Measurement of Underlying Inflation in Fiji

Edwin Dewan

Vikesh Gokal

Shajehan Hussein

Working Paper

2003/04

December 2003

Economics Department

Reserve Bank of Fiji

Suva

Fiji

 The authors are grateful to Sekove Vakausausa for data collection and valuable assistance in calculating the Trim Mean, as well as other colleagues in the Economics Department for their comments in earlier drafts.

Abstract

The term “underlying” inflation often appears in the various works and analysis of central banks and is commonly referred to, as a measure of inflation which does not include transitory price changes.

This paper attempts to determine the most appropriate measure of underlying inflation which can be adopted by the Reserve Bank of Fiji. In this regard, nine measures of underlying inflation were derived. Using testable conditions proposed by Marques et al (2000), these measures were evaluated, to identify the most suitable measure.

The 15 percent Trim Mean was the only measure which satisfied all the relevant criterion and it is recommended that the Reserve Bank of Fiji continue to use the 15 percent Trim Mean as the official measure of underlying inflation.

However, it is important to note that the comparison of the various measures suggests that different measures may do well along different dimensions. Each measure of core inflation provided some insight into how inflation was evolving. Therefore, it may be useful to have other measures of underlying inflation, and to use the information in each of these measures to set a more accurate picture of inflation dynamics.

1.0 Introduction

In many countries, the Consumer Price Index compiled by their respective statistical agencies, are subject to the volatility in prices of some items. Hence, in assessing inflationary pressures, central banks have developed alternative inflation indicators, commonly referred to as underlying inflation. The underlying measure of inflation is also referred to as core inflation. These measure(s) eliminate temporary price fluctuations and reflects permanent price changes that are mainly caused by demand side factors. In other words, the high variance components are excluded from the aggregate inflation measure. Commonly, excluded components include volatile food items, certain energy items, like motor fuel and home heating fuel, interest rates and one-off policy related price changes.

This exclusion allows the monetary authority to make adjustments to the measured rate, if it judges conditions warrant them (Bryan et al. 1999). These measure(s) of core inflation are used by various central banks to set monetary policy, and in a growing number of countries, underlying inflation has become a target for the central bank. Appendix 1 reports core inflation measures used by some inflation targeting countries.

Few authors have tried to formalise the concept of underlying inflation, notably Eckstein (1981), who defined core inflation as *"the trend rate of increase in the price of aggregate supply"*. He constructed the core inflation estimate from a weighted average of the trend growth rates of unit labour costs and capital costs. In a similar spirit, Quah and Vahey (1995) defined core inflation as *"that component of measured inflation that has no medium to long run impact on real output."* Their approach estimates core

inflation from a system of Vector Autoregressive (VAR) equations using the monthly retail price and industrial production data.

The underlying inflation is linked to the headline inflation in the sense that it reflects the trend in inflation. However, the rates of price changes produced from these measures usually differ. For instance, if the headline inflation is higher due to adverse temporary price shocks, then underlying inflation would be lower, as it would only reflect permanent price changes. Similarly, if headline inflation is lower due to positive price shocks that are transient, then the underlying inflation could be higher. Different measures of underlying inflation have different degree of correlation with the headline inflation.

In this paper we investigate several alternative measures of underlying inflation for Fiji, using the monthly CPI data for the period 1991 - 2002. Foreshadowing the results, the 15 percent Trim Mean was the only measure at satisfied all the relevant criteria required in a robust measure of underlying inflation. It is recommended that the Reserve Bank of Fiji continue to use the 15 percent Trim Mean as the official measure of underlying inflation.

The rest of the paper is structured as follows: Section 2 briefly reviews the purpose of underlying inflation. Section 3 discusses the concept of core inflation. Section 4 examines uses and desirable properties of core inflation. Section 5 sets out measures of underlying inflation in Fiji. Section 6 compares some statistical characteristics of these measures. Section 7 evaluates core inflation measures, while Section 8 recommends the measure which could be used by the Reserve Bank of Fiji. Section 9 concludes the paper.

2.0 Purpose of underlying inflation

Monetary policy is the principal means by which the central bank can regularly influence the pace and direction of overall economic activity and the general rate at which prices rise and fall. Price stability is often one of the most important objectives that the central bank is mandated to achieve. In trying to fulfill the objective of price stability, policymakers have to make a choice of which measure of inflation to use.

Since the CPI is a broad based index, well known and regularly published, it often becomes the natural measure of price developments. But, at the same time, this measure often includes a number of components that policymakers perceive as transitory while conducting monetary policy. That is, the CPI is often subject to large temporary shocks, such as the effect of adverse weather conditions, which cause temporary variations in prices. Furthermore, the CPI is also affected by one-off policy related changes, such as changes in prices of good and services that are regulated, changes in taxes and subsidies, government charges and interest rates. Thus, while these temporary factors affect the cost of living in the short-run, they do not directly reflect the permanent inflationary pressures in the economy. Hence, in formulating monetary policy, it is important to abstract these temporary variations in prices and focus on the "core" or "underlying" inflation rate, which represents trend movements.

One of the main reasons why central banks focus on underlying inflation in making monetary policy decisions is that, they are concerned about both the evolution of output as well as inflation. The concern to minimise output volatility while conducting monetary policy is even

extended to explicit inflation targeting central banks (see Stevens and Debelle 1995). Many researchers[1] argue that monetary policy should not respond to inflation components beyond its control, since in attempting to offset these temporary inflationary effects leads to large variations in underlying inflation and real output. There is a general consensus that policymakers should not respond to temporary supply related shocks, as they often generate a short-term conflict between the central bank's inflation and output objectives. Thus, differentiating between demand disturbances and supply disturbances, while conducting monetary policy becomes an important issue.

In the event of a supply shock, policy actions to counter the impact on general prices tend to cause output variations. Since, in the short-run, there exists a trade-off between inflation and output, it often causes a conflict between central bank's two main objectives, price stability and output growth. For instance, assume an adverse one-off supply shock in the form of a cyclone, causes a temporary decrease in output, which leads to a rise in inflation. If the central bank were to respond this temporary phenomenon, then it would be in a dilemma as to whether to take an easing monetary policy stance to increase output or to take tightening stance to contain inflation. Suppose the central bank wishes to concentrate on maintaining price stability at any cost and opts to tighten policy. As a result of this move, output will shrink further, but inflation will be contained. However, with the shock being temporary in nature, output will naturally come back to normal after some time. Once it comes back to normal level, prices will fall below the central bank's desirable level. To

[1] Blinder (1997), Roger (1996).

contain this disinflationary effect, the central bank will have to ease policy, which will result in output going back to initial level, that is, it will offset the decrease resulting from the initial tightening of the policy following the adverse supply shock and inflation will be at desirable levels. Hence, it is argued that price changes resulting from temporary supply shocks normalise when its effect subside, and responding to them only causes output volatility which is a not desirable outcome.

In an event of demand shock, inflation and output stabilisation will in most instances be mutually compatible.[2] A demand shock causes both inflation and output to move in the same direction. Hence, there is no inherent trade-off between output and inflation stabilisation when setting monetary policy. Therefore, monetary policy actions to counter inflationary or disinflationary consequences will always tend to move real activity towards the trend or potential level of output. As a result of a negative demand-side shock to the economy, output will fall below the potential output level, thus reflecting excess capacity in the economy. The excess capacity in the economy implies weak demand, thus leading to a deflationary effect. An accommodating monetary policy stance would be to ease, which would in turn stimulate the economy. The easing of monetary policy would increase demand in the economy and thus narrow the output gap. In a situation like this, economic demand becomes very strong and, thus, eventually tends to exert upward pressure on prices. To contain inflationary pressures, the central bank in this circumstance has to tighten policy settings. A tightening of monetary policy setting will thus, start to "cool-off" the economy, which will see prices and output fall. Output will

fall to the potential level and thus the deviation from the trend output gets dampened, while inflationary pressures subside.

3.0 The Concept of Core Inflation

Core inflation could be viewed as the persistent and/or a generalised component of measured inflation. Both these concepts are associated with expectations and demand pressure components of the measured inflation and exclude supply shocks.

3.1 Core inflation as persistent inflation

Milton Friedman defined inflation as a "…. steady and sustained increase in the general price level".[3] He emphasises the distinction "…between a steady inflation, one that proceeds at a more or less constant rate, and an intermittent inflation, one that proceeds by fits and starts…".[4] The importance of the distinction, according to Friedman, is that the steady or persistent element of inflation will tend to be incorporated into exceptions and, consequently, will be comparatively benign. However, intermittent or transient inflation will be much less benign, precisely because it will be less readily anticipated.

Similarly, Laidler and Parkin defined inflation as *"….a process of continuously rising prices, or, equivalently, of a continuously falling value*

[2] John B. Taylor (1999).
[3] Friedman (1963), p.1
[4] Friedman (1963), p.25

of money,"[5] which also emphasises the persistence or continuity of changes in prices as a defining characteristic of inflation.

The characterisation of core inflation as the persistent element of measured inflation is clearly reflected in Eckstein's definition of core inflation as *"the trend increase of the cost of the factors of production"*. Eckstein distinguishes this element of measured inflation from inflation resulting from (a) supply shocks; and (b) cyclical changes in inflation arising from aggregate demand changes.

Eckstein also discusses that this notion of core *"originates in the long-term expectations of inflation in the minds of households and businesses, in the contractual arrangements which sustain the wage-price momentum, and in the tax system.''* Parkin (1984) shows that, in fact, Eckstein's definition of core inflation really amounts to the expected steady-state inflation rate, which is essentially consistent with Friedman's description of steady inflation.

In other words, if the short-run aggregate supply curve is given by:

$$\Pi_t = \Pi_t^e + g(X_t) + n_t \qquad \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where:

Π_t is the aggregate inflation rate in period *t*

$\Pi^e{}_t$ is the expected inflation

X_t is a measure of excess demand pressure

ν_t is a measure of supply disturbances

then in steady state, where $X_t = 0$ and $\nu_t = 0$,

$$\Pi_t = \Pi^e{}_t \qquad \ldots\ldots\ldots\ldots\ldots\ldots..(2)$$

[5] Laider and Parkin (1975), p. 741

Eskstein's definition of core inflation, $\Pi^{e}{}_{t}$, is:

$$\Pi_t^{nc} = [\Pi_t - g(X_t) - n_t] = \Pi_t^e \qquad \text{……..(3)}$$

This equals the expected inflation rate in steady state, while non-core inflation, $\Pi^{nc}{}_{t}$, is:

$$\Pi^{nc}{}_{t} = g(X_t) + \nu_t \qquad \text{……..(4)}$$

The close linkage between expected inflation and the conception of core inflation as the persistent element of inflation is also implicit in Quah and Vahey's definition of the core inflation *"…as that component of measured inflation that has no medium to long term impact on real output"*.[6] For this component of inflation to be output neutral over the medium to long term, it must be the component of inflation that feeds or reflects inflation expectations.

However, the Quah and Vahey definition of core inflation differs in two important respects from Eckstein's. First, the Quah and Vahey definition includes inflation changes that can have a short-term impact on output. Implicitly, this corresponds to inflation related to excess demand pressures.

In terms of the aggregate supply curve described above, the Quah and Vahey definition of core can be characterised as:

$$\Pi^{c}{}_{t} = [\Pi_t - \nu_t] = \Pi^{e}{}_{t} + g(X_t) \qquad \text{…….(5)}$$

Where non-core inflation is:

$$\Pi^{c}{}_{t} = \nu_t \qquad \text{...……...(6)}$$

[6] Quah and Vahey (1995), p. 1130.

The second respect in which the Quah and Vahey definition of core inflation may differ from that of Eckstein is with regard to inflation expectations. Eckstein's definition appears to be most consistent with a long-term inflation expectation, while Quah and Vahey's is more consistent with short-term expectations which may include cyclical influences.

However, in both cases, supply disturbances having transient impact on inflation are excluded from the definition of core inflation. Therefore, based on the above definitions, the principle definition should be one that exhibits more persistence or less variability than the aggregate (headline) measure of inflation.

3.2 Core Inflation as Generalised Inflation

An alternative conception of core inflation is based on Arthur Okun's definition of inflation as *"…a condition of generally rising prices"*.[7] In this conception, measured inflation is viewed as comprising a generalised or core inflation component associated with expected inflation and monetary expansion, plus a relative price change component, mainly reflecting supply disturbances (Roger 1995).[8] Relative price disturbances are regarded as 'noise' obscuring the more general or underlying evolution of prices.

Implicitly, advocates of core inflation as generalised inflation take the view that supply shocks are the most important source of relative price

[7] Okun (1970).

[8] The definition of generalised inflation with core inflation rate is not a recent one: Fase and Folkertsma (1996), for example, indicate that the notion of 'inner' value of money in the work of Carl Merger in the 1920s essentially corresponds to the generalised component of inflation.

changes. In this case, the conception of core inflation as generalised inflation corresponds closely to the definition proposed by Quah and Vahey, since supply-driven relative price changes affecting the aggregate rate should only have a transient effect.

4.0 Desirable Properties of a Measure of Underlying Inflation

Most central banks, especially those with explicit inflation targets, are concerned with both the cyclical tendency of inflation as well as its steady state or long-run expected value. However, central banks do seek to distinguish between permanent and transient, or generalised and relative price inflation.

A measure of core inflation has three distinct uses for monetary policy purposes. These include a role in the setting or formulation of policy, in providing policy accountability, and in econometric estimation and forecasting. These uses also determine the desirable properties of the core inflation rate. The various uses outlined above also point to a number of properties that the measure should have to be effective. Roger (1998) suggested that, a measure should be[9]:

A. Robust and unbiased
B. Timely
C. Credible
D. Verifiable

[9] Details of these criteria are discussed in sections 4.1-4.4.

4.1 Robust and Unbiased

A measure of underlying inflation that does a poor job in distinguishing between persistent (demand related and expectations) and transient (supply related) movements in inflation will not serve any role well. It is important, both in policy formulation and in providing policy accountability, that the measure not be significantly biased relative to the headline inflation. In other words, changes in headline inflation due to temporary affects should not be reflected in the underlying measure of inflation. If the measure shows a persistent bias, its credibility in providing a public accounting for inflation performance could be jeopardised.

4.2 Timely

The measure of core inflation should be available on a timely basis for everyone. In this context, a measure of core inflation may be regarded as delayed in its availability, if it is subject to significant revision over time.

If the measure of core inflation is not timely, appropriate policy adjustments based on the information conveyed by the measure will be delayed. Therefore, it could have adverse consequences on output and inflation. Alternatively, policy adjustments may be made without focusing on the measure. Thus, depicting that it has little or no value in policy formulation.

Timeliness is also important for the use of a core inflation measure in providing meaningful policy accountability. If the measure of core inflation becomes available only well after the official or headline measure of inflation is released, then for the purposes of explaining current policy or

accounting for inflation outcomes, the underlying measure will have little real value.

4.3 Credible

The measure of core inflation will be ineffective in a policy accountability role if it does not itself have much credibility. Generally, to enhance credibility, it is often ideal to have measures that are simple to understand by everyone. Although it is probably not essential that the technical construction of the measure be widely understood, it probably is quite important that the basic approach taken to construct the measure be able to be conveyed in a non-technical way. Perhaps even more important is that deviations of the underlying measure from the headline measure should be able to be explained in simple terms.

4.4 Verifiable

Moreover, credibility can be further enhanced if the measure is either externally calculated or at least readily able to be verified externally. This reduces the uncertainty amongst the public, even if the central banks may be fair in reporting underlying inflation. The verifiability principle enhances credibility and hence anchors inflation expectation in line with the central bank's inflation forecast.

5.0 Measures of Underlying Inflation

This section calculates several measures of underlying inflation in Fiji. Some of these measures are subjective while others are more technical in nature. The following measures of underlying inflation were derived:

A. Underlying inflation by objective exclusion

   i. Specific Adjustment
   ii. CPI excluding interest rates, energy prices and volatile food items
   iii. CPI excluding volatile items.

B. Underlying inflation by systematic exclusion

   i. Trimmed means (5%, 10% and 15%)
   ii. Weighted median inflation

C. Seasonally Adjusted Inflation

D. Underlying inflation by smoothing

   i. Hodrick-Prescott trend

5.1 Underlying Inflation by Objective Exclusion

The most common approach of measuring underlying inflation is to exclude nominated items from the CPI basket. Typically, the excluded components are those which are volatile, seasonal, subject to administrative price settings (price controlled items) and sensitive to interest rates.

These measures, as with other exclusion methods, use historical volatility of components to derive underlying inflation. A primary assumption of this measure is that the past will be representative of the future. Advantages of exclusion measures are that they are timely, easy to compute and explain. However, the downside is that they require (subjective) judgement about what the least informative price components are for estimating core inflation. To some extent, valuable information may be ignored by exclusion.

There are several widely used measures. However, in Fiji's case, the following three measures have been identified. These are, the specific adjustment method, CPI excluding interest rates, energy prices and volatile food items; and CPI excluding volatile items.

5.1(1) Specific Adjustment

This approach attempts to extract an underlying measure of inflation from the published 'headline' rate by eliminating the estimated effects of specific types of disturbances. Internationally, this method is commonly used to adjust for the effects of indirect tax changes (example, following the introduction of the Goods and Services Tax (GST) in both New Zealand

and Canada) and less commonly, the direct price effects of commodity price shocks (example in New Zealand, see Roger 1995).

Generally, this method works quite well when all the necessary information pertaining to the timing and magnitude of the shock effects on the price series concerned are available. As indirect tax changes affect inflation directly, (such as changes in Value Added Tax (VAT)/GST rates) the initial effect on the CPI can be calculated by using the percentage change in the tax rate and the weight of the goods and items. The calculation of this measure is not a simple process. However, net price indexes which have been developed in Canada, the United Kingdom, Sweden and several other countries, have generally been accepted as measures of inflation which are useful for commentary and analysis.

Domestically, when this measure was applied to the implementation of the VAT rate (10 percent) in 1992, the overall effect on inflation was estimated at 6.8 percentage points. This was a one-off base-related effect, which pushed the headline inflation rate up by the same amount. The impact of these base-related effects are usually for a twelve-month period only.[10] In 2003, the VAT rate was increased to 12.5 percent. The effect on inflation of this increment was an increase of around 1.9 percentage points.

The argument for specific-adjustment is that it results in a more representative price index. It specifically removes non-underlying price movements that cannot be affected by changes in monetary policy.

[10] Since the inflation rate is calculated on a year-on-year percent change basis, the base-related effects erode away after a twelve-month period.

5.1(2) CPI excluding interest rates, energy prices and volatile food items (CPIX1)

This measure removes interest rates, energy prices and volatile food items. Prices of food items, are often subject to seasonal fluctuations, as such they have been historically volatile and are frequently temporary in nature. In many instances, large fluctuations in food prices arise because of disruptions such as cyclones, drought or other seasonal factors, and often, prices tend to normalise once supply is restored. Excluding these fluctuations and hence focusing on CPIX1 is supposed to reduce the uncertainty around the inflation rate trend.

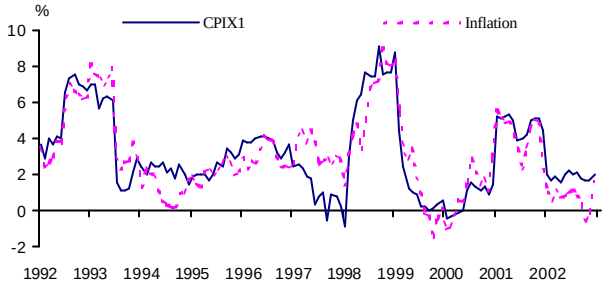
The key argument for excluding interest rate components from the calculation of this underlying measure is to safeguard against the potential instrument instability. For example, a rise in interest rates induced by the central bank in order to counter emerging inflation pressures will have the perverse initial effect of boosting inflation. The danger is that this rise in inflation would lead the Bank to induce further interest rate increases and so on (the phrase "cat chasing its tail" is often used to explain the above argument). Eventually, the indirect inflation dampening effects of tighter policy would come to dominate the direct interest cost effect, but only after a very substantial tightening had occurred. At this point, the whole process would begin to reverse itself. The perverse impact of interest rate movements would thus tend to promote excessive movements in monetary conditions, generating unnecessary and damaging volatility in inflation and real economic conditions.

The reason to exclude energy prices is to remove production-related shocks from the CPI. Changes in energy prices are usually induced by supply-side dynamics and in most countries are induced externally. As such, they may not represent the underlying prices pressures prevailing in the domestic economy. By excluding this component, the remaining CPI becomes more representative of inflation driven by excess demand pressures in the economy. However, this method only excludes petrol and diesel prices, while prices of other energy related products such as kerosene and cooking gas are not discounted. This is due to the unavailability of data at items level.[11]

Food items have historically shown evidence of volatility; especially items termed as "market items"[12]. This volatility can be mainly attributed to seasonal variations, with contributing factors including weather conditions, pest control and irrigation. Excluding these price series provides selected information on the general direction of the remaining items in the basket. Inflation rate based on CPIX1 has been graphed in Figure 1.

[11] Petrol and diesel fuel fall under the service and spare parts section, which also comprises of oil and grease, tyres and spare parts.
[12] The markets items category includes fresh fish, vegetables, rootcrops, fruits and yaqona.

FIGURE 1
CPIX1 and CPI



Source: Reserve Bank of Fiji & Fiji Islands Bureau of Statistics

From the graph, it can be ascertained that there were periods where the headline inflation rate was higher than the underlying measure, and there were certain periods where the opposite was prevalent. For example, in 1997 & 1998, the exclusion inflation rate was relatively lower, suggesting that these items had extreme price movements in contrast to the rest of the items in the CPI.

In 2001, with the re-implementation of the VAT on certain food items, the exclusion inflation rate more or less tracked headline inflation, indicating that the pick up in consumer prices was not underpinned by the price movements of items discounted by CPIX1. In contrast, for most of 2002, the exclusion inflation rate was higher than headline. This differential suggests that a broader range of the items in the CPI had relatively more stable price increases throughout the year, than the excluded items. The headline rate suggested that consumer prices increased less and in October 2002 they actually fell. This confirms that

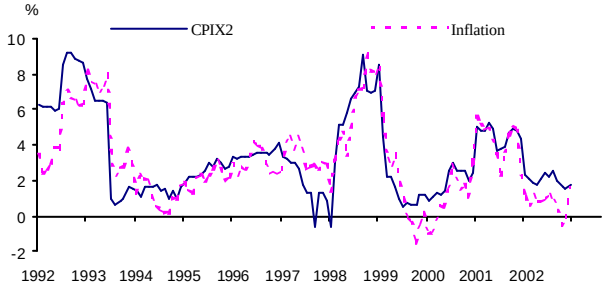
relying solely on the headline measure of inflation may not always be the appropriate indicator for monetary policy action.

5.1(3) CPI Excluding Volatile Items (CPIX2)

This measure subjectively remove items from the CPI basket on volatility grounds, while calculating inflation. Items that are excluded include wheat products, cereals, fresh fish, vegetables & root crops, preserved fruits, fruit, fruit juice, yaqona, dairy products, spices and transport services & spare parts.

The initial exclusion criteria for the items of the CPI were based on data for 10 years. Based on that historical data, items that had annual fluctuations of +/-15 percent or more were excluded under this measure.[13] Food items formed the majority of the list, proving to be historically the most volatile component of the CPI.

FIGURE 2
CPIX2 and CPI



Source: Reserve Bank of Fiji & Fiji Islands Bureau of Statistics

[13] Note that the criteria for identifying volatile items are somewhat arbitrary, as precise definitions for volatility is not available, thus some caveats may apply.

Figure 2 depicts headline inflation and underlying inflation measured by CPIX2. For the 1995 to 2001 period, CPIX2 closely followed the trails of headline inflation. However, there were periods in which the headline inflation was higher than the underlying inflation. This suggests that during these periods consumer prices rose largely because of hikes in prices of volatile items. Furthermore, it is important to note that throughout 1997 headline inflation was above the CPIX2, thus suggesting that inflation was to some extent influenced by higher prices of volatile items. In the twelve months to December 1997, the headline inflation rate was 2.9 percent, whereas inflation excluding volatile items was only 0.9 percent. This confirms that relying solely on headline measure of inflation to conduct monetary policy may not be appropriate. High inflation at times may be largely due to higher prices of volatile items which are seasonal in nature. In 2002, the lower headline rate suggests that the volatile items exhibited greater negative movements in prices, compared with the remainder of the CPI basket.

5.2 Systematic Exclusion - Trimmed Mean

Bryan and Cecchetti (1994) propose tracking trend inflation with the "trimmed mean". The trimmed mean removes from overall inflation all large relative changes in each month, with the set of excluded components changing from month to month. In particular, the trimmed mean excludes the percent changes in price that rank among the smallest or the largest (in numerical terms) changes for the month.

These extreme price movements could reflect:

- Seasonality patterns - e.g. substantial changes in prices of vegetables and rootcrops due to changes in weather conditions.
- Policy changes - structural and/or policy changes implemented by government, e.g. changes in import duty and the re-implementation of VAT.

The rationale for the underlying inflation is calculated using a statistical tool called trimmed mean. The selection of trimmed mean depends on the magnitude of extreme price movements. Generally, a higher trim mean size is selected if the CPI is often subjected to extreme price movements, while a smaller value of trim mean is selected if the CPI is subjected to fewer extreme price movements.

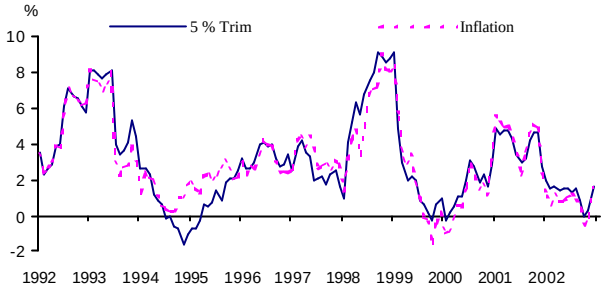
5.2(1) Results – Trimmed Mean

5 Percent Trimmed Mean (TM5)

The 5 percent trimmed mean excludes 5 percent of the extreme right-hand and left-hand side of the price distribution. Looking at Figure 3, it can be noted that this trim measure, more or less mirrors the movement in the headline rate.[14]

[14] A more robust analysis is conducted in section 6.0 of the paper.

FIGURE 3
TM 5 and CPI



Source: Reserve Bank of Fiji & Fiji Islands Bureau of Statistics

Moreover in December 2002, this measure had a year-on-year inflation rate of 1.6 percent, which is exactly the same as the headline rate, indicating that may be this level of trim is insufficient.[15] As such, the extraction of the volatile items appears to have added little, in terms of providing useful policy making information.

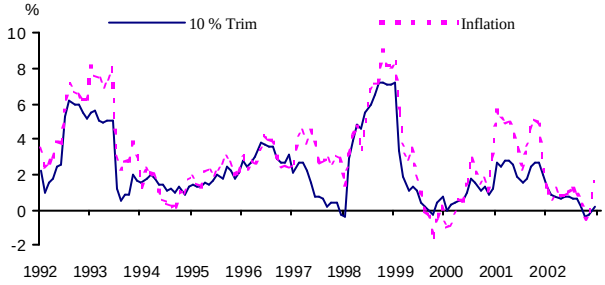
10 Percent Trimmed Mean (TM10)

Under a 10 percent trim, 80 percent of the CPI basket is retained, with 20 percent of the extreme outliers excluded in the calculation of the index. With the exclusion of the extreme movements, the end result is a slightly smoother rate of change in inflation. While the general tracking of the headline rate remains, the rigidities in price movements are less obvious, giving a better indication of trend or persistent inflation. At the same time, it appears as though all of the broad-based movements are

[15] Note that the headline inflat ion rate rose from –0.1 percent in November, as a result of higher prices of vegetables of rootcrops due to seasonal factors. Thus, it suggests that a 5 percent trim was not sufficient.

captured by the measure. This includes, changes in the tax system, such as the re-implementation of VAT. Of particular reference, is the 1998 devaluation, which is indicated by the significant spike in that year (see Figure 4). The spike is only moderately reduced under the 10 percent trim, suggesting that most of the relevant information contained in the price movements for the period have not been removed by the trim. Hence the underlying price pressure, or the persistent factors affecting inflation are still captured.

FIGURE 4
TM 10 and CPI



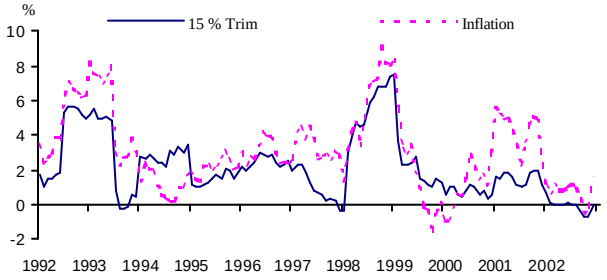
Source: Reserve Bank of Fiji & Fiji Islands Bureau of Statistics

15 Percent Trimmed Mean (TM15)

The 15 percent trim is the current measure used by the Reserve Bank of Fiji to estimate core inflation. This trim sizably reduces the severe fluctuations that are evident under the headline rate of inflation, both in upward price movements, and downward movements. For instance as at December 2002, trim mean inflation was negligible at 0.03 percent, while headline inflation was 1.6 percent (see Figure 5). The differential adjusts

for seasonal prise pressures felt in December, as consumer spending rises. However, more often than not, these pressures fail to persist beyond that period. Also, when compared to the 10 percent trim, the 15 percent trim further reduces the volatility. In reference to the 1998 devaluation, the price rigidities appear to be moderated whilst capturing the broader movement in prices. At the same time, the trend movement of inflation under the 15 percent trim is generally consistent with the headline inflation. In other words, if the headline rate is falling, then generally, so will the trim mean measure.

FIGURE 5
TM 15 and CPI



Source: Reserve Bank of Fiji & Fiji Islands Bureau of Statistics

However, it should be noted that there had been instances in the past when these two measures were not positively correlated. For example, during the January - March 2000 period, the removal of VAT from basic food items in January 2000, caused headline inflation to be negative. At the same time, the trimmed mean measure of inflation was still positive. Deviation in the two measures occurred because in the calculation of the

trimmed mean inflation rate, this extreme negative price movement was excluded, while it was included in the headline inflation figures.

It is important to remember, that in attempting to determine the trend movement in prices, the overall aim is to identify that proportion of inflation, which monetary policy can have an effect on, especially over the longer term. Hence, the trim should be sufficiently adequate to remove one-off shocks, changes in government policy and external imbalances which trigger severe swings or fluctuations in prices. However, at the same time it should not be too excessively large that it eliminates crucial information. [16]

5.3 Weighted Median CPI (WA)

This estimation of underlying inflation groups items in the middle of the total distribution and uses all components of the CPI series to calculate a median rate of change for each month. The weighted median is the mean of the price indices of the CPI components (considering the weights of the components in the private consumer's spending), with an equal weighted number of items on each side of it.

In calculating the weighted median, the monthly price changes for the items are ranked from smallest to largest. Listed next to the price changes are the respective weights of the items in the CPI. When the collective weight reaches 50 percent, the corresponding change in price represents the weighted median inflation rate.

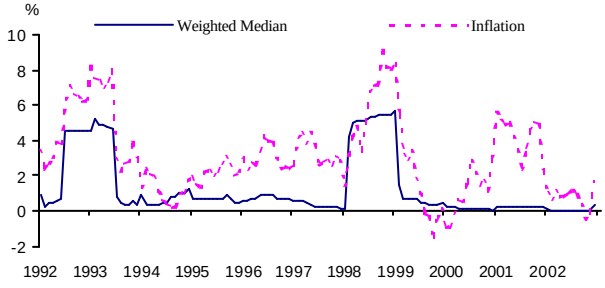
[16] Refer to Appendix 2A for illustration on 20 percent Trim Mean and headline inflation.

The weighted median is an order statistic defined as the 50th percentile of the weighted cross-sectional distribution of the price changes. As an order statistic, the weighted median is generally regarded as a more robust measure of the tendency of the individual price changes that make up the distribution.

However, in Fiji, this measure is not heavily relied upon, as it produces extremely low inflation rates. A lot of items in the CPI basket are under direct price control from the Prices & Incomes Board. As such, there are a lot of items that have zero price movements during certain months. Collectively, around 54 percent of the items in the CPI basket are under price regulation.

This measure fails to accurately estimate underlying price pressures in the domestic economy, mainly due to the fact that these price-controlled items tend to fall at the centre of the total price distribution. As such, the weighted median rate of inflation tends to be nil more often than not, especially in recent years. This is clearly illustrated in Figure 6.

FIGURE 6
WA and CPI



Source: Reserve Bank of Fiji & Fiji Islands Bureau of Statistics

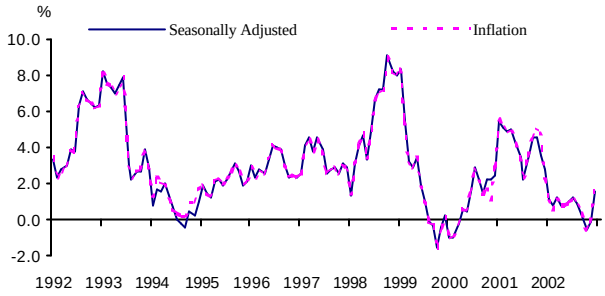
5.4 Seasonally-Adjusted Inflation (SAT)

The Fiji Islands Bureau of Statistics publishes an additional measure to the CPI inflation rate, the seasonally adjusted inflation rate. Seasonal adjustment removes the effects of recurring seasonal influences from many economic series, including consumer prices. The adjustment process quantifies seasonal patterns and then factors them out of the series to permit analysis of non-seasonal price movements. Changing climatic conditions, production cycles, model changeovers, and holidays can all cause seasonal variation in prices. The seasonal movements of the all-items index are derived by aggregating seasonally adjusted component indices. This method is generally preferred by economic policymakers as it eliminates the effects of changes that normally occur around the same time and in about the same magnitude every year.

Fiji's measure however, as the graph indicates (Figure 7) is not quite so robust, especially as an indicator of underlying inflation. The exclusion of seasonal elements, has added little in terms of useful information that could not have been obtained from the headline rate. There have only been a few instances in the past, where the seasonally adjusted rate has deviated from the headline rate.[17]

[17] For this reason, both graphs overlap each other.

FIGURE 7
SAT and CPI



Source: Reserve Bank of Fiji & Fiji Islands Bureau of Statistics

5.5 Underlying Inflation By Smoothening

Hodrick-Prescott Filter (HPT)

This is a smoothing method that is widely used among economists to obtain a level estimate of the long-term trend component of a series. The method was first used in a working paper (circulated in the early 1980's and published in 1997) by Hodrick and Prescott to analyse postwar U.S. business cycles. In this case, it was used to determine the underlying trend movement in prices. It works as a smoothening of the headline inflation rate.

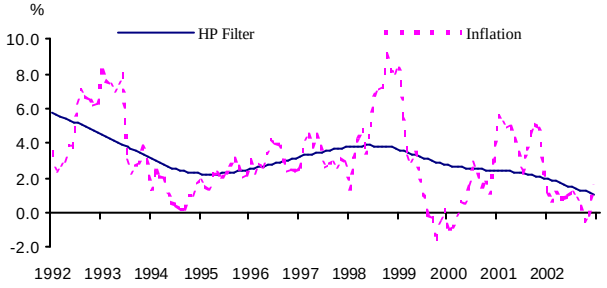
Technically, the Hodrick-Prescott (HP) filter is a two-sided linear filter that computes the smoothed series "s" by minimising the variance around "s", subject to a penalty that constrains the second difference of s. That is, the HP filter chooses to minimise:

$$\sum_{t=1}^{T} (y_t - s_t)^2 + l \sum_{t=2}^{T-1} ((s_{t+1} - s_t)(s_t - s_{t-1}))^2 \quad \text{.....(1)}$$

The Hodrick-Prescott filter is designed to pick up trend components that, while maintaining smoothness, tracks actual values from the time-series data. The l in the equation is a parameter that determines the smoothness.

Figure 9 illustrates this smoothing effect as it tracks the headline rate.

FIGURE 9
HPT and CPI



Source: Reserve Bank of Fiji & Fiji Islands Bureau of Statistics

Over the longer-term, the core inflation rate is expected to converge with the headline rate, barring any shocks or "noise" that may be prevalent in the headline CPI. However, the HP Trend filter is a statistical technique which estimates the core inflation rate based on backseries data and produces a trend line on the end points. Thus, it could prove rather inappropriate to employ the HP Trend as an official measure of underlying inflation, as it lacks credibility (evident from Figure 9). Moreover, the

trend line will be different after the inclusion of new data, i.e. as new monthly CPI figures are added the end point values will differ and that will tend to skew the trend line in a different direction, even for past periods.

5.0 Descriptive Statistics of the Measures of underlying inflation for Fiji, 1991 – 2002

A. Definitions of alternative measures of underlying inflation.

The inflation measures reported in this paper are defined as follows:

CPI: The all-items measure of the Consumer Price Index, as published by the Fiji Islands Bureau of Statistics.

CPIX1 CPI excluding credit service charges (principally mortgage interest and bank charges), vegetables, rootcrops & yaqona, and service and spare parts (which contains fuel prices).

CPIX2 CPI excluding items for which prices are volatile. This includes: vegetables and rootcrops, yaqona, wheat products, cereals, preserved fruits, fruit juice, dairy products and spices, service and spare parts (which contains fuel prices).

TM5 The 5% trimmed mean, calculated from CPI, excluding the top 5% and bottom 5% (by weight in the CPI regimen) of sub-component price changes in month.

TM10 The 10% trimmed mean, calculated from CPI, excluding the top 10% and bottom 10% (by weight in the CPI regimen) of sub-component price changes in month.

TM15 The 15% trimmed mean, calculated from CPI, excluding the top 15% and bottom 15% (by weight in the CPI regimen) of sub-component price changes in month.

WA The weighted median, calculated as the (regimen-weighted) 50^{th} percentile price change in CPI in each month, with weights defined.

SAT The seasonally adjusted series, as calculated by the Fiji Islands Bureau of Statistics.

HPT Hodrick-Prescott technique of smoothing applied to CPI with alpha set (smoothing parameter) at 14400.

Before evaluating the alternative measures of underlying inflation, it is useful to consider the nature of the data involved. The measures of the distribution of consumer prices reported in this paper are derived from the Consumer Price Index Monthly Release, which is compiled by the Fiji Islands Bureau of Statistics. The sample period was from January 1991 to December 2002.

The distribution of the CPI sub-component price movements in a given period can be described by the moments of the distribution. The first four moments are more commonly known as the mean, variance, skewness

and kurtosis of the distribution. These four moments are listed in Table 1 for all the different measures of underlying inflation.

Table: 1 Frequency Distribution of Core Measures
Descriptive Statistics

Core Measure	CPI	CPIX1	CPIX2	HPT	SAT	TM5	TM10	TM15	WA
Mean	3.34	3.77	3.43	3.34	3.33	3.34	2.41	2.22	1.29
Median	2.75	3.00	2.80	3.00	2.90	2.85	1.90	1.90	0.60
Maximum	9.10	10.00	9.10	7.10	9.20	9.10	7.20	7.50	5.70
Minimum	-1.50	-0.60	-0.90	1.10	-1.50	-1.70	-0.40	-0.70	0.00
Std Dev	2.48	2.61	2.41	1.34	2.45	2.56	1.89	1.81	1.72
Skewness	0.51	0.67	0.44	0.98	0.46	0.46	0.83	0.88	1.56
Kurtosis	2.43	2.29	2.15	3.42	2.46	2.43	2.87	3.36	3.82

From Table 1, it can be noted that not all the underlying measures have a mean monthly price change lower than the headline measure. In particular CPIX1 displayed the highest average. In terms of variability, the standard deviations for most of the underlying measures were below that of the headline rate. This is with the exception of CPIX1, TM5 and the SAT measures. All the underlying measures exhibited positive skewness. The skewness of the distribution represents the drift on either side of the mean. Positive skewness indicates that there were higher positive changes compared with negative changes. This also confirms the fact that prices are quite often downward rigid, i.e. the magnitudes of price increases are usually greater than the magnitude of price decreases.

The distribution of the price movements is also characterised by the kurtosis (or peakedness) of the distribution. Kurtosis indicates the degree of dispersion in prices around the mean. If most price movements are close

to the mean, then the kurtosis will be high. In other words the monthly price changes were relatively close to the mean. The WA measure, HPT and the TM15 had excess kurtosis, exhibiting a leptokurtic distribution.

The correlation matrix (see Table 2) measures the relation between the different underlying measures and the headline CPI rate. The seasonally adjusted measure had a relatively higher correlation than the other measures. This is not unusual as there were seldom any disturbances between the seasonally adjusted measure and the headline rate. Observing the correlation gives the users an idea of how close a relationship the core measure has with the headline rate.

If the relationship is too close, the core measure maybe capturing more than just the persistent or underlying movement in prices. In other words, it might be capturing the 'transitory effects' prevalent in the headline CPI. However, it is highly desirable for the core measure to reflect cost-of-living developments over the long-run. As such, the headline and core measure should have a positive correlation which indicates some sort of long-term behaviour. WA had the lowest correlation with the headline rate, followed by TM15.

Table 2: Correlation Matrix

Core Measure	CPI	CPIX1	CPIX2	HPT	SAT	TM5	TM10	TM15	WA
CPI	1.00	0.87	0.89	0.84	0.99	0.95	0.91	0.76	0.75
CPIX1		1.00	0.94	0.70	0.86	0.84	0.87	0.73	0.71
CPIX2			1.00	0.55	0.87	0.87	0.93	0.81	0.76
HPT				1.00	0.65	0.62	0.54	0.46	0.46
SAT					1.00	0.94	0.89	0.74	0.73
TM5						1.00	0.90	0.74	0.77
TM10							1.00	0.92	0.87
TM15								1.00	0.90
WA									1.00

7.0 Evaluating Different Measures of Inflation

According to the core inflation literature, the procedure to select the appropriate indicator of the core inflation still remains a challenging question (Figueiredo and Staub 2002). As discussed, Roger (1998) suggested that a good measure of core inflation should satisfy four properties: timeliness, robustness, unbiasedness and verifiability. Furthermore, Wynne (1999) added to this list the following conditions: forward looking in nature, has a theoretical basis and easily understood by the public.

Marques *et al.* (2000) assert that the above conditions are vague and a little selective despite being important. Some conditions seem to be just pre-requisites. In order to overcome these questions, some authors evaluate core inflation indicators by means of some statistical properties. The evaluation process in this paper is primarily based on the suggestions made

by authors mentioned above, with particular emphasis given to Marques *et al.* (2000) criterion for evaluation.

A basic test is to verify if the core inflation indicator shows lower variability than the headline index. Intuitively, a measure of core inflation should be less volatile than the headline inflation, because this statistic seeks to retain only lasting movements in prices excluding transitory effects. According to the standard deviations in Table 3, the measures exhibiting the lowest variability are the HP-Trend, followed by the weighted median and the 15 percent trimmed mean.

Table 3: Measure of Variability - 1990 – 2002 (Monthly CPI)

Core Inflation Measure	Standard Deviation (s)
CPI	2.48
CPIX1	2.62
CPIX2	2.41
TM5	2.56
TM10	1.89
TM15	1.81
WA	1.72
SAT	2.45
HPT	1.34

Simply evaluating the measures on variability grounds, leads us to believe that HP trend rate of inflation, provides the most consistent measure of the underlying price pressures in the economy. However, in comparison with the headline CPI inflation rate, most of the other measures of underlying inflation exhibit lower variability as well, and at the same time,

they are more revealing in terms of which components of the CPI are the main contributors of the underlying price movements. As such, this criterion should mainly serve as an initial assessment for a measure of underlying inflation. The following exposes the various measures of underlying inflation to a more robust evaluative criterion.

In order to systemise a set of required properties, Marques *et at.* (2000) introduced statistical conditions that have to be met by any core inflation indicator. In the discussions that follow, we implicitly assume that any candidate to be a core inflation measure meets the prerequisites of being timely and computable once and for all. The attraction of the statistical conditions is that they attempt to formalise the relationship between the headline inflation rate and the core inflation by exploiting information contained in the differential of the two. The conditions essentially imply that the headline rate of inflation should converge to core inflation in the long run but not *vice versa*.

Condition 1

The first condition is the existence of a stable long-run relationship between the core measure and headline inflation. For any given period t, the inflation rate π_t is broken down into the sum of two components: a permanent component, named trend (core) inflation π^*_t; and a temporary component represented by μ_t. By definition, in each period of time:

$$p_t = p_t^* + m_t \qquad \text{……..(1)}$$

In equation 1 it is assumed that temporary disturbances in the inflation rate, μ_t, are caused by developments such as changes in weather conditions, disturbances in the demand and supply of goods, etc. By definition μ_t is expected to be random with a zero mean and finite variance, as positive shocks are offset by the negative ones. In other words μ_t is a stationary series.

To evaluate whether the core inflation measures are cointegrated with headline inflation, they were first tested, along with headline CPI for stationarity. This was accomplished via the Augmented Dickey-Fuller (ADF) unit root test.

Table 4: Unit Root Test

Core Inflation Measure	Augmented Dickey-Fuller Test I(0)
CPI	-2.91*
CPIX1	-2.99*
CPIX2	-3.57**
TM5	-3.25*
TM10	-3.23*
TM15	-3.00*
WA	-3.05*
SAT	-2.90*
HPT	-3.53**

Notes: **(*) denotes significance at the one (five) percent levels. The critical values for the Augmented Dickey-Fuller tests are – 3.4783 and - 2.8822 at one and five percent respectively.

From the above results, it can be seen that for all the above measures, we can reject the null hypothesis of a unit root, at the significance level of 5

percent. This suggests that the core inflation measures are integrated at the level of *I(0)*.

The next step is to test for cointegration of the core measures with headline CPI. For this purpose, the Engle-Granger (1987) residual-based test procedure was used. It is essentially a unit root test of the residuals from the regression where π_t and π^* are headline and core inflation respectively:

$$p_t = a + bp_t^* + v_t \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

The test result are summarised in Table 5. They show that the measures are cointegrated with headline inflation at the different significance levels. In addition, all measures have coefficients relatively close to unity, but the TM15 exhibits the closest relationship.

Table 5: Engle-Granger Cointegration Test Results

Core Inflation Measure	Coefficient β	ADF Test Statistic for Residual I(0)
CPIX1	0.82	-3.05**
CPIX2	0.91	-3.39**
TM5	0.92	-3.43**
TM10	1.19	-3.58*
TM15	1.04	-3.02**
WA	1.08	-3.07**
SAT	0.99	-4.12*
HPT	1.17	-3.53*

Notes: **(*) denotes significance at the five (one) percent levels. The critical values for the Augmented Dickey-Fuller tests are – 3.4783 and -2.8822 at one and five percent respectively.

The cointegration validates that $Z_t = \pi_t - \pi^*_t$ (which is the difference between the headline and the core) exhibits a zero mean. To put it simply, the impact of relative price movements on the headline inflation rate has a zero mean once all relative prices are adjusted. The unitary coefficient implies that that there is no display of a permanent divergence between the core inflation rate and the headline inflation rate. If this were not the case, it would suggest that core measure was not fully capturing some part of the trend rate of inflation.

Condition 2

Similar to $Z_t = \pi_t - \pi^*_t$ in Condition 1, if $Z_t = \pi_t - \beta\pi^*_t$ is stationary, but $\beta \neq 1$, then a permanent divergence between the core measure and the headline rate exists. In this case, π^*_t does not account for all the permanent component of π_t. The net result shall correspond to either a faster (if $\beta<1$) or slower (if $\beta>1$) systematic growth of π^*_t vis-à-vis π_t and therefore the two variables will tend to drift apart.

There is an error correction mechanism given by $Z_t = (\pi_{t-1} - \pi^*_{t-1})$ for $\Delta\pi_t$, i.e. $\Delta\pi_t$ may be written as:

$$\Delta p_t = \sum_{j=1}^{m} a_j \Delta p_{t-j} + \sum_{j=1}^{n} b_j \Delta p^*_{t-j} - g(p_{t-1} - p^*_{t-1}) + e_t \quad \ldots\ldots\ldots(3)$$

Effectively Condition 2 formalises the assumption that the headline inflation rate converges to core inflation in the long run, or to use Marques et al's (2000) terminology, core inflation should be an 'attractor' of the

headline rate. If the condition holds then, when π_t is above (below) π^*_t, π_t will at some point decrease (increase) to π^*_t.

Table 6: Results of Condition2 g = 0

Variable	*With Constant*	*Without Constant*
CPIX1	-2.247**	-2.556**
CPIX2	-2.460**	-2.412**
TM5	-1.165	-1.166
TM10	-2.985**	-3.597**
TM15	-2.446**	-2.659**
WA	-2.701**	-3.840**
SAT	-2.153*	-2.122*
HPT	-3.846**	-3.829**

Notes: **(*) denotes significance at the one (five) percent levels. Critical values : P(t<-2.326) = 0.01- P(t<-1.645) = 0.05 ;

Table 6 presents the results of the test for condition 2. The test was carried out by estimating equation (2) (both with and without a constant term) and testing whether the null hypothesis of $\gamma = 0$ was rejected. This was a simple t-test. With the exception of the TM5, all other measures of "underlying" inflation rejected the null of $\gamma = 0$, at the 5 percent significance level. Thus, it can be concluded that with the exception of the 5% trimmed mean, all other indicators meet condition 2: *core inflation should be an attractor of the headline rate.*

Note that Condition 2 also includes as a special case, the requirement of the Granger causality. In particular, this condition requires that π^*_t Granger causes π_t i.e., that π^*_t is a leading indicator of π_t.

Table: 7 Index	Null Hypothesis	F Statistic
CPIX1	CPIX1 does not Granger cause CPI	4.24*
CPIX2	CPIX2 does not Granger cause CPI	2.11
TM5	TM5 does not Granger cause CPI	2.67
TM10	TM10 does not Granger cause CPI	4.19*
TM15	TM15 does not Granger cause CPI	3.86*
WA	WA does not Granger cause CPI	4.82*
SAT	SAT does not Granger cause CPI	1.58
HPT	HPT does not Granger cause CPI	4.30*

Note: * Null Hypothesis rejected for five percent level of significance

Looking at the results of the granger causality test, the core measures satisfying this causal relationship include TM10, TM15, WA, CPIX1 and HPT. This test exhibits that at a 5 percent level of significance that these core measures act as an "attractor" for the headline rate.

Condition 3

This condition aims to prevent that condition 2 does not occur the other way around, i.e. that π_t is not an attractor for π^*_t and also that π^*_t is not sensitive to observed outliers in π_t. Otherwise it will be difficult, if not impossible, to anticipate the future path of inflation by looking at π^*_t. The fact, for instance, that in a given period π^*_t is above π_t, allow us to anticipate the future path of π_t only if π^*_t is not a function of π_t. By

requiring strong erogeneity of π^*_t this condition implies simultaneously that the error correction term does not appear in the equation for π^*_t (i.e., that π^*_t is weekly exogenous for the parameters of the cointegration vector) and also that π_t does not Granger cause π^*_t. In other words condition 3 implies that in the error correction model for $\pi^*_{t:}$ is:

$$\Delta p^*_t = \sum_{j=1}^{r} d_j \Delta p^*_{t-j} + \sum_{j=1}^{s} q_j \Delta p_{t-1} - l(p^*_{t-1} - p_{t-1}) + h_t \quad \text{.....(4)}$$

The results of this test are listed in Table 8. This causality test is quite defining in terms of assessing whether the headline measure of inflation is actually an "attractor" for the core measure. Only the TM15 and CPIX2 satisfied this criterion. All the other measures failed the test, which tends to imply that they share a convergence to headline inflation. This makes it extremely difficult to infer anything about the future path of headline inflation by looking at the core, simply because the relationship runs both ways.

Table 8: Granger – Causality Test Results

Index	Null Hypothesis	F Statistic
CPIX1	CPI does not Granger cause CPIX1	1.37
CPIX2	CPI does not Granger cause CPIX2	0.03*
TM5	CPI does not Granger cause TM5	0.20
TM10	CPI does not Granger cause TM10	1.60
TM15	CPI does not Granger cause TM15	0.00*
WA	CPI does not Granger cause WA	0.41
SAT	CPI does not Granger cause SAT	7.02
HPT	CPI does not Granger cause HPT	0.09

Note: * Hypothesis accepted at 95 percent level of significance. Lag of 1 year

8.0 Recommendations

Part of the aim of this paper was to introduce testable conditions for a core inflation indicator, and to use these conditions to evaluate the trend inflation indicators calculated by the RBF. The key results for the above range of trend inflation measures are listed in Table 8.1. Only one measure passed all three tests: TM15.[18] It is important to note here, that these conditions essentially imply that the core inflation causes the headline rate of inflation to converge in the long-run. This basically proves that the core measure is fully capturing the trend rate of inflation, and that headline

[18] Note the 20 percent Trim Mean (TM20) does not satisfy all relevant conditions. Refer to Appendix 2B for details.

inflation is moving 'one for one' with core inflation after relative prices have been adjusted.

Table 9: **Core Inflation Measure**	**Condition 1**	**Condition 2**	**Condition 3**
CPIX1	√	√	×
CPIX2	√	×	√
TM5	√	×	×
TM10	√	√	×
TM15	√	√	√
WA	√	√	×
SAT	√	×	×
HPT	√	√	×

Note: Tick indicates the passing of the measure at significance level of five percent

The current underlying measure used by the RBF is the TM15. In addition to passing these statistical conditions, it arguably satisfies the other four properties: timeliness, robustness, unbiasedness and verifiability. One slight drawback of the measure is its complexity. It has been argued that with its relative complexity, verifiability maybe an issue, especially when communicating to the public about the measure. However, the measure has been used in Fiji, for over three years now, and the public has been made aware of the measure through various RBF publications. As such, given its qualitative properties as a core measure, the adoption of TM15 has its merits.

9.0 Conclusion

Core inflation measures are generally intended to identify the underlying trend inflation from monthly CPI figures that often include unusual price changes in some components. Most central banks compute various core inflation measures on a regular basis. By looking at the core inflation measures, central banks prevent themselves from being misguided by effects of temporary shocks on the evolution of the CPI.

The purpose of identifying the underlying inflation rate is to categorise that part of the headline rate that the RBF wants to exert significant influence on. It is that component of the headline rate that is not influenced by supply shocks or changes in tax regimes, or any other one-off price shocks. More often than not, monetary policy does not have any effect on the noise surrounding the core. However, much harm can be done to the economy, if the central bank reacts to these temporary price shocks.

From the nine core measures, the TM15 was the only measure which satisfied all the relevant criterion suggested by Marques *et al* (2000). Moreover, the TM15 also satisfied the other essential criteria of timeliness, robustness, credible and verifiable. Thus, it is recommended that the RBF continue to use the TM15 as the official measure of underlying inflation.

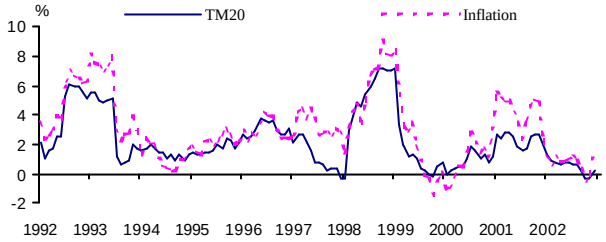
Appendix 1

Table 1: Official Measures of Core Inflation in some Inflation Targeting Countries

Country	Target Price Index
Canada	Core CPI (excl. food, energy and indirect taxes)
New Zealand	Headline CPI (since 1999, headline CPI excludes interest charges; prior to then, targets were defined in terms of the headline CPI less interest charges and other first round effect prices)
South Africa	Core CPI (excl. Interest costs)
Thailand	Core CPI (excl. raw food and energy prices)
United Kingdom	RPIX (excl. mortgage interest)

Appendix 2A

FIGURE 1
TM20 and CPI



Source: Reserve Bank of Fiji & Fiji Islands Bureau of Statistics

Appendix 2B: Results of TM20

Table: 1 Frequency Distribution of Core Measures
Descriptive Statistics

Core Measure	CPI	TM20
Mean	3.34	2.41
Median	2.75	1.91
Maximum	9.10	7.23
Minimum	-1.50	-0.39
Std Dev	2.48	1.89
Skewness	0.51	0.84
Kurtosis	2.43	2.84

Table 2: Correlation Matrix

Core Measure	CPI	TM20
CPI	1.00	0.91
CPIX1		1.00
CPIX2		
HPT		
SAT		
TM5		
TM10		
TM15		
WA		

Table 3: Unit Root Test

Core Inflation Measure	Augmented Dickey-Fuller Test I(0)
CPI	-2.91*
TM20	-3.46*

Notes: **(*) denotes significance at the one (five) percent levels. The critical values for the Augmented Dickey-Fuller tests are – 3.4783 and - 2.8822 at one and five percent respectively.

Table 4: Engle-Granger Cointegration Test Results

Core Inflation Measure	Coefficient β	ADF Test Statistic for Residual I(0)
TM20	1.19	-3.59*

Notes: **(*) denotes significance at the five (one) percent levels. The critical values for the Augmented Dickey-Fuller tests are – 3.4783 and - 2.8822 at one and five percent respectively.

Table 5: Results of Condition2 $\gamma = 0$		
TM20	-3.59**	-2.97**
Notes: **(*) denotes significance at the one (five) percent levels. Critical values : P(t<-2.326) = 0.01- P(t<-1.645) = 0.05 ;		

Table: 6 Index	Null Hypothesis	F Statistic
TM20	TM20 does not Granger cause CPI	4.30*
Note: * Null Hypothesis rejected for five percent level of significance		

Table 7: Granger – Causality Test Results		
Index	**Null Hypothesis**	**F Statistic**
TN20	CPI does not Granger cause TM20	0.68
Note: * Hypothesis accepted at 95 percent level of significance. Lag of 1 year		

Table 8: Core Inflation Measure	Condition 1	Condition 2	Condition 3
TM20	√	√	×
Note: Tick indicates the passing of the measure at significance level of five percent			

References

Apel, A. & P. Fansson (1999). A Parametric Approach for Estimating Core Inflation and Interpreting the Inflation Process, *Sveriges Riksbank Working Paper* Series No. 80, Sveriges Riksbank

Bryan M., S. Checchetti and R. Wiggins (1997). Measuring Core Inflation, Monetary Policy, University of Chicago Press.

Clark. T. E. (2001). Comparing Measures of Core Inflation, Economic Review – Second Quarter 2001, Federal Reserve Bank of Kansas City

Dewan, E & S. Vakausausa (2003). Behaviour of Market Items, Information Paper, Reserve Bank of Fiji *(unpublished)*

Domestic Economy Division, (1998). Measures of Core Inflation for Singapore. – E31, Economics Department, Monetary Authority of Singapore.

Eckstein O. (1981). Core Inflation, Prentice – Hall, (Englewood Cliffs, N.J)

Figueiredo, F.M.R. & R. B. Staub (2002). Evaluation and Combination of Core Inflation Measures for Brazil, Central Bank of Brazil, Research Department.

Friedman, M. (1963). Inflation. Causes and Consequences, Asia Publishing House, New York, USA

Hogan, S., M. Johnson, and T. Lafleche (2001). *Core Inflation Technical No.89,* Research Dept, Bank of Canada

Johansen, S. (1995). Likelihood-based inference in cointegrated vector auto-regressive models, Oxford University Press

Lafleche, T. (1997). Statistical measures of the trend rate of inflation, *Bank of Canada Review,* Autumn

Mankikar, A. and J. Paisley (2002). What do measures of Core Inflation really tell us? Bank of England *Quarterly Bulletin*, Bank of England.

Mio, M. and M. Higo (1999). Underlying Inflation and the Distribution of the Price Change: Evidence from the Japanese Trimmed-Mean CPI, Institute of Research and Economic Studies, Bank of Japan

Morling, S. Hussein, S and E. Dewan (1999). Modelling *Inflation Processes in Fiji, Working Paper,* Reserve Bank of Fiji

Nessen, M. and U. Soderstrom (2000). Core Inflation and Monetary Policy, Sveriges Riksbank *Working Paper Series No. 110,* Sveriges Riksbank

Roger, S. (1995). Measures of Underlying Inflation in New Zealand, 1981-95 *Discussion Paper G95/6,* Reserve Bank of New Zealand

Roger, S. (1998). Core Inflation: Concepts, Uses and Measurement, *Occasional Papers No. 24,* South East Asian Central Banks (SEACEN)

Roger, S. (2000). Relative Prices, Inflation and Core Inflation, *IMF Working Paper WP/00/58,* International Monetary Fund

Smith, J. K. (2002). Weighted Median Inflation: *Is this Core Inflation? Research Paper* – Department of Economics, Trinity University

Taylor, J. B. (2000). Remarks for the Panel Discussion in "Recent Changes in Trend and Cycle", Stanford University

Wynnes M. A. (1999). Core Inflation: a review of some conceptual issues, *Working Paper No. 5* European Central Bank