Relative price variability: Which components of the consumer price index contribute towards its variability?

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Abstract

This paper follows work by Choi, Kim and O'Sullivan (2011), but deviates from their analysis by looking at the relative price variability (RPV) of selected components of the consumer price index (CPI) rather than an aggregate measure. The purpose of this work is to analyse which components are more variable and to see if there has been a change in the RPV (i.e., mean and distribution) since the adoption of inflation targeting (IT) in South Africa. A semi-parametric methodology has been used, and the RPV of components pre-IT and during the IT era were considered to see if the relationship of RPV components produces results similar to those presented for aggregate headline CPI for South Africa in Choi et al. (2011). The results suggest that in most cases, the components of the CPI have experienced decreased mean inflation rates and narrower distributions during the IT period with the changes in the mean and distribution of RPV decreasing and narrowing in most cases. Furthermore, the nature of the relationship of the RPV of the components with inflation seems to fit a quadratic specification well, with a minimum relative price variability at a positive rate of inflation. These results are found to be fairly robust during the period tested.

JEL classification: E31, E52

Keywords: deviation, inflation targeting (IT), relative price variability (RPV)

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Abbreviations

CPI	consumer price index
IT	inflation targeting
RPV	relative price variability

1. Introduction

It has long been acknowledged that high inflation can be destabilising for an economy. One mechanism through which this works is the effect of inflation on relative prices and the effect of relative prices on inflation. Empirical literature suggests that the relationship between relative price variability (RPV) and inflation is either positively linear or U-shaped. A linear relationship is based on the belief that the least distortionary level of inflation is zero and that any rate of inflation greater than zero leads to greater RPV (the consequences of a negative relationship is not considered). A U-shaped relationship on the other hand suggests that people have aversion to both high inflation and deflation and as a result RPV is minimised at a low positive rate of inflation, with distortions increasing the further from this point that inflation goes in either direction. Both functional forms hold implications for how monetary authorities affect RPV through changing the inflation rate. A linear positive relationship between RPV and inflation rate suggests that monetary policy authorities that embark on a disinflationary process would lower RPV through reducing inflation. In contrast, the U-shaped relationship suggests that there is a value of the inflation rate that minimises RPV. This implies that it is only worthwhile reducing inflation to the minimisation or threshold point. RPV falls as the inflation rate converges to the threshold (minimisation point) from either above or below. For high inflation goods, where the RPV is positively correlated with inflation, which exceeds the threshold, this suggests that monetary authorities can improve welfare through disinflationary policies that would lead to lower RPV. However, for those low inflation goods below the threshold, a disinflationary monetary policy would not necessarily improve the welfare if the relationship is U-shaped. The U-shaped relationship implies the marginal effect of inflation on RPV varies with individual inflation rates[1].

Apart from the debate over the potential shape of the relationship between inflation and RPV, theory is unable to clarify if the optimal inflation rate, when trying to minimise distortions with respect to RPV, is zero or some positive, non-zero level. Two primary arguments in this matter are the grease argument put forward by Rotemberg (1996) and the sand theory put forward by Lucas and Barro. According to the grease argument the optimal inflation rate is non-zero. In contrast, the sand theory suggests that the optimal inflation rate is zero. By minimising money illusion and price uncertainty, and ensuring the most efficient wage- and price-setting behaviour, this inflation rate leads to the lowest RPV.

Choi, Kim and O'Sullivan (2011) set out to investigate the functional form of the relationship between inflation and RPV at the aggregate level for a number of economies with an emphasis on the effect of the adoption of inflation targeting (IT) on this relationship. They found a U-shaped relationship between inflation and RPV for a number of the economies, including South Africa. This paper builds on the work done by Choi et al. (2011), by looking at the relationships of selected components of the CPI with overall inflation to see if the pattern observed at the aggregate level exists for all components or only for some. It further investigates if the adoption of IT has led to any changes in these relationships. This paper does not disaggregate RPV in the spirit of Domberger (1987), but rather aims to look at the relationships underlying the results for South Africa reported in Choi et al*.* (2011).

Semi-parametric regression methods are employed for this analysis. The results based on the whole sample period conclude that the relationship between inflation and RPV is U-shaped with minimisation points around non-zero and zero inflation rates. We tested for functional forms between pre- and post-IT periods using non-parametric equations. The analysis found, at most, no functional relationship between RPV and inflation rate in the pre-IT period. However, in the post-IT period we find a positive U-shape in most cases, with RPV minimised around a positive inflation rate and in a few cases around a zero inflation rate. This U-shape suggests monetary authorities can improve welfare through disinflationary policies that lower RPV up to these threshold points but there may be no improvement in the welfare when the inflation rate is below the threshold value.[2]

The rest of this paper considers this more explicitly: section 2 sets out the theoretical framework for this paper, section 3 presents a brief literature review, section 4 looks at the data used for the study, section 5 provides a descriptive analysis of the data,

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[1] U-shaped relationships suggest that RPV dips with increasing levels of inflation initially but rises as when inflation rises past a certain threshold (Choi 2010).
[2] This implies that RPV is minimised when inflation is reduced to these points.

section 6 presents the econometric analysis considering the methodology and results and section 7 offers a conclusion.

2. Theoretical framework

This field of study is concerned with the effect that individual price changes will have on relative prices and the resulting consumer mix that is chosen. A further debate also surrounds the issue of which level of inflation is best for economic welfare- zero or a low, positive rate of inflation. Rotemberg's (1996) grease argument implies that in an inflationary environment the actual price set by firms can fall short of the desired price levels,[3] which may result in higher average output, lower mark-ups and higher social welfare. Lucas and Barro's sand theory suggests that zero inflation minimises money illusion and price uncertainty. This ensures the most efficient wage and price-setting behaviour, leading to the lowest RPV. As a result of fewer confusing signals, the true prices of commodities are observed resulting in consumers being able to maximise their welfare. In this case, positive inflation is perceived to be the sand in the wheels of efficient welfare allocation.

A further concern is the confusion that arises among consumers and produces when prices change as to whether these changes are a reflection of inflationary pressures or merely a singular relative price change. For example, individual price increases could lead to increased relative prices against those goods and services that have had no price changes.[4] This would require that consumers alter their consumption mix. Given the argument thus far, it could be concluded that a decrease in individual prices could equivalently lead to an increase in utility/welfare. This might not be the case though if the variability is somehow tied to misperceptions about the state of the economy. From the consumer's point of view, if a change in the price of a number of items in the consumer mix is viewed to be inflationary (when in fact it is not), then a consumer might end up purchasing a mix of goods and services that are at a non-optimising level. This could also be the case if inflation is perceived as relative price changes.

[3] Under a costless adjustment assumption, when firms change prices, it will be toward a desired price level.

[4] And indeterminate relative price changes if prices move in the same direction.

Similarly, from the production side, a firm that views a price increase in its product as being inflationary might alter its production mix differently from when it were an increase in its product price relative to other goods (perhaps due to increased demand). Therefore, if the firm incorrectly identifies the process leading to the increased price, it might alter its output incorrectly, which would lead to the firm producing at a non-profit-maximising level (Bleijer and Leiderman, 1982). A further reason given by Bleijer and Leiderman as to why RPV should ideally be minimised are that high RPV will decrease the value of prices as signals and will shorten contract times (and therefore increase contracting costs).

Fischer (1981) presents a useful summary of the types of relationships between inflation and RPV that have been presented and tested in the literature. He first suggests that the literature on the relationship between RPV and inflation falls into two broad categories of theories, in one category either RPV or inflation are determined exogenously results in the other given hypothesised market behaviour, the other theory illustrates how exogenous factors in the economy cause either or both inflation and RPV. These theories can then be further disaggregated into six sub-categories. The first category looks at models with rational expectations, market clearing and misperceptions such that unexpected changes in the price level will lead to higher RPV. All of this is powered by an unexpected change in the money supply, as much policy-making is based more on interest rates than on money supply. However, it is likely that unanticipated interest rate changes would have a similar effect. The next model is based on a menu cost approach, in which inflation is assumed to be exogenous. Owing to staggered price setting, not all prices change to ensure that relative prices remain the same at the same time leading to an increase in relative prices. In this model increasing and decreasing inflation can lead to increased RPV. The next relationship is based on the assumption that RPV is exogenous as prices are sticky downwards, thus when there is excess demand for goods and services, prices can increase, but when there is excess supply, prices do not decrease. In this case, high price variability leads to higher inflation. Next, Fischer describes models in which shocks in the economy affect many aspects of the economy including inflation and RPV. In this case shocks to the economy can affect both inflation and RPV, although due to various factors the speed of reaction of these two variables to the shocks may be different. For example, if the shocks cause a shift in demand from one good to another, the changes in the prices of the two goods are not necessarily going to be proportional to the change in demand due to different price elasticities of those two goods. Another set of models observed are those in which macroeconomic policy results in increased inflation and increased RPV. The mechanism here is such that a change in government spending will alter the composition of final demand and, hence, cause a change in the rate of inflation and relative prices. Finally, models in which macroeconomic policy is accommodating to moderate the effect of economic shocks on output, RPV and employment at the expense of low inflation is the last category of model outlined by Fischer. In this model it is expected that the monetary authority uses accommodating monetary policy to mitigate the effects of real shocks on real output that usually lead to increased RPV and unemployment. This policy stance is expected to lead to increased inflation.

3. Literature review

The motivation to study RPV is that it is the best available variable from which to infer the effect of price changes to individual goods and services (rather than general price level changes) on the welfare of the consumer, albeit an indirect measure (Fischer, 1981). Inflation is defined as a general price increase in the cost of living – thus the change in price of individual goods or services does not necessarily lead to an increase in inflation.[5] Prices of different goods and services have been found to exhibit different degrees of price stickiness in South Africa (Creamer and Rankin, 2007) which could then lead to increased RPV when the general price level rises or falls. It is this change in the relative prices that can lead to consumers having to change the proportion of income that is spent on these goods and services – potentially impacting negatively on the welfare of the consumer.

When tested empirically, there has been much support for a positive relationship between inflation and RPV (see Parks, 1978; Domberger, 1987), although tentative evidence of a U-shaped relationship did arise in Logue and Willet (1976). Vining and

Elwertowski (1976) found that the distribution of individual prices (in the consumer price index (CPI)) is not stable over time with a relationship between the distribution of prices and inflation emerging such that the distribution showed signs of skewness to the right during periods of rising inflation and skewness to the left during periods of decreasing inflation. This does suggest that the general price level, using CPI as an observed measure, could very well be influenced by the prices of individual components. This is further supported by the analysis conducted in Fischer (1981) where he finds that food and oil prices have a strong influence on the relationship between inflation and RPV.

The Choi et al*.* (2011) study dubs some of the countries in the sample 'high-inflation countries', and others 'low-inflation countries', some adopted IT during the period under review and some did not. This study finds that countries with initially high inflation experience a decrease in the mean of inflation, RPV and in their distributions. South Africa is included in the sample of countries that are high-inflation countries (before it adopted IT). The results suggested that, for South Africa, the adoption of IT led to a decrease in the mean and narrowing of the distribution of inflation and RPV. Furthermore, the paper found that the relationship between inflation and RPV in South Africa was U-shaped (before and after the adoption of IT, although the rate of inflation at which RPV is minimised falls in the post-adoption period).

There are also studies that have investigated the stability of the relationship between RPV and inflation. Dabus (2000) found that the relationship between inflation and RPV exhibits structural changes across different levels of inflation rates in Argentina. Caglayan and Filizetekin (2003) showed the association between RPV and inflation was nonlinear with respect to changes in inflation in Turkey. Choi et al. (2011) found a time varying nature of the relationship between RPV and inflation rate.

However the use of aggregated data comes with the risk that the degree of RPV can be understated (Danziger, 1987) which Parsley (1996) suggests can lead to conclusions that the relationship is weaker than it actually is. Parsley further argues that the observed variability may be due to product changes within the price indices

[5] Although Vining and Elwertowski (1976) do find, that in the case of the US, inflation can be caused

resulting in composition changes that may overestimate the effect of inflation on relative price variability. Another argument suggested by Parsley is that aggregation increases the simultaneity biases to an extent that unobserved variables may be drivers of both inflation and relative price variability. In the view of Caglayan and Filiztekin (2003), the relationship between inflation and RPV is important to enhance the understanding of the transmission mechanism of inflation, as well as the welfare costs of inflation and to explain the disparate responses to inflationary shocks in different markets.

4. The data

The data used in this paper comes from Statistics South Africa. It is the monthly data for the components and total CPI for historical metropolitan areas from January 1980 until December 2008 and the components and total CPI for primary urban areas from January 2009 until December 2011. We have effectively updated the sample used in Choi et al. (2011), but were unable to splice all the series due to the change in the composition of the CPI basket and the classification system used. A data appendix is provided (Annexure A) that details the series used and their composition. The series used account for over 74 per cent of the CPI for metropolitan areas and over 63 per cent for the CPI for primary urban areas. The data have been seasonally adjusted using the Census X12 method[6] (as in Choi et al., 2011) and the month-on-month log difference taken to calculate the monthly inflation rate and the price changes for the various components of the CPI.

The RPV variable in this case is calculated as the absolute value of the difference between the component price change $\left(p_{j,t}\right)$ and inflation $\left(\pi_t\right)$ as given in equation [1]:

$$RPV_{j,t} = \left|p_{j,t} - \pi_t\right| \qquad [1]$$

where $p_{j,t} = \ln P_{j,t} - \ln P_{j,t-1}$, with $P_{j,t}$ being the price index level of component *j* at time *t*, and inflation defined as the month-on-month log difference of the CPI level.

by extreme increases by few goods or services in the relevant inflation basket.

[6] This was only done for those series that were found to have seasonality present, of which 12 series did not.

This is a slight deviation from the normal calculation, due to the approach of this paper which looks at the relationship of the RPV of the components of the CPI with inflation, rather than a fully aggregated measure.[7]

5. Descriptive analysis

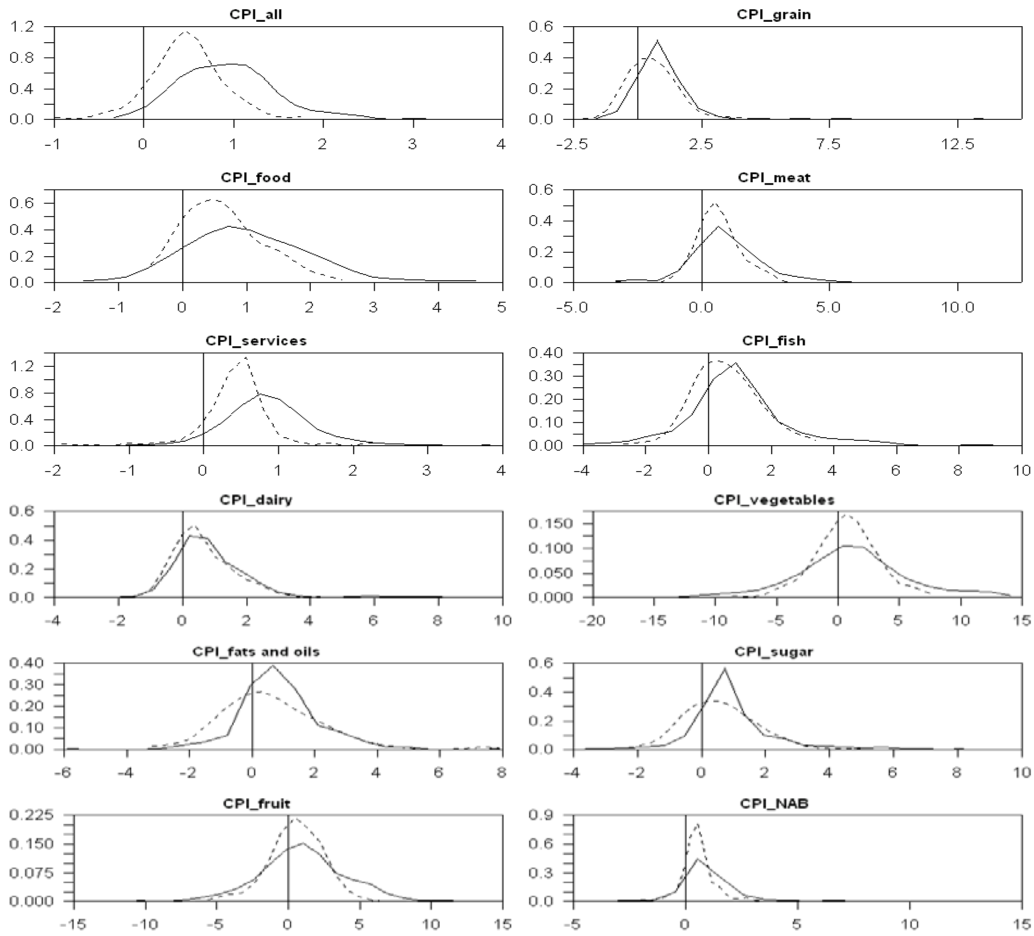
Table 1 Summary statistics for inflation and RPV

	Inflation				RPV			
	Pre-IT		Post-IT		Pre-IT		Post-IT	
	Mean	(Error)	Mean	(Error)	Mean	(Error)	Mean	(Error)
ALL	0.939	(0.545)	0.476	(0.405)				
COMMODITIES	0.969	(0.617)	0.506	(0.508)	0.290	(0.260)	0.225	(0.213)
SERVICES	0.891	(0.649)	0.434	(0.532)	0.420	(0.383)	0.280	(0.278)
FOOD	1.039	(0.991)	0.625	(0.620)	0.664	(0.556)	0.426	(0.369)
GRAIN	1.036	(1.488)	0.625	(1.102)	0.829	(1.213)	0.703	(0.706)
MEAT	1.097	(1.720)	0.664	(0.934)	1.028	(1.229)	0.603	(0.647)
FISH	0.944	(1.736)	0.546	(1.062)	1.231	(1.232)	0.849	(0.676)
DAIRY	0.972	(1.372)	0.652	(0.933)	0.886	(1.071)	0.665	(0.595)
FATS AND OILS	0.869	(1.391)	0.683	(1.754)	1.019	(0.999)	1.210	(1.169)
FRUIT	1.038	(3.058)	0.566	(2.070)	2.275	(2.006)	1.515	(1.431)
VEGETABLES	1.072	(4.728)	0.657	(2.588)	3.358	(3.180)	1.982	(1.706)
SUGAR	0.990	(1.534)	0.572	(1.183)	1.022	(1.157)	0.914	(0.746)
NON-ALCOHOLIC BEVERAGES	1.107	(1.670)	0.550	(0.772)	1.029	(1.384)	0.595	(0.575)
HOT BEVERAGES	0.945	(1.515)	0.502	(1.018)	1.084	(1.084)	0.733	(0.660)
ALCOHOLIC	1.002	(1.249)	0.617	(0.487)	0.786	(0.906)	0.473	(0.472)
TOBACCO	1.230	(1.528)	0.794	(0.907)	1.087	(1.132)	0.665	(0.782)
CLOTHING AND FOOTWEAR	0.766	(0.824)	-0.142	(0.667)	0.600	(0.582)	0.727	(0.625)
CLOTHING	0.760	(0.862)	-0.085	(0.744)	0.638	(0.586)	0.739	(0.636)
FOOTWEAR	0.801	(1.060)	-0.258	(0.890)	0.792	(0.724)	0.863	(0.842)
FUEL	0.871	(1.227)	0.931	(1.332)	0.780	(0.949)	0.790	(1.149)
FURNITURE AND APPLIANCES	0.754	(0.799)	0.165	(0.437)	0.528	(0.564)	0.497	(0.391)
FURNITURE	0.816	(1.138)	0.067	(0.589)	0.662	(0.877)	0.657	(0.471)
APPLIANCES	0.693	(0.895)	0.170	(0.804)	0.626	(0.610)	0.656	(0.595)
HOUSEHOLD CONSUMABLES	1.159	(1.557)	0.577	(0.672)	0.972	(1.118)	0.435	(0.522)
DOMESTIC WORK	1.137	(0.459)	0.551	(1.062)	0.647	(0.488)	0.757	(0.860)
HEALTH	1.127	(1.346)	0.667	(0.480)	0.841	(1.105)	0.424	(0.440)
TRANSPORT	0.930	(1.471)	0.436	(1.676)	0.893	(0.963)	1.089	(1.003)
VEHICLES	1.132	(1.247)	0.153	(0.508)	0.742	(0.856)	0.521	(0.404)
RUNNING COSTS	0.813	(2.229)	0.800	(3.048)	1.187	(1.723)	2.118	(1.951)
PUBLIC TRANSPORT	0.779	(1.717)	0.232	(0.825)	1.171	(1.181)	0.637	(0.719)
COMMUNICATION	0.988	(3.759)	0.173	(0.993)	1.729	(3.203)	0.729	(0.829)
RECREATION AND CULTURE	0.807	(1.171)	0.049	(0.704)	0.796	(0.746)	0.639	(0.587)
READING MATTER	1.119	(2.680)	0.475	(0.988)	1.273	(2.350)	0.640	(0.849)
EDUCATION	1.386	(3.404)	0.733	(0.965)	1.125	(3.198)	0.531	(0.903)
PERSONAL CARE	0.968	(0.741)	0.421	(0.571)	0.494	(0.520)	0.440	(0.406)

[7] The typical calculation is the weighted sum of the square of the expressions in the absolute value marks in equation [1], all square rooted. The deviation here is to consider the deviation of price changes of the components of CPI from the changes in CPI individually to understand how they contribute to the final outcome.

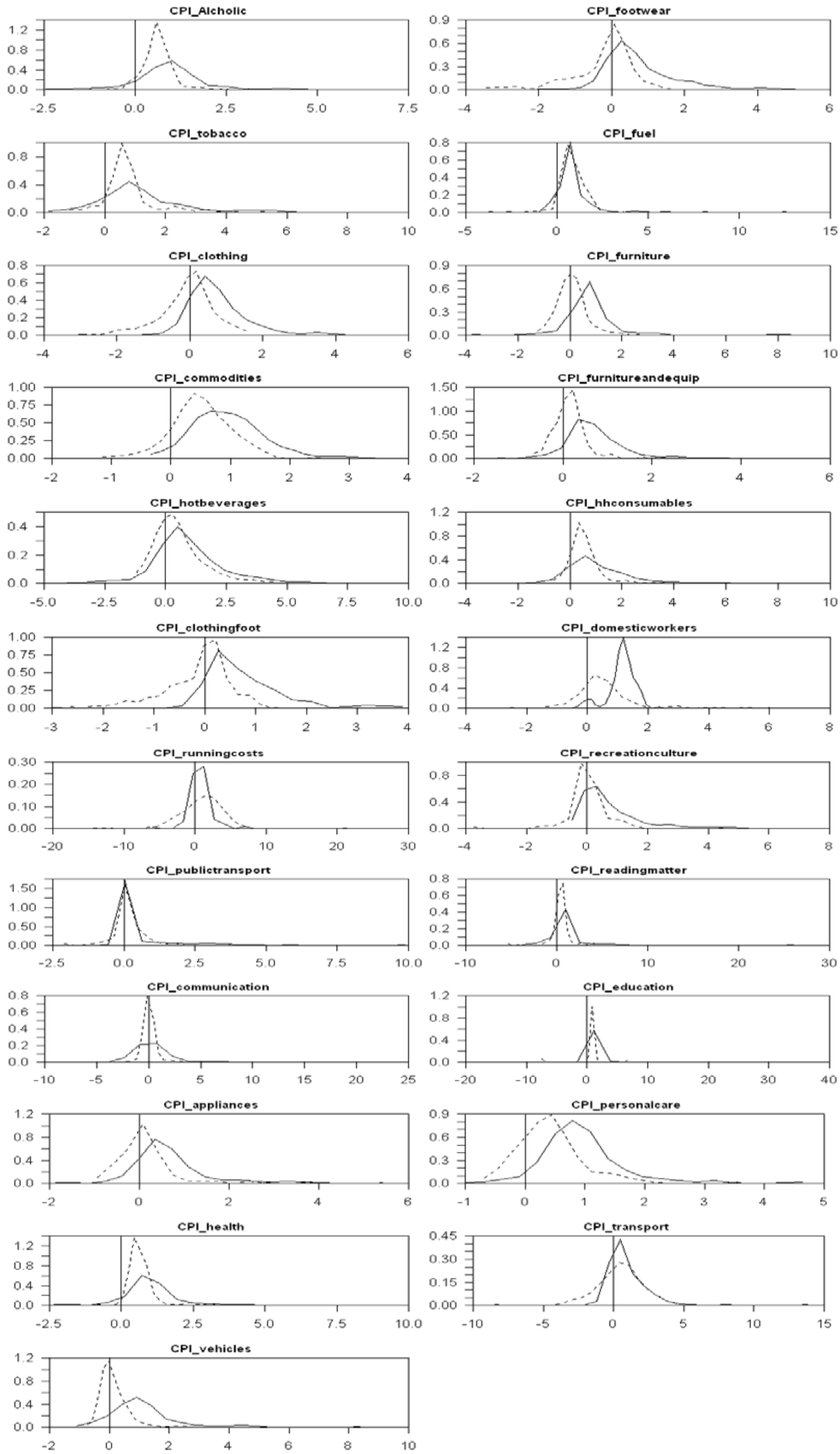
Table 1 reports the summary statistics for the inflation rate in per cent and RPV which is the absolute value of the ratio of the percentage change in the price of the CPI category to the percentage change of the overall CPI (thus anything greater than one suggests that the average change in the CPI category change is greater than the average change in the overall CPI and vice versa) before and after the adoption of the IT framework. The mean inflation rates under the IT framework are lower relative to those before IT, except in the case of fuel. This indicates that adoption of IT is likely to have contributed to the reduced mean inflation rates. Similarly we compare the mean RPV before and under the IT framework. The mean RPV is lower under the IT framework except for fats and oils, clothing and footwear, clothing, footwear, fuel, appliances, domestic workers, transport and running costs which increased.

Figure 1 Density plots of the inflation rate and the rate of price changes for components of the CPI



Dotted lines (solid line) denote the post-IT (pre-IT) period

Figure 1 (continued)

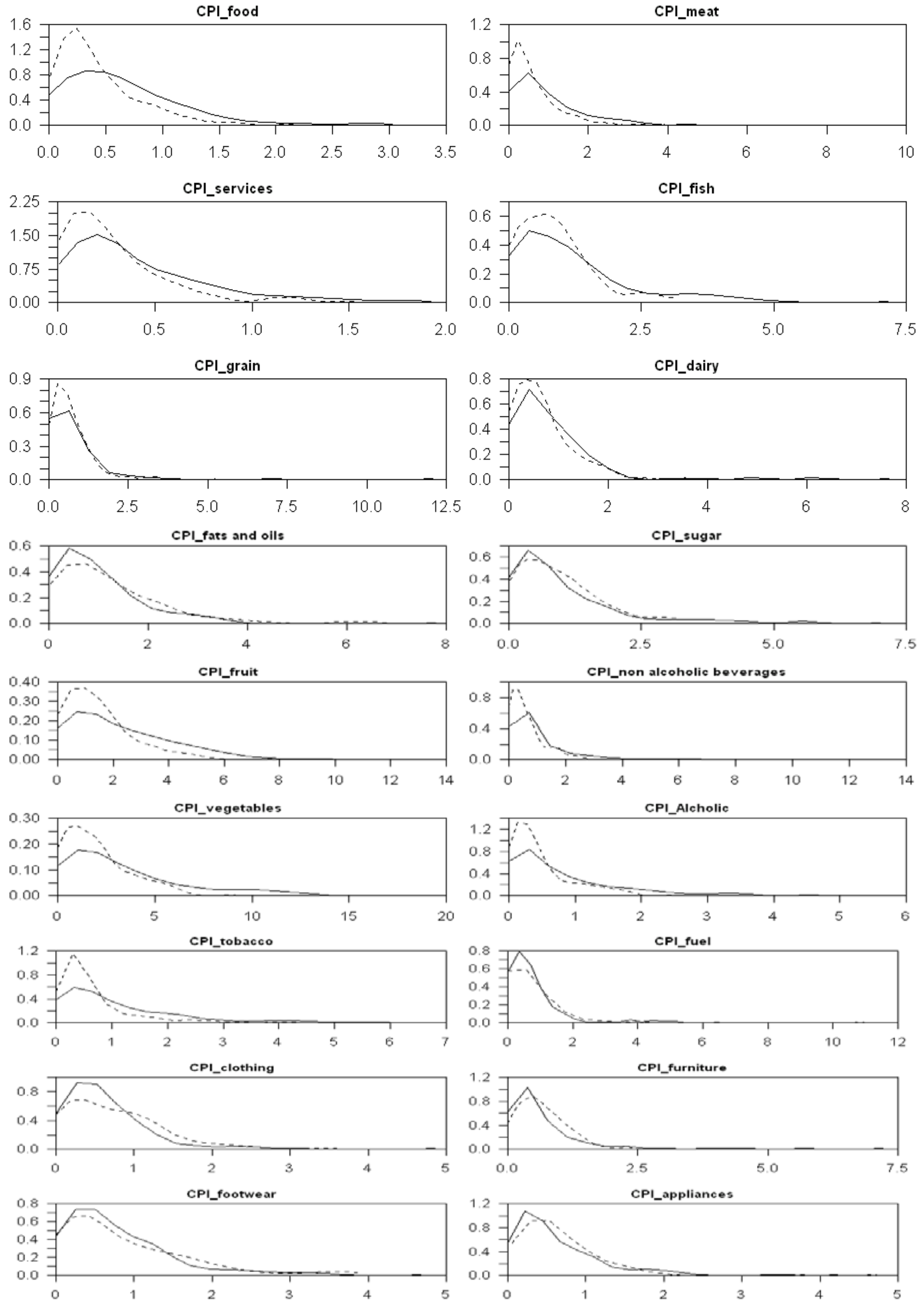


Dotted lines (solid line) denote the post-IT (pre-IT) period

The density plots in Figure 1 suggest that the adoption of IT affected the mean inflation rates and dispersion of these variables. In most inflation components there is a leftward shift in the peak of density plots in the post-IT period, suggesting that the mean inflation rate declined in this period. However, the density plots become wider for the transport, fats and oils, and running costs categories. Moreover, we assess the differences in the RPV between the pre- and post-IT periods using the density plots.

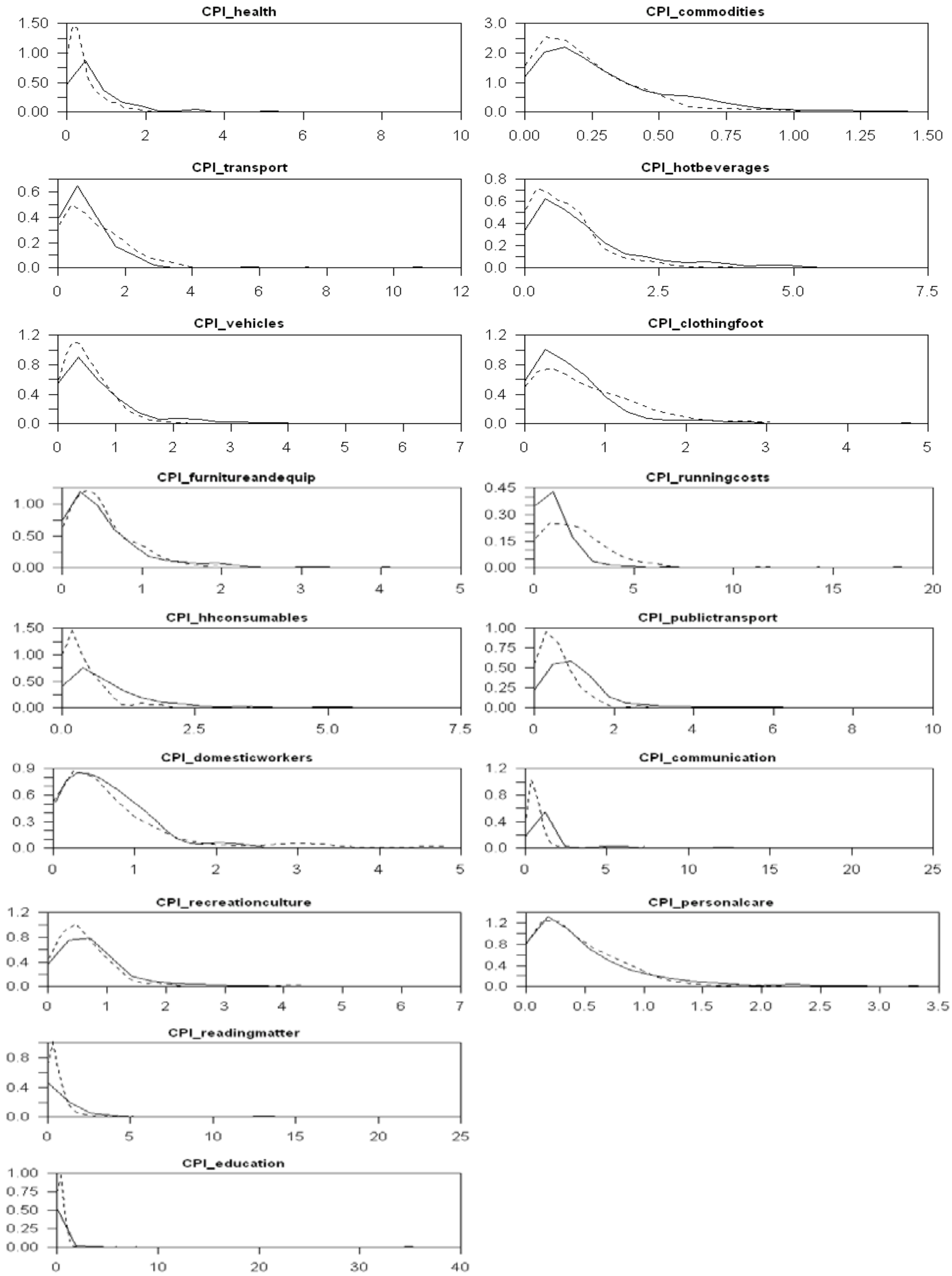
In Figure 2, we find the density plots have shifted inwards, indicating that the variability of these inflation components decreased. However the density plots for the footwear, furniture, appliances, fats and oils, transport, clothing, clothing and footwear, running costs and personal care shifted outwards, indicating that their variability has increased under the IT framework. Both the reported summary statistics and the density plots point to the same conclusion that in most cases both the mean inflation rates and RPV declined under the IT framework.

Figure 2 Density plots of the RPV for components of the CPI



Dotted lines (solid line) denote the post-IT (pre-IT) period

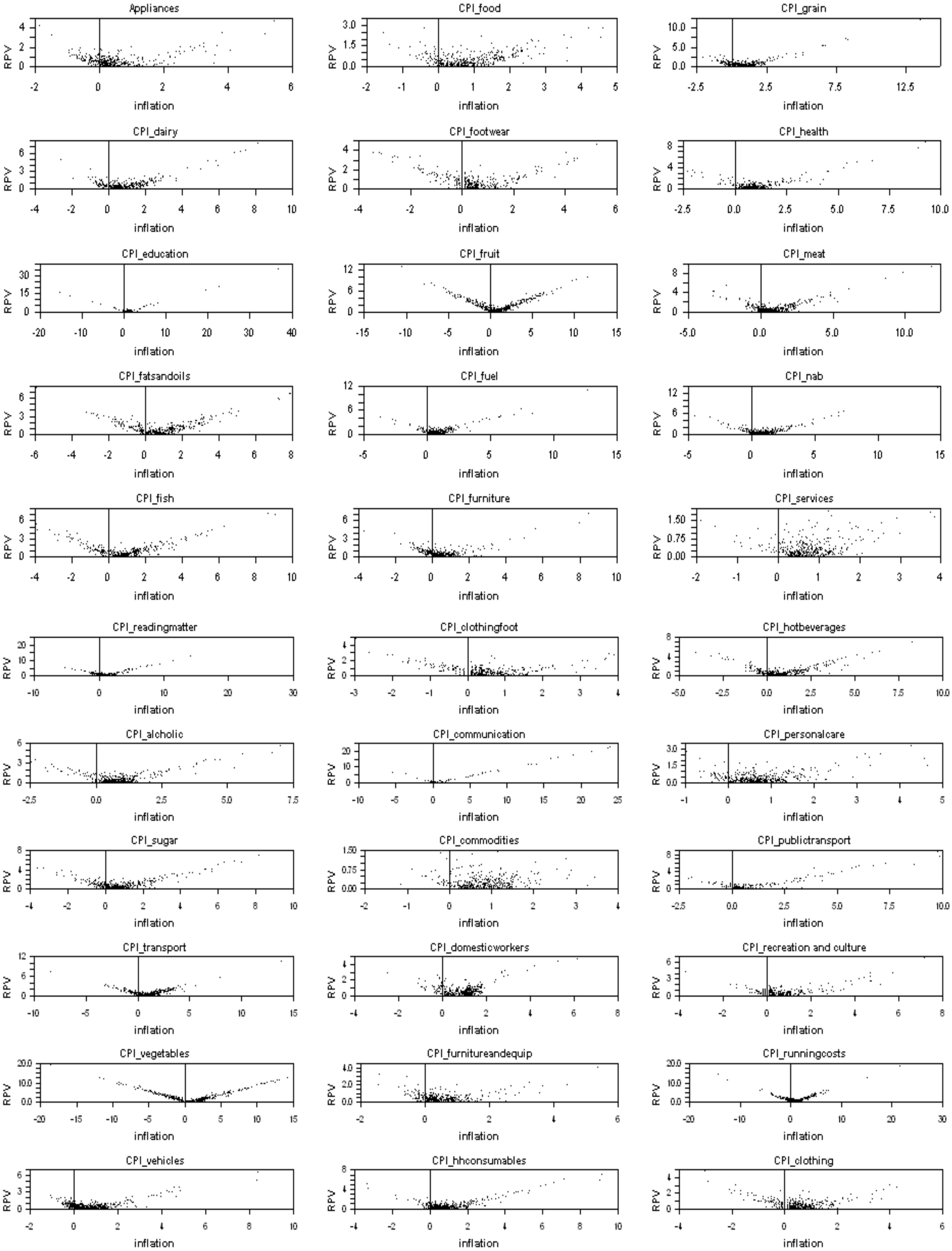
Figure 2 (continued)



Dotted lines (solid line) denote the post-IT (pre-IT) period

We also investigated graphically the relationship between the inflation rates and RPV which has been hypothesised in literature to be in a quadratic form. In Figure 3, we find evidence of quadratic relationship between RPV and inflation rates in some inflation components. However the relationships seem weaker for the communication, services, commodities and personal care categories which display relatively more dispersed or scattered points.

Figure 3 The relationship between RPV and inflation



6. Econometric analysis

We use various econometric techniques to explore the relationship between the RPV and inflation using regression analysis.[8] Following various studies (Choi 2010, Choi et al. 2011, Fielding and Mizen 2008) we utilise a semi-parametric regression approach to identify the underlying functional form of the relationship between inflation rate and RPV without imposing any prior assumptions. Subject to results on the functional form, we then apply the parametric regression technique to both full sample and subsamples separated by the adoption of IT. Lastly, we conduct sensitivity analysis using rolling regression analysis to check the robustness of the regression results. We examine to what extent the adoption of IT might have impacted on the RPV of individual components after taking into account the structural change in these components. Furthermore, we examine whether the structural change in the high-inflation components but not in the low-inflation components category had different effects.

6.1 Underlying functional form and semi parametric regression analysis

According to Choi et al. (2011) there is lack of concrete guidance from economic theory concerning the underlying functional form of the relationship between inflation and RPV. They argue that it is better to utilise a semi-parametric approach to investigate this matter, as it combines features of both parametric and non-parametric models. This maintains the easy interpretability of the former and retains partly the flexibility in the latter model. We follow Fielding and Mizen (2008), Choi (2010), Choi et al. (2011) in defining the partially linear model as follows:

$$RPV_{j,t} = Y_{j,t}{}'\beta + f_j(\pi_t) + \eta_{j,t} \qquad [2]$$

where $Y_{j,t}$ is a $(p+q)\times 1$ vector of explanatory variables which include lagged terms of RPV, $(RPV_{j,t})$ and inflation (π_t) where $Y'_{j,t} = \{RPV_{j,t-1},..., RPV_{j,t-p}, \pi_{t-1},..., \pi_{t-q}\}$. The function $f_j(.)$ is an unknown smooth differential function that captures a contemporaneous effect of inflation on RPV. We use this function to determine the

[8] Choi et al. (2011) cautions that a seemingly loose structural connection in the link between inflation and RPV in low inflation components does suggest a collapse of the link between the two variables are they as suspected to have undergone some different structural changes.

underlying functional form of the relationship between inflation and RPV. The function $f_j(\pi_t)$ in equation [2] is estimated using a semi parametric technique in two stages. Firstly, the parameter vector is estimated from the regression equation of the form

$$RPV_{j,t} = \hat{Y}_{j,t}{}'\beta + \mu_{j,t} \quad [3]$$

where $\hat{Y}_{j,t}{}'$ is the residual from the non-parametric regression $Y_{j,t}$ on π_t.We use the Nadaraya-Watson kernel regression estimator and the Gaussian kernel based on automatic bandwidth selection method. Secondly, we then estimate this function parametrically using equation [4] as done in Fielding and Mizen (2008), Choi (2010), Choi et al. (2011) with particular attention paid on the estimation of the first derivative of $f_j(\pi_t)$. We interpret the results in relation to the underlying relationship:

$$\hat{\mu}_{j,t} = f_j(\pi_t) + \nu_{j,t} \quad [4]$$

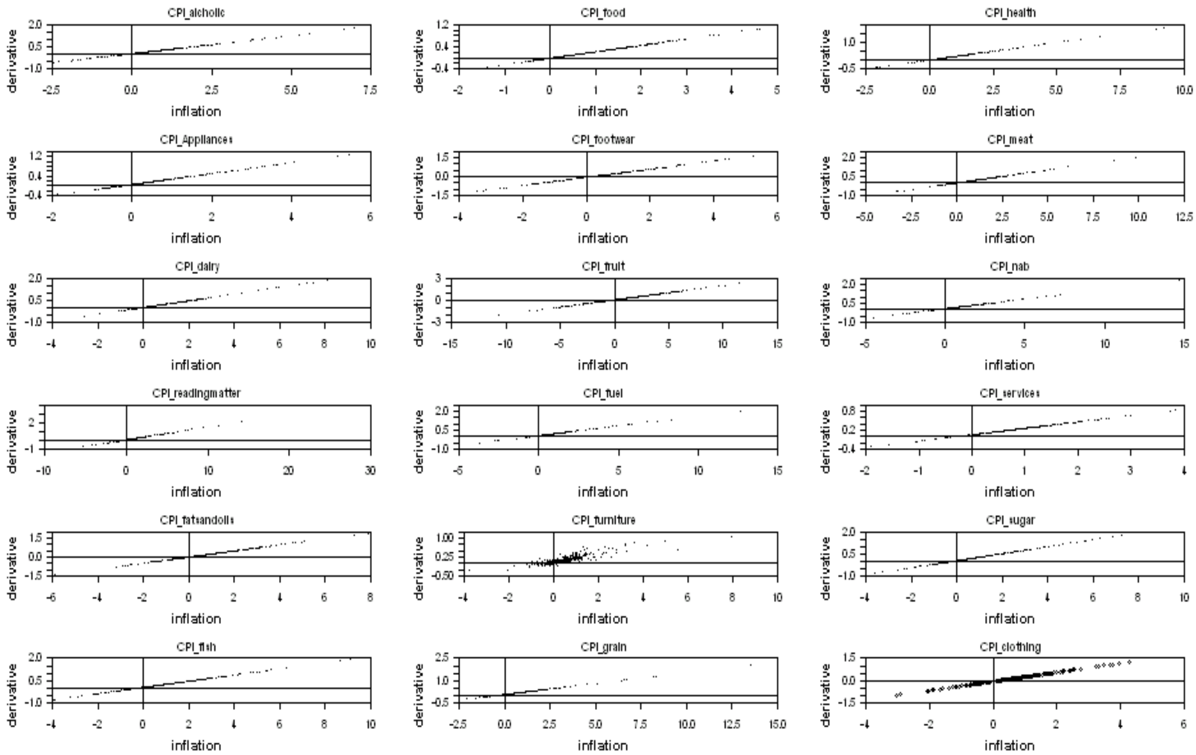
where $\hat{\mu}_{j,t} = RPV_{j,t} - \hat{Y}_{j,t}{}'\beta$ and $f_j(\pi_t)$ some function of inflation. We are interested in the derivative given by $f_j'(\pi_t) = \frac{\partial f_j(\pi_t)}{\partial \pi_t}$ which captures the marginal effect of π_t on $f_j(\pi_t)$. Alternatively this shows the sensitivity of the RPV to marginal increases inflation. If $f_j'(\pi_t) > 0$, $(f_j'(\pi_t) < 0)$ then RPV increases (decreases) with the inflation rate and $f_j'(\pi_t) = 0$ gives the threshold level of the inflation rate where RPV is minimised. We interpret the results in relation to the underlying relationship. Firstly if the underlying relationship is linear, this implies the fitted $f_j'(\pi_t)$ would be close to a constant. Secondly, when $f_j'(\pi_t)$ is linear, this suggests that the true relationship is quadratic.

The plots of the semi parametric estimates of $f_j'(\pi_t)$ for the full sample for different values of the inflation rate are shown in Figure 4. The horizontal x-axis corresponds to the point where the derivative is zero ($f_j'(.) = 0$). The point where $f_j'(.) = 0$ indicates the point where RPV is minimised at the corresponding inflation rate (π_j^*). When the inflation rate is below π_j^*, then $f_j'(\pi_t) < 0$ implies that the function $f_j(\pi_t)$ is downward sloping. $f_j'(\pi_t) > 0$ suggests that $f_j(\pi_t)$ is upward sloping given that the inflation rate exceeds π_j^*. The quadratic relationship between the inflation rate and

RPV is deduced by a transition of $f_j'(\pi_t)$ from negative to positive values. The absence of discontinuity about the threshold implies the smooth transition of the $f_j'(\pi_t)$, suggesting that the underlying $f_j(\pi_t)$ is not closer to a V-shape but a U-shape.

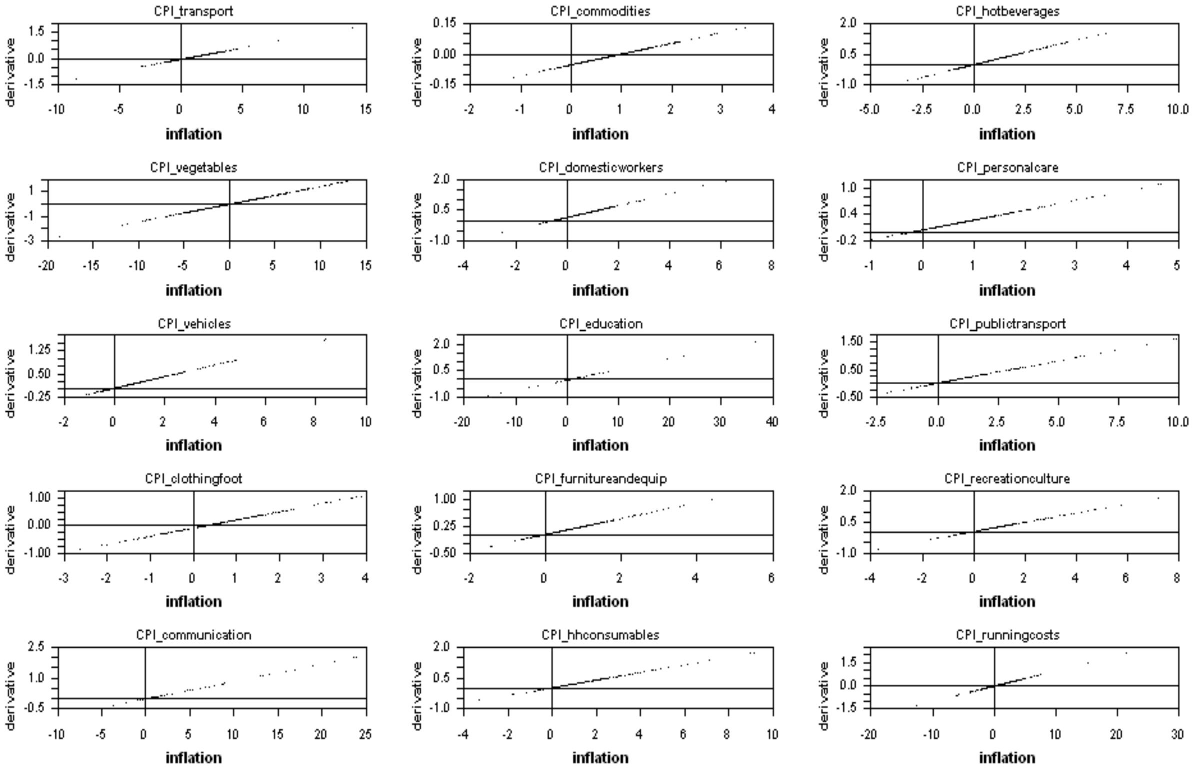
The results are shown in Figure 4. We find that in most cases the shapes of fitted $f_j'(\pi_t)$ are linear and upward sloping indicating that $f_j(\pi_t)$ has a quadratic or U-shaped form.[9]

Figure 4 Results of the semi-parametric estimation



[9] Choi et al. (2011) found that the point where $f_j'(.)$ intersects the x-axis was at a lower π_j^* in the second subsample in the case of the high initial inflation countries. This indicated that U-shaped relationship has shifted leftward as the mean inflation declined. We fail to find evidence supportive of a monotonic relationship between inflation and RPV in the case of high inflation products (and product groups).

Figure 4 (continued)



6.2 The U-shaped relationship and parametric regression analysis

According to Choi et al. (2011) the semi-parametric analysis suggests that a well-specified parametric model of the inflation-RPV relationship should include two main features, namely (i) a quadratic profile and (ii) structural changes in the underlying model. We utilise the parametric modelling approach that accommodates both the inflation levels (π_t) and squared inflation (π_t^2) as explanatory variables including the lagged terms of both RPV and inflation. This specification allows the RPV to respond differently to both inflation level, π_t and squared inflation level, π_t^2. Moreover, it nests both the linear and quadratic models. The inclusion of the square term of inflation was motivated by evidence of the U-shaped pattern found in Figure 3 and support from some earlier studies (Choi 2010; Choi et al. 2011; Parks 1978) which reported inflation volatility as a significant explanatory variable.

$$RPV_{j,t} = \kappa_0 + \sum_{m=1}^{l} \kappa_h RPV_{j,t-m} + \beta_1 \pi_t + \beta_2 \pi_t^2 + \sum_{i=1}^{p} \phi_i \pi_{t-i} + \varepsilon_{j,t} \qquad [5]$$

Certain characteristics of this quadratic functional form are particularly of great interest in this analysis. The coefficients on squared inflation (π_t^2) or β_2 in equation [5] captures the direction of curvature. A U-shaped relationship occurs when β_2 is positive and an inverted U-shaped when β_2 is negative and the estimate of β_2 has to be statistically significant. Moreover when β_2 is very close or approaches zero the functional form collapses to a linear form hence the relationship between RPV and inflation is only determined by β_1. The minimum point in the quadratic model pertains to the value of the inflation rate level (π_t) at which the estimated RPV takes the lowest value that corresponds to π_j^*. The minimum point of the U-shaped function derived from equation [2] is defined by

$$\pi_j^* = -\frac{\beta_1}{2\beta_2} \qquad [6]$$

There are possible combinations of coefficients of both the inflation rate and squared inflation rate which yield a U-shape at different turning points. For example in equation [6] for the U-shaped function to be around a positive inflation $\pi_j^* > 0$ occurs when $\beta_2 > 0$ and $\beta_1 < 0$. Furthermore, for the U-shape to be around a negative inflation rate $\pi_j^* < 0$ requires that $\beta_2 > 0$ and $\beta_1 > 0$. Moreover when $\beta_1 = 0$ it implies that $\pi_j^* = 0$ indicating a U-shape would be around the zero inflation rates irrespective of the sign on β_2. Lastly, when $\beta_2 \approx 0$, then π_j^* explodes because it is not properly defined (as the relationship is linear if β_1 is significant or the relationship does not exist if β_1 is insignificant).

There are implications regarding the U-shape centred round an inflation rate equal to zero $(\pi_j^* = 0)$ or about a non-zero inflation rate $(\pi_j^* \neq 0)$. A U-shaped association between RPV and inflation around the inflation rate equal to zero implies that the RPV would increase with inflation (or deflation). However, the RPV increases monotonically with deviations from the π_j^* inflation rate, and not the inflation rate when the U-shaped relationship is around the non-zero inflation rate. Choi et al. (2011), using the aggregated data, found that there was little support for the view that the minimum point of the U-shape was about a zero inflation rate $\left(\pi_j^* = 0\right)$.

Similarly the results of the full sample reported in Table 2 confirm that the relationship is U-shaped about a positive inflation rate which is significantly different from zero for some components. Secondly, the effect of inflation volatility on RPV is non-negative $\beta_2 \geq 0$ in all cases, while that of the inflation level is negative $\beta_1 < 0$ for most cases. This indicates that a U-shaped relationship between inflation and RPV exists. Thirdly, apart from π_j^* being positive and significantly different from zero, the findings suggest that the RPV-related welfare costs of inflation are minimised when the inflation rate exceeds zero compared to when it is zero. Lastly $\beta_2 > 0$ and $\beta_1 > 0$ are positive and significant for communication and reading matter suggesting that the U-shape relationship is minimised at a negative inflation rate, π_j^*. The grain and public transport components suggest the U-shape relationship is minimised at the zero inflation rates mainly because $\beta_1 = 0$. This indicates that RPV varies monotonically with the inflation rate.

Table 2 Parametric regression results for the full sample

	β_1 (error)	β_2 (error)	π^* (error)	Significance
APPLIANCES	-0.567 (0.044)	0.251 (0.013)	1.127 (0.052)	0.000
CLOTHING	-0.432 (0.030)	0.233 (0.011)	1.434 (3.444)	0.677
CLOTHINGFOOT	-0.495 (0.033)	0.242 (0.012)	1.022 (0.059)	0.000
COMMUNICATION	*0.422 (0.035)*	*0.023 (0.002)*	*-8.985 (1.434)*	*0.000*
COMMODITIES	-0.118 (0.040)	0.063 (0.017)	0.928 (0.176)	0.000
READINGMATTER	*0.195 (0.038)*	*0.034 (0.002)*	*-0.126 (0.038)*	*0.001*
DAIRY	-0.276 (0.037)	0.157 (0.007)	0.878 (0.089)	0.000
DOMESTICWORKERS	-0.299 (0.050)	0.199 (0.013)	0.754 (0.092)	0.000
EDUCATION	-0.239 (0.025)	0.035 (0.001)	3.418 (0.310)	0.000
FATSANDOILS	-0.264 (0.026)	0.152 (0.006)	0.868 (0.071)	0.000
FISH	-0.331 (0.027)	0.150 (0.006)	1.104 (0.071)	0.000
FOOD	-0.295 (0.046)	0.185 (0.015)	0.798 (0.079)	0.000
FOOTWEAR	-0.423 (0.025)	0.226 (0.008)	0.934 (0.047)	0.000
FRUIT	-0.188 (0.016)	0.113 (0.003)	0.830 (0.065)	0.000
FUEL	-0.115 (0.040)	0.091 (0.005)	0.634 (0.194)	0.001
FURNITURE	-0.411 (0.034)	0.152 (0.006)	1.351 (0.079)	0.000
FURNITUREANDEQUIP	-0.622 (0.052)	0.260 (0.015)	1.199 (0.059)	0.000
GRAIN	*0.005 (0.037)*	*0.077 (0.004)*	*-0.030 (0.241)*	*0.901*
HEALTH	-0.235 (0.040)	0.135 (0.006)	0.868 (0.119)	0.000
HHCONSUMABLES	-0.197 (0.036)	0.120 (0.006)	0.821 (0.119)	0.000
HOTBEVERAGES	-0.347 (0.030)	0.175 (0.007)	0.995 (0.065)	0.000
MEAT	-0.208 (0.033)	0.098 (0.005)	1.056 (0.139)	0.000
NAB	-0.102 (0.035)	0.084 (0.004)	0.609 (0.186)	0.001
PERSONALCARE	-0.317 (0.053)	0.196 (0.016)	0.806 (0.085)	0.000
PUBLICTRANSPORT	*0.040 (0.041)*	*0.085 (0.006)*	*-0.239 (0.258)*	*0.355*
RECREATIONCULTURE	-0.330 (0.034)	0.171 (0.008)	0.963 (0.068)	0.000
RUNNINGCOSTS	-0.080 (0.021)	0.052 (0.002)	0.771 (0.192)	0.000
TRANSPORT	-0.109 (0.024)	0.072 (0.003)	0.754 (0.149)	0.000
VEGETABLES	-0.115 (0.016)	0.071 (0.002)	0.806 (0.109)	0.000
VEHICLES	-0.149 (0.042)	0.115 (0.007)	0.650 (0.153)	0.000
ALCOHOLIC	-0.372 (0.035)	0.180 (0.008)	1.034 (0.069)	0.000
SUGAR	-0.305 (0.030)	0.163 (0.006)	0.933 (0.068)	0.000
SERVICES	-0.257 (0.040)	0.179 (0.015)	0.716 (0.076)	0.000

We also report the results estimated using the two subsamples in Table 3. The results confirm that the IT framework has impacted on the relationship between inflation and RPV. In most cases, before the adoption of IT, we found that $\beta_2 < 0$ and $\beta_1 > 0$ and were insignificant, suggesting there was no clear relationship between RPV and inflation. In contrast, under IT we find in most cases that $\beta_2 > 0$ and $\beta_1 < 0$ and were significant suggesting a U-shape relationship about a positive non-zero inflation rate. Moreover this finding indicates that the underlying relationship between inflation and RPV is not stable over time. In the situation where $\beta_2 > 0$ and $\beta_1 > 0$ under the IT framework, the latter coefficient tends to be insignificant. This was found for the communication and running costs categories, suggesting that the U-shaped relationship is minimised at a zero inflation rate. Furthermore we find that the U-shaped relationship is minimised at a zero inflation rate in the domestic workers, fuel and health categories under the IT framework as $\beta_1 < 0$ and insignificant.

Table 3 Parametric regression results for the subsamples pre- and post-IT

	Pre-IT							Post-IT						
	β_1	(error)	β_2	(error)	π^*	(error)	Significance	β_1	(error)	β_2	(error)	π^*	(error)	Significance
APPLIANCES	0.194	(0.107)	-0.063	(0.036)	1.535	(0.379)	0.000	-0.336	(0.067)	0.229	(0.017)	0.735	(0.109)	0.000
CLOTHING	0.098	(0.089)	-0.009	(0.033)	5.366	(15.623)	0.732	-0.341	(0.051)	0.269	(0.032)	0.634	(0.153)	0.000
CLOTHINGFOOT	0.120	(0.093)	-0.045	(0.035)	1.330	(0.565)	0.019	-0.497	(0.062)	0.222	(0.040)	1.120	(0.315)	0.001
COMMUNICATION	-0.370	(0.188)	0.000	(0.010)	-753.286	(31848.652)	0.981	0.027	(0.072)	0.122	(0.012)	**-0.109**	(0.306)	0.722
COMMODITIES	0.061	(0.070)	-0.033	(0.025)	0.925	(0.523)	0.078	-0.085	(0.051)	0.183	(0.035)	0.233	(0.115)	0.044
READINGMATTER	-0.340	(0.116)	-0.003	(0.007)	-60.910	(164.898)	0.712	-0.061	(0.035)	0.210	(0.010)	0.146	(0.083)	0.082
DAIRY	0.275	(0.118)	-0.062	(0.030)	2.206	(0.573)	0.000	-0.206	(0.058)	0.255	(0.021)	0.404	(0.090)	0.000
DOMESTICWORKERS	0.473	(0.244)	-0.061	(0.110)	3.880	(5.133)	0.451	-0.096	(0.070)	0.164	(0.016)	0.293	(0.188)	0.122
EDUCATION	-0.595	(0.088)	0.008	(0.006)	35.258	(23.647)	0.137	-0.055	(0.028)	0.132	(0.004)	0.208	(0.105)	0.050
FATSANDOILS	0.061	(0.065)	-0.037	(0.023)	0.814	(0.642)	0.206	-0.196	(0.049)	0.135	(0.009)	0.722	(0.156)	0.000
FISH	-0.060	(0.080)	0.030	(0.023)	0.998	(0.827)	0.229	-0.270	(0.041)	0.302	(0.019)	0.448	(0.054)	0.000
FOOD	-0.015	(0.076)	0.050	(0.027)	0.146	(0.696)	0.834	-0.165	(0.092)	0.316	(0.049)	0.260	(0.113)	0.022
FOOTWEAR	-0.115	(0.113)	-0.003	(0.039)	-17.216	(214.843)	0.936	-0.420	(0.064)	0.200	(0.026)	1.049	(0.280)	0.000
FRUIT	0.059	(0.056)	-0.009	(0.019)	3.266	(5.324)	0.540	-0.083	(0.032)	0.120	(0.006)	0.343	(0.129)	0.009
FUEL	0.056	(0.105)	-0.051	(0.023)	0.544	(0.839)	0.517	-0.079	(0.059)	0.074	(0.006)	0.535	(0.370)	0.151
FURNITURE	0.049	(0.094)	-0.016	(0.023)	1.568	(1.774)	0.378	-0.575	(0.056)	0.455	(0.038)	0.632	(0.054)	0.000
FURNITUREANDEQUIP	0.173	(0.105)	-0.067	(0.034)	1.294	(0.354)	0.000	-0.734	(0.088)	0.474	(0.048)	0.774	(0.060)	0.000
GRAIN	-0.139	(0.097)	-0.011	(0.014)	-6.435	(11.700)	0.583	-0.144	(0.053)	0.163	(0.012)	0.443	(0.143)	0.002
HEALTH	-0.126	(0.101)	-0.053	(0.024)	-1.187	(1.421)	0.404	-0.144	(0.132)	0.279	(0.048)	0.258	(0.197)	0.193
HHCONSUMABLES	0.128	(0.084)	-0.023	(0.019)	2.783	(1.540)	0.072	-0.315	(0.084)	0.251	(0.028)	0.628	(0.115)	0.000
HOTBEVERAGES	0.035	(0.089)	-0.015	(0.027)	1.121	(1.735)	0.519	-0.322	(0.055)	0.272	(0.021)	0.591	(0.070)	0.000
MEAT	0.059	(0.077)	0.017	(0.015)	-1.686	(3.404)	0.621	-0.142	(0.042)	0.231	(0.015)	0.309	(0.081)	0.000
NAB	-0.023	(0.082)	-0.011	(0.013)	-1.018	(4.531)	0.822	-0.231	(0.059)	0.262	(0.025)	0.440	(0.090)	0.000
PERSONALCARE	0.035	(0.110)	-0.011	(0.033)	1.597	(2.274)	0.483	-0.284	(0.082)	0.287	(0.036)	0.495	(0.101)	0.000
PUBLICTRANSPORT	-0.193	(0.107)	0.020	(0.018)	4.732	(3.053)	0.122	-0.326	(0.060)	0.223	(0.015)	0.730	(0.104)	0.000
RECREATIONCULTURE	0.129	(0.103)	-0.019	(0.027)	3.356	(2.797)	0.231	-0.321	(0.042)	0.221	(0.013)	0.726	(0.095)	0.000
RUNNINGCOSTS	-0.058	(0.085)	-0.001	(0.009)	-22.468	(173.081)	0.897	0.037	(0.029)	0.077	(0.004)	**-0.240**	(0.184)	0.195
TRANSPORT	0.056	(0.071)	-0.013	(0.010)	2.113	(2.080)	0.311	-0.054	(0.032)	0.108	(0.007)	0.250	(0.153)	0.104
VEGETABLES	0.094	(0.050)	0.003	(0.013)	-15.371	(67.249)	0.819	-0.100	(0.028)	0.138	(0.006)	0.365	(0.100)	0.000
VEHICLES	0.142	(0.097)	-0.027	(0.020)	2.604	(1.279)	0.043	-0.762	(0.098)	0.484	(0.052)	0.787	(0.060)	0.000
ALCOHOLIC	-0.317	(0.083)	0.049	(0.025)	3.202	(1.061)	0.003	-0.475	(0.095)	0.426	(0.044)	0.557	(0.076)	0.000
SUGAR	0.020	(0.093)	-0.030	(0.027)	0.335	(1.332)	0.802	-0.306	(0.043)	0.246	(0.016)	0.623	(0.067)	0.000
SERVICES	0.024	(0.080)	0.013	(0.030)	-0.908	(4.893)	0.853	-0.245	(0.037)	0.218	(0.023)	0.562	(0.079)	0.000

6.3 π_j^* and the inflation target

Thus far, this paper has considered the nature of the relationship between observable inflation and unobservable RPV for a number of individual components of the CPI, providing evidence that the relationship, if not before, is quadratic in the period since the adoption of IT. The spread of statistically significant π_j^*'s presented in Table 3 (reflected in Figure 5) is quite wide, ranging from between 0.00 to 3.20 per cent for the pre-IT sample (this represents a spread of 0.00 to 45.93 per cent in annual terms). The pre-IT π_j^*'s are quite different across different products and categories within this range, with a good number of π_j^*'s being not significantly different from zero.[10] Turning attention to the post-IT figures though, provides some interesting results as the range of statistically significant π_j^*'s narrows in this sample to between 0.00 and 1.12 per cent (the equivalent of a range of 0.00 to 14.3 per cent in annual terms).

Figure 5 Evolution of π_j^*'s

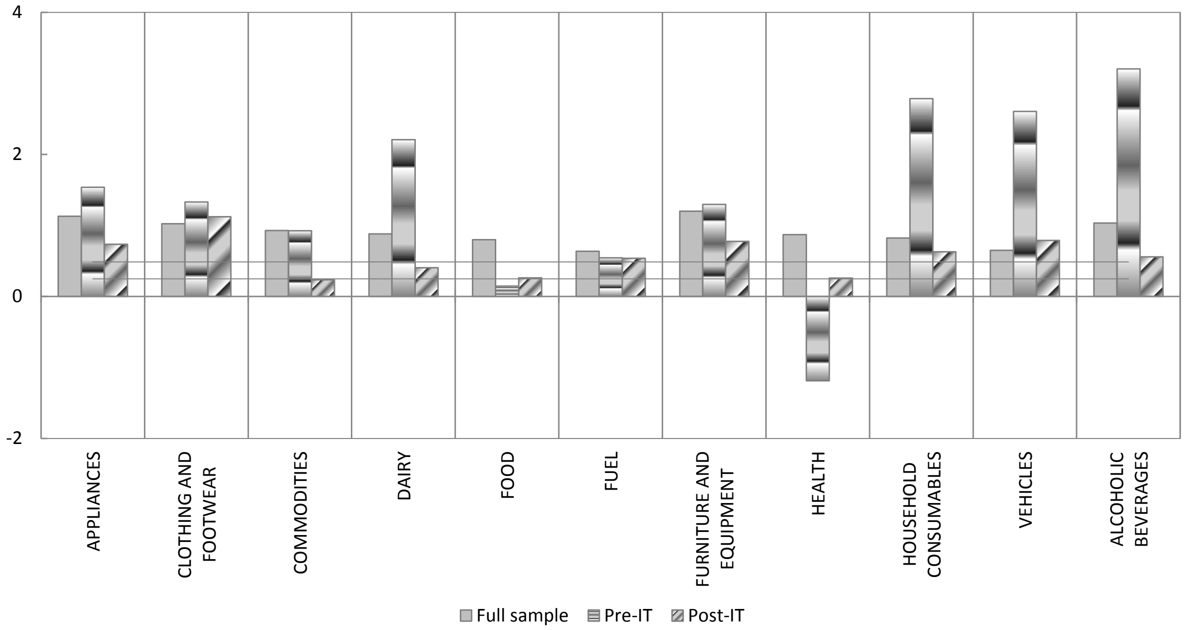


Figure 5 looks at those categories that had a significant quadratic relationship prior to the adoption of IT showing the π_j^*'s for the whole, pre-IT and post-IT period. A

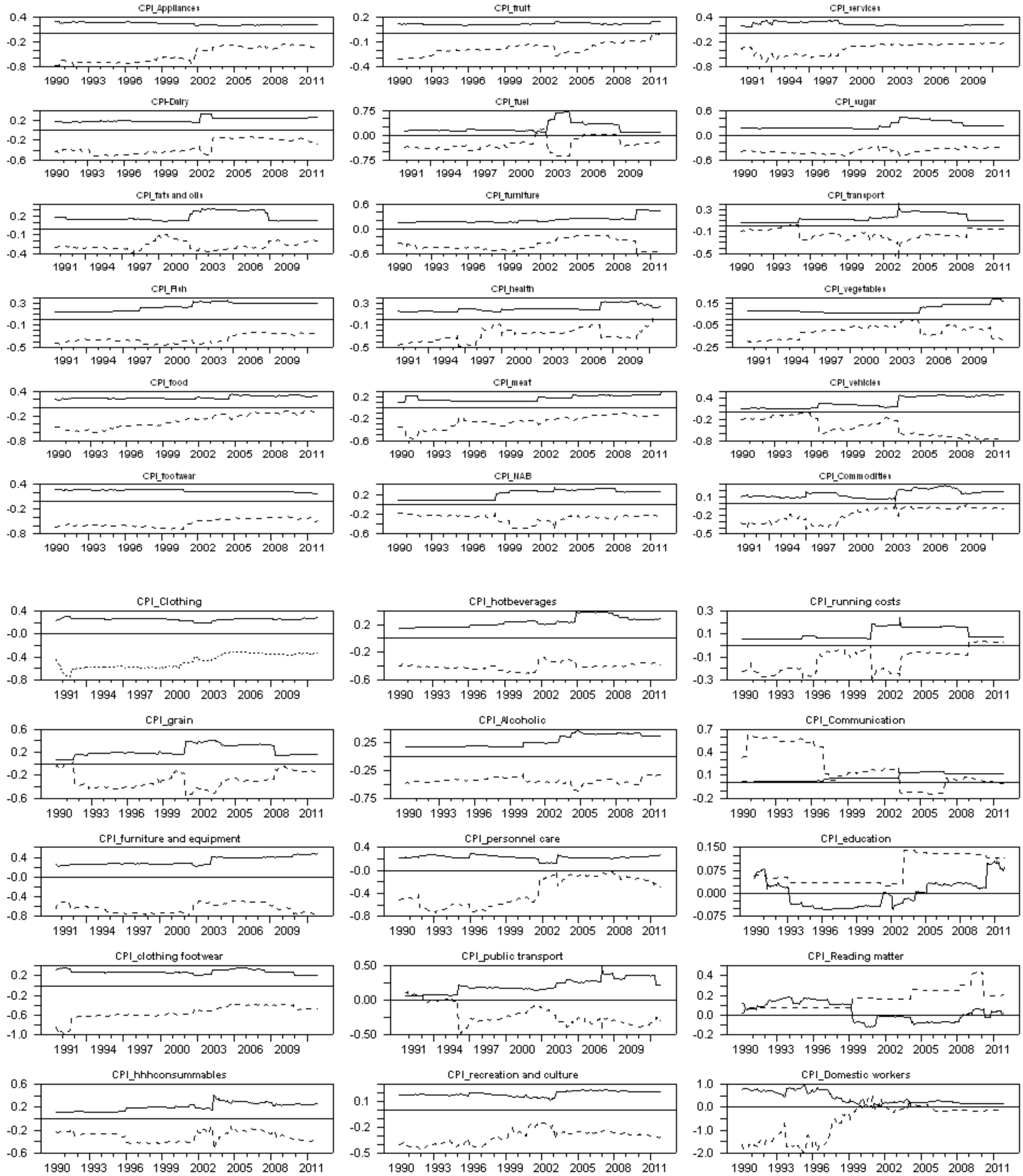
[10] The full range for pre-IT π_j^*'s from Table 3 is between -753.29 and 35.26 per cent.

distinct convergence is observed, whereby those categories that had negative (high positive) π_j^*'s have tended to rise (fall) in the post-IT period. A month-on-month equivalent of the 3 to 6 per cent target band for South Africa, suggests a target band of 0.2466 and 0.4868 per cent (this calculation has been done assuming that inflation is compounded). The results presented in this context suggest that there are 11 categories that have fallen within this target band (including from some categories that did not have a quadratic relationship in the pre-IT period). Furthermore, considering the deviation of the π_j^*'s from this band, we find that the average deviation has decreased dramatically, which suggests that IT is a more transparent form of monetary policy-making, which has resulted in the described convergence in π_j^*'s due to less uncertainty in the economy. The adoption of IT could possibly have led to some kind of behavioural change in behaviour the by price setters, who may have aligned prices changes to fit better with the nominal anchor.

6.4 Robustness check using rolling regression analysis

The preceding evidence from the subsamples suggests that the adoption of the IT framework has changed the relationship between inflation and RPV. Thus the underlying relationship between inflation and RPV may not be stable over time. Owing to the time-varying nature of the relationship, inferences made from the full sample without taking the identified structural period into account can be of limited advantage in detecting the true relationship. Hence, we follow Choi et al. (2011) to use the rolling regression approach based on equation [5] to capture the time-varying properties of the relationship without imposing any prior restrictions on the timing of break-points. This approach has greater flexibility in detecting structural changes over time since the full sample results are vulnerable to time variation in the conditional mean of the inflation process. Moreover, it allows for each rolling sample to have a completely different estimate, and the specification allows the RPV to respond differently to both the inflation level (π_t) and the square of the inflation level (π_t^2). These two parameters are vital in determining the time-varying behaviour of the relationship between inflation and RPV, which is captured by instability over rolling samples.

Figure 6 Rolling regression results for β_1 and β_2

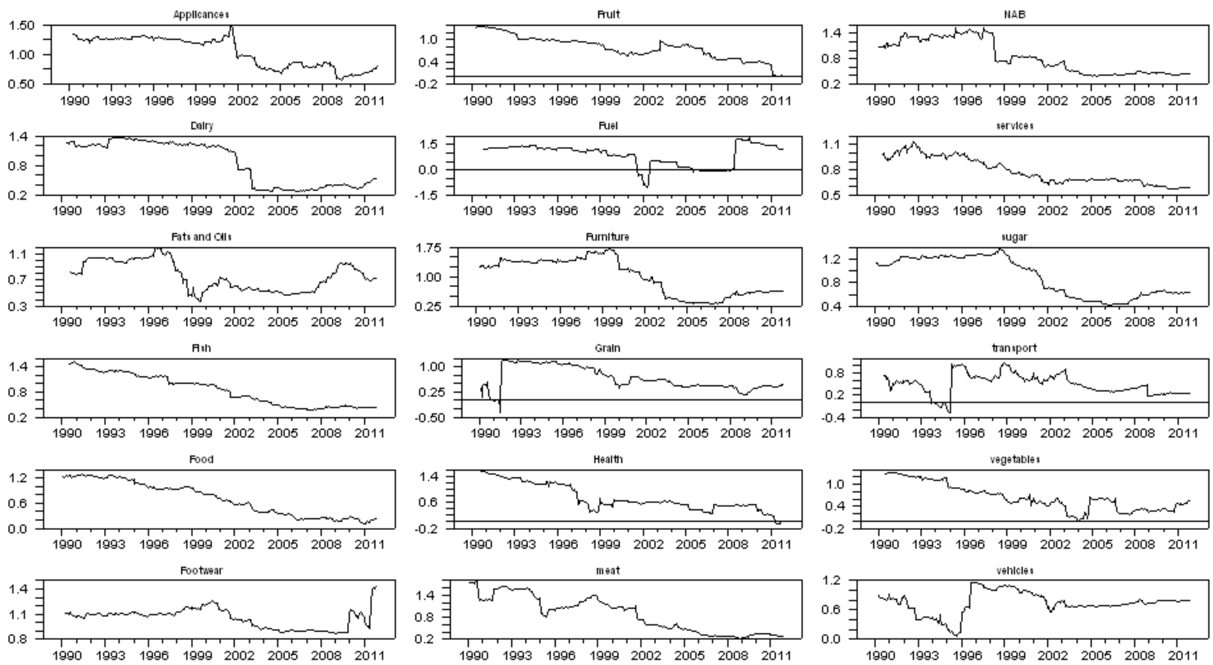


Dotted lines (solid line) denotes the β_1 and (β_2).

The rolling estimates of β_1 and β_2 for various goods are shown in Figure 6. We used a rolling window of ten years. The numbers on the horizontal axis represent the end of the ten year window. For example, 1990 captures the period 1980-1990. We find that the rolling estimates of β_2 are consistently positive, whereas the estimates for β_1 are negative, excluding the education, communication and reading matter components in which β_1 tends to be positive. Thus the relationship between inflation and RPV is U-shaped about a non-zero inflation rate in most components of inflation, suggesting that the RPV increases with the deviation of the inflation rate from π_j^*.

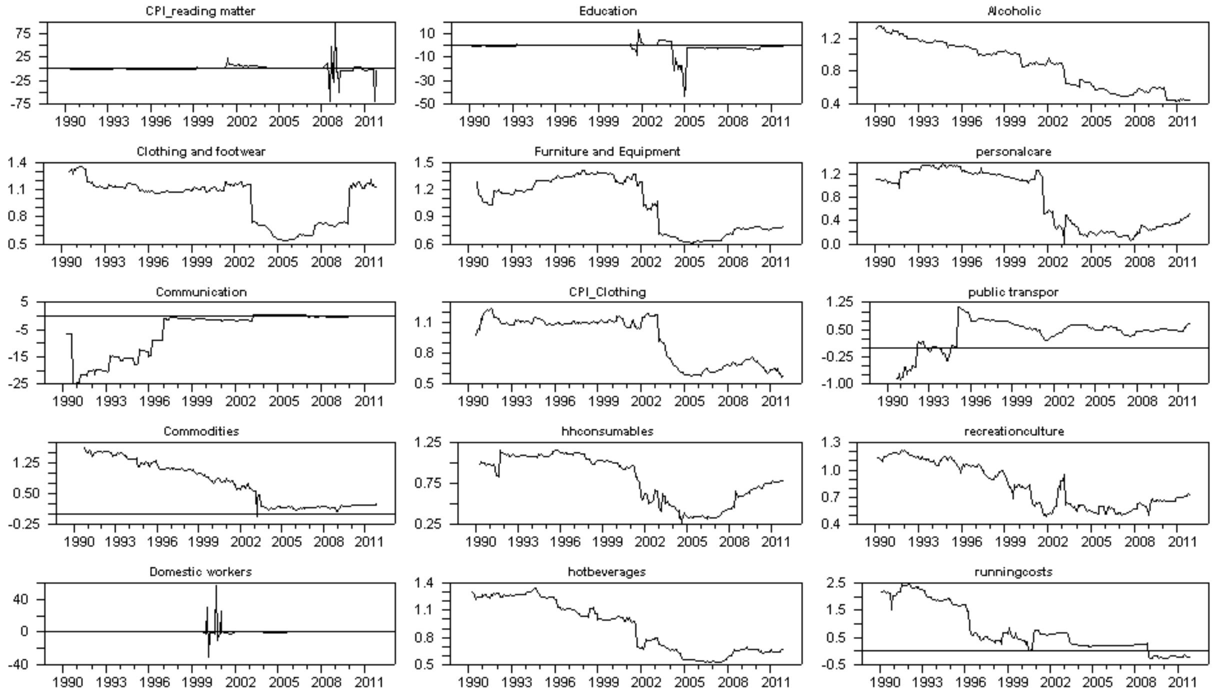
In addition, we also calculate the time-varying π_j^* based on equation [6] using the rolling regression estimates of β_1 and β_2 for various goods. The time-varying π_j^* values are shown in Figure 7. It is evident that in most inflation components the π_j^* fell to lower levels during the IT period except for reading matter, education, communication and domestic workers. However for clothing and footwear, clothing, and for fuel it has increased after 2008. According to Choi et al. (2011) these results suggest that the U-shaped relationships shifted.[11] Furthermore, this relationship is confirmed by results reported for the full sample of π_j^* reported in Table 2. We find that in most cases π_j^* is positive and significantly different from zero suggesting that the relationship between inflation and RPV is U-shaped about a positive inflation rate.

Figure 7 Rolling regression results for π^*



[11] According to Choi et al (2011) the important role of π^* in the inflation –RPV nexus raises questions about how to interpret the nonzero π^* and how the π^* could be related to the inflation target.

Figure 7 (continued)



Considering the π_j^*'s, there is definitely some evidence that the relationship between inflation and RPV started changing prior to the formal adoption of IT as some of the subcategories considered exhibit behaviour changes that seems to coincide with the so-called eclectic approach to IT which was adopted by the South African Reserve Bank during the 1990's. The most significant shifts still seem to occur in the results which contain the periods after the August 1999 announcement of the formal adoption of IT.

7. Conclusion

This paper set out to investigate the nature of the relationship between the RPV of the components of the CPI and inflation and if any change had been observed since the adoption of IT. Other than a few components, it was found that the inflation rates of these components have experienced a decrease in their mean rates and a tightening of their distributions. Furthermore, the RPV of these components has mostly seen a decrease in their means as well as a narrowing of their distributions.

Formal analysis followed an approach used by Fielding and Mizen (2008) and Choi et al. (2011). This approach used both parametric and non-parametric techniques in considering the nature of the relationship between RPV and inflation. Estimation of the model suggested that for most of the components of CPI, a quadratic specification (in the relationship with inflation) was the correct specification and this was largely supported by the results of the rolling regressions. Furthermore, the rate of inflation at which RPV was minimised $\left(\pi_j^*\right)$ was found to be significantly positive. Considering the models that have been tested in previous literature as laid out by Fischer (1981), not much can be definitively concluded as to the actual mechanism that drives the relationship between RPV and inflation in South Africa, or if it is restricted to only one channel (which is unlikely). Furthermore, the effect of unexpected inflation versus expected inflation has not been tested here. Theories supported by these results, include the menu cost mechanism, and that both RPV and inflation are affected by a common shock (although with different lags possibly) as well as both policy related mechanisms described by Fischer. Furthermore, inefficiencies in the form of higher contracting costs relatively sticky prices (in that price changes up are more frequent than price changes downward) could also help explain the mechanism underlying the results reported in this paper.

This paper has not attempted to test alternative causes of the decrease in mean inflation and RPV other than the adoption of IT. The evidence presented though, does suggest that the adoption of IT is probably at least one potential explanation for this observation as well as for the change in the relationship between RPV and inflation.

Appendix A: Data

Variable	Description	Old CPI Comprises:	Weight	New CPI Comprises:	Weight
CPI_all	All items in the CPI		100.00		100.00
CPI_commodities	Commodities/Goods		57.14		53.24
CPI_services	Services		42.86		46.76
CPI_food	Food		20.99		13.63
CPI_grain	Grain products	White, brown and whole-wheat bread, rolls, cake flour, self-raising flour, bread flour, mealie meal/maize flour, sorghum meal, corn flour, breakfast oats, taystee wheat, mabella, cereal flakes, puffed rice, rice, mealie rice samp, spaghetti, macaroni, noodles, Marie biscuits, crackers, rusks, cakes, tarts, baby food, other	3.81	Rice, white and brown bread, sweet biscuits, savoury biscuits, pasta, cake, cake and bread flour, mielie meal, porridge, cereals and samp	2.91
CPI_meat	Meat products	Beef and veal: rump steak, sirloin, fillet, topside without bone, brisket with bone, chuck with bone, hind quarter, t-bone, shin with bone, neck, thick flank. Mutton: leg, chops, shoulder, rib, neck, half a sheep, loin flank. Lamb: leg, chops, shoulder, rib, neck, half a lamb, loin, flank. Pork: chops, leg, shoulder. Chicken: whole, portions. Venison, minced meat, voerewors, pork sausages, Vienna's, French polony, cooked sliced ham, biltong, dried sausage, bacon, meat spread, corned beef, meat patties, baby food containing meat	5.66	Beef: rump steak, brisket, chuck, t-bone, mince, meat patties, extract. Pork chops and sausage, Lamb chops. Chicken: whole fresh and frozen, portions fresh and frozen, pies. Boerewors, Vienna's, polony, ham, biltong, bacon and russians, meat pies.	4.35
CPI_fish	Fish products	Fresh hake and snoek. Frozen hake, haddock, fish finders, cakes. Canned tuna, pilchards in tomato sauce, pilchards in chilli sauce, sardines, fish paste. Fish portions in crumbs, fish portions in batter, smoked fish, dried fish. Frozen sea food mixture, shrimps, lobster.	0.69	Frozen: hake, fish fingers, crumbed fish portions, battered fish portions. Tinned: tuna and other fish. Fish paste	0.67
CPI_dairy	Milk, cheese and eggs	Fresh milk, maas, butter milk, sour milk, cream, yoghurt plain and flavoured, sorbet, full cream ice cream, frozen yoghurt, skimmed milk powder, whiteners, condensed milk, evaporated milk, longlife milk, milk formula, soya milk	1.96	Fresh and long life full cream and low fat and powdered, condensed, sour and evaporated milk, whiteners, plain and flavoured yoghurt, cheddar and gouda cheese and cheese spread, fresh cream, prepared custard and eggs	1.78
CPI_fatsandoils	Fats and oils	Choice butter, medium fat spread, low fat spread, yellow margarine block, cooking oil, peanut butter, vegetable cooking fat, lard	0.76	Margarine spread and brick, peanut butter and sunflower oil	0.50
CPI_fruit	Fruit	Apples, grapes apricots, peaches, plums, pears, bananas, pawpaw's, pineapples, mangoes, avocado's, guavas, oranges, naartjies, grapefruit, lemons, watermelon, strawberries, melon. Canned: pears, peaches, guavas, fruit cocktail. Dried: peaches, prunes, raisins. Fruit juice. Roasted/not roasted coconut, almonds, pecans, walnuts, peanuts, baby food, granadilla pulp, dates.	1.09	Fresh oranges, lemons, bananas and apples. Dried fruit, raisins, nuts and peanuts.	0.45
CPI_vegetables	Vegetables	Potatoes, sweet potatoes, green mealies, onion, tomato, green beans, cabbage, cauliflower, carrots, pumpkin, marrow, gem squash, beetroot, lettuce, marogo, other fresh. Frozen: green beans, peas, carrots, mixed vegetables, cauliflower, corn kernels, potato chips, pumpkin. Canned: corn, sweet corn, baked beans, peas, butter beans, green beans. Dries: peas, beans, lentils. Baby food. Prepared salads.	2.00	Fresh lettuce, spinach/marogo, cabbage, cauliflower, broccoli, tomatoes, pumpkin, green/yellow/red peppers, cucumber, green mealies, onions, carrots, beetroot, mushrooms, potatoes and sweet potatoes. Frozen vegetables, peas, potato chips and carrots. Dried peas, beans and lentils. Tinned sweet corn, baked beans, peas and butter beans. Prepared salads, atchaar and potato crisps.	1.54
CPI_sugar	Sugar	White and brown sugar, artificial sweeteners, icing sugar, castor sugar	0.50	White and brown sugar, chocolate slab and bar, sweets, ice cream	0.70
CPI_hotbeverages	Hot Beverages	Instant coffee, ground coffee, coffee beans, Ceylon tea leaves, tag less, tagged, rooibos tea leaves, bags, herbal tea leaves, bags, cocoa, hot chocolate	1.07	Instant coffee, Ceylon/black and rooibos tea	0.31
CPI_nab	Non-alcoholic beverages	Soft drinks: orange, coca-cola. Mineral water. Orange squash and other flavours. Flavoured drink syrups.	1.10	Coffee, tea, fizzy drinks (can and bottle) fruit juice (and concentrates), dairy mixtures	1.35
CPI_alcholic	Alcoholic beverages	Brandy, Whisky (local and imported), gin, vodka, cane, liqueur. Beer, lager, dark (English), apple cider, sorghum (prepacked and own container). Wine, natural dry red, semi-sweet white, sparkling, cooking, sherry (medium cream and other), port. Alcoholic fruit beverages	1.40	Brandy, whiskey, liqueur, red and white wine, sherry, port, local beer, imported beer	3.38
CPI_tobacco	Cigarettes and tobacco	Cigarettes and tobacco	1.14	Cigarettes and tobacco	2.24

Appendix A (continued)

Variable	Description	Old CPI Comprises:	Weight	New CPI Comprises:	Weight
CPI_clothingfoot	Clothing and footwear		3.25		3.89
CPI_clothing	Clothing	Encompasses everything in the new and quite a bit more, including patterns, non-disposable nappies, lace etc.	2.04	Socks, business and casual trousers, jeans, business and casual shirts, jacket, knitwear, underpants, business and casual skirts, blouse, shirt, pyjamas, bra, panties, dress, t-shirt, shorts, tracksuit trousers and top, non-disposable nappies, baby-grow, water-proof.	2.73
CPI_footwear	Footwear	Boots, shoes and sandals, takkies, running shoes, slippers, golf shoes, slip-ons, footwear repairs	1.21	Shoes, sports shoes, slippers, sandals, infant shoes	1.16
CPI_fuel	Fuel	Electricity, gas, paraffin, firewood, charcoal, coal, methylated spirits.	3.49	Electricity, paraffin, firewood and candles	1.71
CPI_furnitureandequip	Furniture and equipment		2.53		5.62
CPI_furniture	Furniture	Bedroom suite, wardrobe, dressing table, cot, dining room suite, lounge suite, kitchen table, cabinet unit, garden furniture, loose chairs, wall unit, display cabinet, coffee table, desk, carpets, runner, floor tiles, repair costs	0.95	Bedroom suite, dining room suite, lounge suite, kitchen table and chairs, fitted carpets, floor tiles, loose carpets	1.11
CPI_appliances	Household appliances	Refrigerator, deep freezer and refrigerator combination, chest freezer, stoves, microwave oven, washing machine, dish washer, tumble drier, vacuum cleaner, floor polisher, carpet cleaner, iron, kettles and percolators, sewing machine, over locker, knitting machine, electrical beater, food processor, electric frying pan, toaster, waffle pan, sandwich-maker, lawn mower and edge trimmer, heater, lamp, fan, non electric stoves, heaters, sewing machines, lawnmowers. Repairs.	0.80	Refrigerator/Freezer and refrigerator combination, Freezer, stove and oven, microwave oven, iron, kettle, electrical frying pan, toaster	0.72
CPI_hhconsumables	Household consumables	Soap, washing powder, liquid detergents and bleaches, brushes and brooms, polish, scouring agents, matches and candles, fertilizer and lime, chlorine and acid, other cleaners	1.25	Bleach, laundry soap, washing powder, dish-washing liquid, wax shoe polish, air freshener, indoor insecticide, domestic worker wages	2.72
CPI_domesticworkers	Domestic workers		3.48		2.12
CPI_health	Health	Doctors fees, dentists fees, physiotherapists, occupational therapists, opticians, traditional doctors, hospitals, nursing homes, clinics, prescription medicines, prescription fees, other medicine, therapeutic appliances and equipment, contributions to medical aid, medical insurance	7.15	Pain killers, cough mixture, vitamin and mineral supplement, sinus medication, fungal medication, cold and flu medication, heartburn medication, muscle pain relief gel, sore throat lozenges, laxative, GP's, Obs and Gynae's, Physicians, Paediatricians, Dentists, Ward fees, Theatre fees and consumables.	1.47
CPI_transport	Transport		14.84		19.16
CPI_vehicles	Vehicles	Sedan, Station wagon, mini-buses, bakkies, four-wheel drives, motor cycles, scooters, bicycles, caravans all new and used	5.95	Hatchback, Sedan, Bakkie, SUV/MPV all new and second hand options	11.55
CPI_runningcosts	Running costs	Fuel, oil and ghries, tyres and tubes, batteries, shock absorber, disc pads, brake shoe, engine cylinder head gasket, piston, rings, exhaust valve, distributor points, main bearing linters, clutch friction plate, oil filter element, air filter element, spark plug, fan belt, headlight, fuel pump, services, installation costs, panel beating and other repair work, licence and registration fees, toll fees, parking fees, traffic fines, driving lessons, car wash	7.05	Tyre, shock absorbers, Disk pads, Engine cylinder head, gasket, clutch friction plate, spark plug, fan belt, unleaded petrol, diesel, minor service, major service, car wash, licence issue and application fees, motor vehicle licence and registration fees, parking, toll fees	4.85
CPI_publictransport	Public transport	Bus fees, Train fees, Taxi's and rented vehicles, boat transport, aeroplane, other	1.84	Train fees, local bus fares, taxi fare, long-distance bus fares, air fares	2.76
CPI_communication	Communication	Telephone fees, Cellular phone fees, internet subscription, postage, other	2.98	Stamps, rental of post box, cell phone, telephone fees, cell phone fees, internet subscription costs	3.21
CPI_recreationculture	Recreation and culture		3.31		4.30
CPI_readingmatter	Reading matter	Books, magazines, newspapers	0.39	Top 10 books, newspapers, magazine, writing pad, pencil pen	0.75
CPI_education	Education	Tuition and attendance fees for day care mothers, crèches and playgroups, pre-primary schools and after school centres, school fees, teachers training, agricultural and technical colleges, university fees, private tuition, other	3.48	Primary school fees, secondary school fees, university fees	2.33
CPI_personalcare	Personal Care	Hairdressers, hair drier, hot brush, warm curlers, electrical shaver, shampoo, hair spray, mousse, gel, relaxers, colour shampoo, conditioner, soap, bath oils and salts, toothpaste, tooth brush, moth-wash, dental floss, shaving soap, cream, blades, after-shave lotion, perfume and colognes, make up, wigs and hair pieces, powder and deodorants, toilet paper others	3.67	Shampoo, conditioner, tissues, sanitary pads, tampons, bar of soap, toothbrush, skin lotion, roll-on deodorant, toilet paper, disposable nappies, toothpaste, aerosol deodorant	1.57

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