divided into two periods (Chart 1 and Table 1). The first was between 1994 and 1997 during which the economy underwent sharp disinflation, with the inflation rate falling from over 20% at the beginning of the period to around 3% at the end of 1997. The inflation rate has been much lower since 1998, and the economy has also experienced sporadic deflation. Fluctuations in inflation have also been smaller. An important question is whether the recent pick-up in inflation represents a distinct upturn in the inflation cycle.

An examination of the components of the CPI basket reveals that food has the largest weight, accounting for around 40% of consumption expenditure. Yet it was a relatively more volatile item, falling from an average inflation rate of 15.6% per annum before 1998 to 1.0% deflation after 1998.

In the current inflation episode, food has been the key driving force with prices rising by close to an annual rate of 10% since last November – a rate only seen during the high inflation period in the early 1990s. Housing costs also saw notable increases in the last few months. Upward pressures on prices of other consumption items have been more subdued. In particular, two categories – household facilities, articles and maintenance services; and traffic and communication appliances – have seen the largest price falls in recent years, and their prices are still declining at an annual rate of around 2%.

Price developments in urban and rural areas have followed broadly the same trend (Chart 1). However, inflation has in general been higher in rural than urban areas since September 2001. Notably, the inflation differential between the two regions has risen in the current episode to almost two percentage points in the first two months of 2004. This is probably closely related to a more rapid rise in food prices. Section VI will examine in more details causes of this widening price differential between the two regions.

III. A Review of Core Inflation Measures

Central banks and academics have carried out extensive work on developing good measures of core inflation. Broadly speaking, there are three approaches – structural, exclusion-based and statistical. The structural approach draws a direct link between policy and core inflation, defining the latter as the inflation that is controllable through monetary policy, *e.g.* Quah and Vahey (1995), Blix (1995), Bjornland (1997) and Claus (1997). The difficulty with it, however, is that the resulting measure of core inflation tends to be sensitive to the assumptions underlying the model, and the arrival of new data will result in a change in the historical core inflation series produced by the model. This makes it difficult to explain to the general public and can undermine credibility of monetary policy. As the name suggests, the exclusion-based approach excludes certain items from the aggregate inflation in order to remove the influence of unrepresentative price movements. The final approach often uses formal statistical methods to construct core inflation measures.

This paper applies the last two approaches to derive five core measures. The remainder of this section will briefly discuss the rationales behind these measures.

The exclusion-based approach: CPI excluding food and energy

This is the most commonly used method for assessing underlying inflation. The Bureau of Labor Statistics in the United States computes a core inflation measure that consists of a weighted average of all CPI components except for food and energy. The rationale for exclusion is that food and energy are subject to large, short-term variations due to factors such as weather and oil supply. Many of the variations are driven by non-monetary factors, and can be quickly reversed. As such, food and energy prices do not necessarily convey much useful information about underlying price trends.

One issue with exclusion-based measures is that they might discard potentially useful information about core inflation that may be contained in food and energy prices or whatever categories that are excluded. This concern is particularly significant for less developed economies such as the Mainland where food tends to have a much larger weight in the CPI basket than in advanced economies. They are further subject to the shortcoming that a once-and-for-all judgement has to be made about what prices can be ignored in calculating core inflation.

Principal component analysis

Principal component analysis is a statistical method that explains variations of a group of variables (in this case the different components of a price index) by summarising them into a number of factors – referred to as principal components. It is often found that a large fraction of the original variables' variations is explained by the first principal component, which is then said to represent the most interesting dynamics of these variables. The details of principal component analysis can be found in the Technical Appendix.

Exponential smoothing

Exponential smoothing is a method which forecasts the current value of a variable by taking a weighted average of its past values. Cogley (2002) applies it to the US data, and shows that it outperforms other core measures in filtering out transient shocks and in focusing on more persistent movements in inflation. This measure tends to be smoother than other core indicators.

The Edgeworth index

The Edgeworth index is calculated by assigning smaller weights to the more volatile components of the CPI. The rationale is that the more variable CPI components are, the less useful they are in signalling the underlying price trend. Unlike the exclusion-based approach, this method down-weights relatively more volatile items instead of eliminating them. Dow (1994), Diewert (1995) and Wynne (2001) have estimated this type of indices for the US. Details of the Edgeworth index are provided in the Technical Appendix.

One issue in deriving the Edgeworth index is that it involves an arbitrary choice of a time period for calculating volatility. Some studies use a full sample, which gives the index an unfair advantage when evaluating its ability in tracking headline inflation in real time. One way of overcoming this problem is to use only the past 12 months, for example, for calculation. This allows the weights to change over time as the volatility of different categories of prices changes over time. The speed with which the weights change in response to changes in volatility will be determined by the choice of the fixed number of periods in calculation.

IV. Application for the Mainland

Data

The National Bureau of Statistics of China publishes data on year-on-year changes of CPI components both for the Mainland as a whole, and for urban and rural areas. However, disaggregate data are only available for seven major categories of consumption expenditure. Further breakdown in a comprehensive manner is only published on an annual basis, and hence cannot be used to derive indicators of underlying inflation on a timely basis. For constructing the exclusion-based CPI measure, weights for different CPI components are needed. These can be calculated from data on disaggregate consumption expenditure. All the data are extracted from the CEIC.

As discussed earlier, price developments on the Mainland are distinctly different in the periods before and after 1998. Our analysis will focus on the second period of relatively stable inflation.[2]

[2] From an econometric point, the inflation series appear to be locally mean-reverting during this period, which alleviates the potential problem of spurious correlations.

Measures of core inflation for the Mainland

Based on the discussion in the previous section, a number of core inflation measures are derived (Charts 2a-d). The five measures are: a) CPI excluding food[3] (EX); b) CPI extracted using principal component analysis (PC); c) CPI using exponential smoothing (ES); and d) two Edgeworth measures (INV1 and INV2). The difference between the two Edgeworth indices is explained later.

The five core inflation measures track the headline inflation to different degrees. An inspection of the plots of the different core inflation measures against the headline inflation suggests that PC deviates from headline inflation significantly, even though it averages out to have the same mean as the latter (Chart 2b and Table 2). In fact it is the only core measure that is negatively correlated with the headline inflation (Table 3). It is more volatile than the headline inflation, and thus does not adequately reduce volatility.

EX is better at tracking the headline inflation with a positive correlation of 0.64 with the latter, and is also less volatile than the headline measure.

In deriving the exponential smoothing measure (ES), a decision needs to be made on how quickly the influence of the past price movements dies down. The final ES measure adopted in this study is calculated under the assumption that half of the adjustment will take place in 4 quarters. This is a plausible speed of adjustment, and the results are robust to a range of assumptions with regard to the adjustment process. ES has a correlation of 0.74 with the headline inflation, as well as achieving a reduction in volatility. Compared to the other core indicators, ES appears to be particularly smooth.

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3 There is no information on the energy component of the CPI in the Mainland.

The Edgeworth indices are derived using volatility calculated based on historical data. We have experimented with using the past 12, 18 and 24 months for calculation, and found that the core measure obtained from applying 12 months has the highest correlation with the headline inflation. It may be because measures using too long a lag give unwarranted influence to the pre-1998 period when inflation developments were distinctly different from the period after 1998.

Two Edgeworth measures are reported. INV1 uses all the seven major categories of the CPI for calculation. As can be seen in Chart 2d, it is below the headline inflation for almost the whole post-1998 period. A desirable property of a core inflation measure is that if the headline inflation deviates from it, the headline should adjust to the core measure. The fact that INV1 is persistently below the headline measure would imply that the latter always needs to adjust downward, which is not reasonable. The reason that INV1 is consistently lower is that the two items with the most rapidly falling prices – a) household facilities and services; and b) traffic and communication appliances – are also relatively less volatile, and thus are given more weights by construction in calculating this indicator. In an effort to overcome this problem, we derive a second Edgeworth index – INV2 – by excluding those two categories. These two categories account for only around 15% of total consumption expenditure, and thus their exclusion does not significantly reduce the coverage of the resulting core measure.

A comparison of INV1 and INV2 shows that both are more strongly correlated with the headline inflation, especially INV2, than other core measures. Compared with other core measures, INV1 and INV2 appear to strike a reasonable balance between having a high correlation with the headline inflation and achieving a reduction in volatility. However, INV1 has a much lower mean than the headline and other core inflation measures, reflecting the problem of a downward bias.

V. Evaluating Measures of Core Inflation

There are many criteria for evaluating how good core inflation measures are. Wynne (1999) lists a few, suggesting that core measures should:

- be able to be calculated in real time;
- contains information useful for forecasting future changes in inflation;
- be easily understood by the public;
- not change history when new observations are added; and
- ideally have some theoretical basis.

In this section we evaluate the performance of the five core inflation measures against some of these criteria.

Computable in real time

All the five indices derived above only use historical data, and thus can be calculated in real time.

Verifiable

The five measures are derived using formal statistical measures. They can be verified by independent analysts, which can increase the credibility of these measures in particular, and that of monetary policy conduct in general.

Forward looking

A good core inflation measure should be able to forecast the movement of the headline inflation in that deviations of the headline inflation from the core measure should lead to the adjustment of the headline towards the core, but not the reverse adjustment of the core towards the headline. That is, we can run the following regressions:

(1) $\pi_{t+h} - \pi_t = \alpha_{h,h} + \beta_{h,h}(\pi_t - \pi_t^{core}) + u_{t+h,h},$

(2) $\pi_{t+h}^{core} - \pi_t^{core} = \alpha_{h,c} + \beta_{h,c}(\pi_t - \pi_t^{core}) + u_{t+h,c},$

where:

π_{t+h}	:	h-period-ahead headline inflation
π_t	:	headline inflation
π_{t+h}^{core}	:	h-period-ahead core inflation
π_t^{core}	:	core inflation.

A core inflation measure is forward looking if Equation (1) has high explanatory power while Equation (2) has little. This means that the wedge between π_t and π_t^{core} is useful for forecasting future movements of the headline inflation, but not for those of core inflation.

Table 4 reports the results of these regressions.[4] The upper panel of the table shows that EX and PC is not helpful for predicting the headline inflation. ES has some predictive power over a 12-month horizon. The two Edgeworth indices can forecast the headline inflation as the wedge between the headline and core inflation rates causes the headline to adjust toward the core inflation, with INV1 doing marginally better over the 12-month horizon and INV2 over the 6-month horizon. Nevertheless, they seem to contain little useful information about future movements of the headline inflation.

The lower panel of Table 4 shows that the first three measures – EX, PC and ES adjust toward the headline inflation, while the two Edgeworth indices do not.

4 The Generalised Method of Moments is used for estimation to deal with the simultaneity issue, and the standard errors have been corrected for heteroskedasticity and autocorrelation.

Overall, results in this section suggest that INV2 is a better core inflation measure for the Mainland. It is highly correlated with the headline inflation, and slightly more forward looking than the three non-Egdeworth core inflation measures. Nor does it suffer from the same downward bias as INV1. According to INV2, inflation pressures are more subdued than suggested by the headline inflation.

VI. Core Inflation in Urban and Rural Areas

As noted above, inflation in rural areas has been higher than in urban areas in recent years. A close examination of the breakdown of consumer prices shows that the prices of the two items – food and housing costs – have been rising much faster in rural areas, especially since last November. These two components account for a greater share in consumption expenditure in rural areas, at 62% compared to 48% for urban areas (Table 5). As a result, the inflation differential between rural and urban areas has risen in the past few months.

This section applies the same methods to assess underlying inflation in rural and urban areas. The descriptive statistics of the five core measures reveal a similar pattern of the rural and urban core inflation measures as that of the nation-wide ones (Table 6). A few notable observations are: a) PC for both regions has the same mean as the headline inflation, but is more volatile; b) ES seems to be smoother than other indicators; c) INV1 contains a large negative bias than others. There is one notable difference between rural and urban areas. Similar to the nation-wide measures, PC is not correlated with the headline inflation, while the two Edgeworth indices have high correlation in the case of urban areas (Table 7). For rural areas, all the core measures are highly correlated with the headline inflation, including PC.

In testing the forward looking characteristics, Table 8 shows that again the three non-Edgeworth indicators are very poor core measures in that they are not able to predict future movements of the headline inflation, but converge to the latter instead. The two Egdeworth indices can forecast the urban headline inflation over both the 6- and 12-month horizon, and the predictive power is higher than in the case of nation-wide inflation. However, they are not useful in predicting the headline inflation in the case of rural areas by and large, except over the 6-month horizon using INV2.

The analysis in this section suggests that the nation-wide price developments are dominated by those in urban areas, reflecting much higher average consumption in urban than rural areas. In 2003, the urban population was two thirds of the rural population, but average consumption expenditure in urban areas was more than three times that in rural areas.

Weighing the performance of the five core measures based on different criteria, INV2 is probably the best for urban areas. It suggests a modest underlying inflation rate of around 1% at present.

INV2 is also a better measure of underlying inflation for rural areas as it is highly correlated with the headline inflation and achieves a reduction in volatility, but its weakness is that it contains little information useful for forecasting the headline inflation. Nevertheless, INV2 suggests that underlying inflation in rural areas is around two percentage points higher than in urban areas.

VII. Assessing Inflationary Pressures in the Mainland and the Policy Implications

This paper has constructed a number of measures of underlying inflation on the Mainland in order to assess inflation pressures in recent months. Of the five different core inflation measures derived, an Edgeworth index, which assigns smaller weights to the more volatile CPI components, performs better than others in achieving a balance between high correlation with the headline inflation and a reduction in volatility. This measure suggests that inflation pressures are more subdued than indicated by the headline inflation. Underlying inflation in rural areas is around two percentage points higher than in urban areas at present. However, nation-wide price developments are dominated by those in urban areas, reflecting higher urban consumption expenditure. Nevertheless, these results need to be interpreted with caution as even this preferred core inflation measure contains limited information useful for forecasting future headline inflation, especially in the case of rural areas.

It is difficult to judge at this point how strongly inflation will rise in the coming periods. On the one hand, it can be argued that inflationary pressures may well intensify. Increases in food prices and housing costs raise the cost of living. This might lead to demand for higher wages, triggering an upward spiral of wage and price adjustment. This, coupled with sharp rises in prices of raw materials as a result of fast investment growth, might eventually translate into higher general prices. On the other hand, however, upward wage pressures might be limited, given the large surplus labour on the Mainland. Separately, excess investment is likely to lead to over-capacity, restraining prices down the road. Given the complexity of economic dynamics, it is important to monitor a broad set of indicators in assessing the likely future path of inflation, including price developments other than consumer prices, pass-through between different prices as well as both the demand and supply sides of the economy.

Summary of Core Inflation Measures

EX	:	CPI excluding food
PC	:	core inflation derived by principal component analysis
ES	:	core inflation derived by exponential smoothing
INV1	:	the Edgeworth index using all the seven major CPI components
INV2	:	the Edgeworth index using five CPI components, *i.e.* excluding: a) household facilities and services; and b) traffic and communication appliances

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Technical Appendix

Principal component analysis

Principal component analysis is a commonly used non-parametric method for extracting relevant information from confusing data. It attempts to explain the total variability of p correlated variables through the use of p orthogonal components, which are themselves weighted linear combination of the original variables. Mathematically, define a random vector:

(A.1) $$X = \begin{bmatrix} X_1 \\ X_2 \\ \vdots \\ X_p \end{bmatrix}.$$

The first principal component can be expressed as:

(A.2) $$Y_1 = a_{11}X_1 + a_{12}X_2 + \ldots + a_{1p}X_p .$$

The a_{ij} are scaled such that $a_1^{'}a_1 = 1$. Y_1 is the linear combination that accounts for the maximum variability of the p variables. Its variance is λ_1.

The second principal component Y_2 is similarly formed, with additional conditions that that its variance, λ_2, explains the maximum amount of the remaining variability of the p variables, and that Y_2 is orthogonal to the first principal component, *i.e.* $a_1^{'}a_2 = 0$.

Up to p principal components can be extracted in the same way. However, it is often found that the first $k<p$ principal components explain a large fraction of the total variability of the p variables, and thus said that the most interesting dynamics occur in the first k dimensions.

The weights used to create the principal components are the eigenvectors of the characteristic equation:

(A.3) $$(S - \lambda_i I)a = 0, \text{ or}$$
$$(R - \lambda_i I)a = 0,$$

where S is the covariance matrix, and R is the correlation matrix. The λ_i -- variances of the components -- are the eigenvalues, and are obtained by solving $|S-\lambda_i I|=0$.

The Edgeworth index

The Edgeworth index is obtained by re-weighting the CPI components, using as weights the inverse of the volatility of the difference between the inflation rate of each CPI component and the headline inflation rate. Both standard deviations and variances have been used as measures of volatility. If standard deviations are used, then:

(A.4) $$Edgeworth=\sum_{i=1}^{N}\omega_{it}\pi_{it}\ ,$$

with:

$$\omega_{it}=\frac{\frac{1}{\sigma_{it}}}{\sum_{j=1}^{N}\frac{1}{\sigma_{jt}}}\ ,$$

$$\sigma_{it}=\sqrt{\frac{\sum_{j=1}^{T}(y_i-\bar{y})^2}{T-1}}\ ,$$

$$y_i=\pi_{it}-\pi_t\ ,$$

$$\bar{y}=\frac{1}{T}\sum_{i=1}^{T}(\pi_{it}-\pi_t)\ ,$$

for i=1, 2,…, N.

In the formula, π_t is the headline inflation, π_{it} the inflation rate of CPI components, N the number of components, and T the number of time periods.

Chart 1. Headline Inflation (1994.1-2004.3)

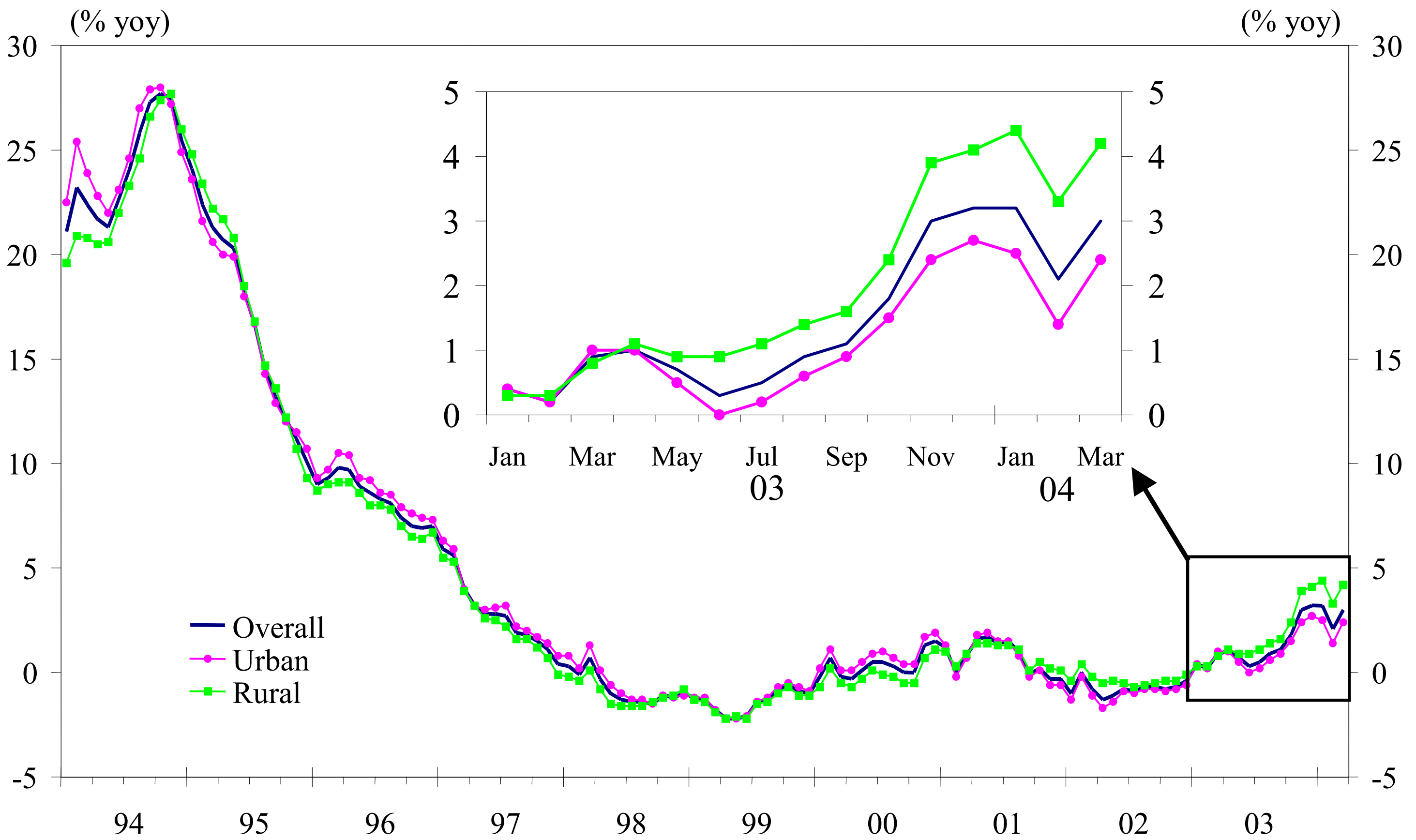

Table 1. Components of Headline Inflation

		1994.1-2004.3		1994.1-1997.12		1998.1-2004.3	
	Weight	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Headline CPI inflation	**100**	**5.1**	**8.4**	**13.1**	**8.7**	**0.0**	**1.3**
Core CPI inflation excluding food	**60**	**3.7**	**5.5**	**9.6**	**4.4**	**0.0**	**1.0**
Food	40	5.6	12.0	15.6	13.7	-0.8	3.3
Clothing	8	3.0	7.0	10.5	5.8	-1.8	0.9
Household facilities, articles and maintenance services	6	0.9	4.8	5.8	4.3	-2.2	0.4
Medicines, medical care and personal articles	7	4.0	4.7	9.3	3.0	0.7	1.3
Traffic and communication appliances	9	-1.7	3.7	0.9	4.3	-3.4	2.0
Recreational, educational, cultural articles and services	17	5.3	5.6	10.7	4.3	1.8	2.7
Residence	12	6.2	6.6	12.9	5.7	1.9	1.8

Source: CEIC.

Chart 2. Alternative Measures of Core Inflation (1998.1-2004.3)

Chart 2a: EX (CPI excluding food)

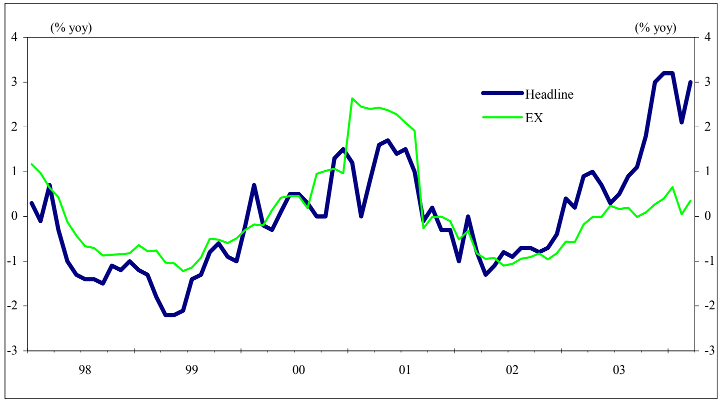

Chart 2b: PC (Core inflation by principal component analysis)

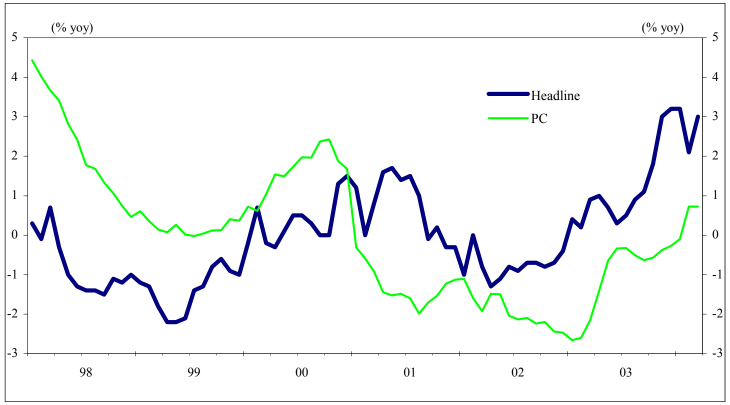

Chart 2c: ES (Core inflation by exponential smoothing)

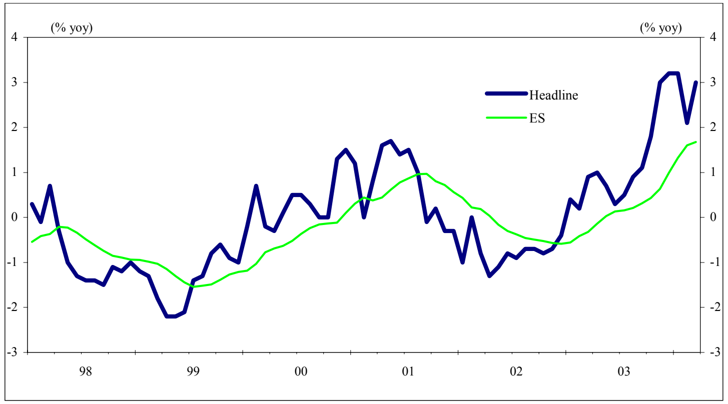

Chart 2d: INV (the Edgeworth index)

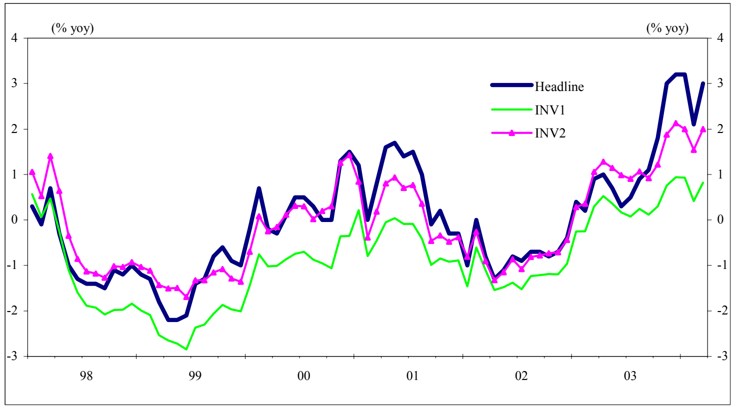

Table 2. Descriptive Statistics of Core Inflation Measures (1998.1-2004.3)

	Mean	Standard deviation	Minimum	Maximum
Headline	0.0	1.3	-2.2	3.2
EX	0.0	1.0	-1.2	2.6
PC	0.0	1.7	-2.7	4.4
ES	-0.2	0.8	-1.5	1.7
INV1	-0.9	1.0	-2.8	0.9
INV2	-0.1	1.0	-1.7	2.1

Table 3. Correlation between Headline and Core Inflation Measures (1998.1-2004.3)

	Headline	EX	PC	ES	INV1	INV2
Headline						
EX	0.64					
PC	-0.06	0.13				
ES	0.74	0.55	-0.24			
INV1	0.91	0.61	-0.03	0.73		
INV2	0.94	0.63	0.11	0.68	0.96	

Table 4. Forecasting Performance of Core Inflation Measures

Dependent Variable: $\Delta_h \pi_t$

	EX			PC			ES			INV1			INV2		
	α	β	Adjusted R^2	α	β	Adjusted R^2	α	β	Adjusted R^2	α	β	Adjusted R^2	α	β	Adjusted R^2
h=6	0.50	0.87	-0.09	0.29	0.00	-0.02	0.29	-0.01	-0.01	0.86	-0.72	0.06	0.30	-1.09	0.10
	(1.90)	(2.03)		(0.72)	(0.02)		(0.76)	(-0.03)		(0.60)	(-0.45)		(0.80)	(-0.79)	
h=12	1.00	1.54	0.00	0.52	0.02	-0.02	0.54	-0.94	0.04	1.68	-1.43	0.12	0.54	-0.82	0.04
	(2.72)	(2.01)		(0.69)	(0.05)		(0.35)	(-1.41)		(0.64)	(-0.54)		(0.75)	(-0.29)	

Dependent Variable: $\Delta_h \pi_t^{core}$

	EX			PC			ES			INV1			INV2		
	α	β	Adjusted R^2	α	β	Adjusted R^2	α	β	Adjusted R^2	α	β	Adjusted R^2	α	β	Adjusted R^2
h=6	0.25	0.99	0.06	-0.20	0.36	0.24	0.07	0.52	0.52	-0.03	0.20	-0.01	0.15	0.01	-0.01
	(0.73)	(2.24)		(-0.18)	(1.82)		(0.46)	(4.99)		(-0.03)	(0.18)		(0.46)	(0.01)	
h=12	0.67	1.77	0.22	-0.29	0.46	0.21	0.30	0.60	0.27	0.60	-0.30	0.00	0.38	-0.05	-0.02
	(0.95)	(1.61)		(-0.14)	(0.97)		(0.45)	(1.55)		(0.28)	(-0.14)		(0.54)	(-0.02)	

Table 5. Components of Headline Inflation: Urban vs Rural (1998.1-2004.3)

	Urban			*Rural*		
	Weight	Mean	Standard deviation	Weight	Mean	Standard deviation
Headline CPI inflation	**100**	**0.0**	**1.2**	**100**	**0.1**	**1.5**
Core CPI inflation excluding food	**62**	**0.0**	**1.1**	**54**	**0.1**	**1.2**
Food	38	-0.9	3.2	46	-0.8	3.5
Clothing	10	-1.9	1.0	6	-1.5	0.8
Household facilities, articles and maintenance services	6	-2.5	0.4	4	-1.8	0.5
Medicines, medical care and personal articles	7	0.2	1.6	6	1.4	1.2
Traffic and communication appliances	10	-3.5	1.9	7	-3.3	2.2
Recreational, educational, cultural articles and services	18	1.7	2.9	15	1.6	2.7
Residence	10	3.2	2.5	16	0.6	1.7

Source: CEIC.

Table 6. Descriptive Statistics of Core Inflation Measures: Urban vs Rural (1998.1-2004.3)

	Urban				***Rural***			
	Mean	Standard deviation	Minimum	Maximum	Mean	Standard deviation	Minimum	Maximum
Headline	0.0	1.2	-2.2	2.7	0.1	1.5	-2.2	4.4
EX	0.0	1.1	-1.5	2.9	0.1	1.2	-1.8	2.3
PC	0.0	1.9	-2.9	3.8	0.0	1.7	-2.7	3.8
ES	-0.2	0.7	-1.5	1.3	-0.2	0.9	-1.6	2.4
INV1	-0.9	0.7	-2.2	0.6	-0.8	1.3	-3.1	2.6
INV2	-0.1	0.9	-1.7	1.8	0.0	1.4	-2.3	3.5

Table 7. Correlation between Headline and Core Inflation Measures: Urban vs Rural (1998.1-2004.3)

Urban

	Headline	EX	PC	ES	INV1	INV2
Headline						
EX	0.53					
PC	-0.07	0.31				
ES	0.65	0.49	-0.25			
INV1	0.89	0.55	0.02	0.56		
INV2	0.89	0.56	0.20	0.47	0.95	

Rural

	Headline	EX	PC	ES	INV1	INV2
Headline						
EX	0.83					
PC	0.80	0.75				
ES	0.85	0.75	0.79			
INV1	0.96	0.85	0.89	0.88		
INV2	0.98	0.85	0.85	0.85	0.98	

Table 8. Forecasting Performance of Core Inflation Measures: Urban vs Rural

Dependent Variable: $\Delta_h \pi_t$

Urban

	EX			PC			ES			INV1			INV2		
	α	β	Adjusted R^2	α	β	Adjusted R^2	α	β	Adjusted R^2	α	β	Adjusted R^2	α	β	Adjusted R^2
h=6	0.30	0.55	-0.05	0.20	-0.05	0.01	0.21	-0.11	-0.01	1.16	-1.18	0.17	0.23	-1.28	0.18
	(1.05)	(1.41)		(0.49)	(-0.24)		(0.52)	(-0.31)		(1.41)	(-1.32)		(0.67)	(-2.06)	
h=12	0.56	0.58	-0.01	0.36	-0.11	0.02	0.39	-0.96	0.07	2.44	-2.55	0.38	0.44	-1.62	0.18
	(0.99)	(0.65)		(0.46)	(-0.28)		(0.28)	(-1.66)		(1.72)	(-2.12)		(0.65)	(-1.50)	

Rural

	EX			PC			ES			INV1			INV2		
	α	β	Adjusted R^2	α	β	Adjusted R^2	α	β	Adjusted R^2	α	β	Adjusted R^2	α	β	Adjusted R^2
h=6	0.61	0.90	-0.11	0.39	0.30	0.00	0.39	0.13	-0.01	0.45	-0.05	-0.01	0.54	-1.90	0.11
	(1.52)	(1.29)		(0.87)	(1.32)		(0.94)	(0.17)		(0.19)	(-0.02)		(0.98)	(-0.96)	
h=12	1.29	2.26	-0.05	0.58	0.82	0.25	0.76	-0.93	0.01	0.70	-0.02	-0.02	0.56	1.38	-0.04
	(2.80)	(2.80)		(1.22)	(4.65)		(0.24)	(-0.97)		(0.16)	(-0.00)		(0.66)	(0.43)	

Dependent Variable: $\Delta_h \pi_t^{core}$

Urban

	EX			PC			ES			INV1			INV2		
	α	β	Adjusted R^2	α	β	Adjusted R^2	α	β	Adjusted R^2	α	β	Adjusted R^2	α	β	Adjusted R^2
h=6	0.03	0.73	0.11	-0.28	0.22	0.10	0.05	0.52	0.51	0.35	-0.38	0.00	0.06	-0.34	-0.02
	(0.09)	(1.94)		(-0.27)	(1.17)		(0.29)	(5.28)		(0.56)	(-0.70)		(0.20)	(-0.55)	
h=12	0.19	1.04	0.18	-0.48	0.29	0.09	0.23	0.56	0.26	1.20	-1.25	0.23	0.25	-0.88	0.06
	(0.19)	(0.96)		(-0.22)	(0.67)		(0.31)	(1.69)		(1.68)	(-2.04)		(0.44)	(-1.34)	

Rural

	EX			PC			ES			INV1			INV2		
	α	β	Adjusted R^2	α	β	Adjusted R^2	α	β	Adjusted R^2	α	β	Adjusted R^2	α	β	Adjusted R^2
h=6	0.48	1.27	-0.04	0.11	1.04	0.35	0.11	0.52	0.53	-0.32	0.78	0.03	0.36	-0.33	-0.01
	(1.45)	(2.25)		(0.21)	(4.83)		(0.63)	(3.20)		(-0.22)	(0.46)		(0.66)	(-0.18)	
h=12	1.15	2.59	0.23	0.19	2.02	0.68	0.42	0.65	0.28	-0.33	1.14	0.05	0.40	2.48	0.00
	(2.43)	(3.53)		(0.39)	(10.63)		(0.60)	(0.87)		(-0.10)	(0.33)		(0.51)	(0.80)	