WHAT PRICE-LEVEL DATA CAN TELL US ABOUT CONSUMER PRICE RIGIDITY IN ZIMBABWE

Mike Nyawo*

Stellenbosch University

ABSTRACT

This paper reports findings of the main features of pricing and price setting behaviour over the period corresponding to the introduction of the multicurrency system in Zimbabwe. The data covers 291 products items spanning across 21 supermarkets and is unique by product, store, brand and unit. In particular, the paper reports the frequency and size of price changes, the duration of prices and heterogeneity in the pricing behaviour across different product categories. The paper finds that price changes are infrequent but change more than once a year. There is evidence of substantial heterogeneity in price setting behaviour across different products categories. In addition, variations in the frequency of price changes tend to co-move together with month-on-month inflation rates and the size of price decreases seem to be more common than the size of price increases, suggesting downward nominal price rigidity. Further research is essential to decompose the variation of the frequency of price changes and to unpack the synchronisation in the setting of price within and across retail outlets.

JEL Classification: E30, E31, D40, D21

Keywords: Pricing conduct, multicurrency, pricing heterogeneity, price rigidity

* Mike Nyawo (mikenyawo@sun.ac.za) is a PhD Candidate at the Department of Economics of Stellenbosch University. This work was done under the supervision of Prof Neil Rankin, whom I wish to thank for the fruitful discussions and invaluable comments.

1 INTRODUCTION

The study of pricing and price setting behaviour of firms at a disaggregated level is an important part of economic theory and is the starting point of modern-founded macro models (Nchake, Edwards, & Rankin, 2014b). Baudry (2007) argues that the response of output, inflation and employment to a shock is highly dependent on the flexibility of prices. A number of theories on price stickiness have been developed (see Taylor, 1980 and Calvo, 1983), but their assessment on flexibility of prices has been limited due to lack of information, particularly disaggregated data at consumer price level. Historically, most micro-studies which used disaggregated data concentrated more on specific products or markets (see Cechetti, 1986 on magazine prices, Lach and Tsiddon, 1992 on food product prices).

In light of this, there has been a renewed interest in the study of pricing and price setting behaviour of firms at a disaggregated level driven by the increasing availability of rich micro price data sets (Klenow & Malin, 2010a). The increasing body of evidence has grown over the past decade and has allowed researchers to re-evaluate theoretical pricing models and to assess the role of price stickiness in generating persistent responses of output to monetary shocks (Elberg, 2014). Studies of micro price data sets used to compute the CPI have been used in a number of countries to study price dynamics at a micro level, including the United States ((Bils & Klenow, 2004), (Klenow & Malin, 2010a); Spain (Álvarez & Hernando, 2006); Italy (Fabiani, Gattulli, Sabbatini, & G, 2006); France (Baudry, Bihan, Sevestre, & Tarrieu, 2007); South Africa (Creamer, Farrell, & Rankin, 2012); Sierra Leone (Kovanen, 2006); and Lesotho (Nchake et al., 2014b)).

The common findings in these studies is that there appear to be no particular pattern of pricing behaviour across this group of studies, and this means that the outcomes of the empirical findings are country specific. In particular, there has been large heterogeneity in the pricing and price setting behaviour, which is often contradictory to macro-economic theory of price setting. In addition, very little of this type of work has been done for countries that adopt a new currency as a medium of exchange and how price dynamics change during the initial adjustment period. This study contributes to this literature by looking at the price setting behaviour of Zimbabwean retailers using highly disaggregated price data during the period corresponding to the adoption of a multicurrency system to end hyperinflation.

2 BACKGROUND AND CONTEXT OF STUDY

Zimbabwe adopted a multicurrency regime dominated by the US dollar in January 2009 after experiencing a period of hyperinflation and severe economic crisis. Although official statistics last released by the Zimbabwe National Statistics Agency (Zimstat) indicated that month-on-month inflation reached 231 million percent by July 2008, the International Monetary Fund (IMF, 2009) estimated the hyperinflation rate to be 489 billion percent as of September 2008. In an attempt to restore credibility of the financial system, the government of Zimbabwe introduced a multicurrency regime dominated by the US dollar but with the South African Rand, Botswana Pula, British Pound and the Euro also accepted as a medium of exchange.

Soon after the introduction of the multicurrency system, month-on-month inflation declined sharply and prices of commodities began to stabilise (Hanke & Kwok, 2009, p. 362). Most domestic prices were mitigated by lower regional prices particularly from South Africa (Piffaretti, 2011). By examining prices at a highly disaggregated level, it is possible to track these changes and mechanisms through which they occurred. The frequency and size of these price adjustments is important to academics and policy makers for formulation of competition, trade and monetary policy.

Little attention has been devoted to the price dynamics on a micro economic perspective after a country gives away its seignorage and adopts a foreign currency as a medium of exchange. Although Pesantes (2005) analysed how Ecuador adjusted after it dollarized in 1999 using CPI data, this study differs in that it provides a more detailed analysis of price setting behaviour of firms after the adoption of a new currency. In addition, the dynamics and circumstances leading to the implementation of dollarization in Ecuador are quite different to the Zimbabwean perspective[2]. It is within this context that this study will be carried out. The primary focus of this paper is the unique dataset on monthly product prices at the retail level obtained from the National Incomes and Pricing Commission in Zimbabwe.

[2] The economy of Ecuador was rocked by a number of external shocks [Berckermen (2002) mentioned that a significant drop in oil prices, foreign financial crisis in South East Asia, Russia and Brazil and extensive damage to agriculture and infrastructure by El Nino]

3 LITERATURE REVIEW

3.1 Introduction

Literature has analysed theoretical models of pricing and pricing behaviour to explain nominal rigidities and price stickiness. Two types of models are dominant in literature: time dependant and state dependant pricing models. The next section will describe and explain these two groups of models, highlighting their notable differences and try to link them in the developing country context. In addition, related empirical evidence on price setting behaviour will be analysed, to compare the findings to theoretical models of price setting behaviour.

3.2 Theoretical evidence of price setting

3.2.1 Time dependant pricing models

In time dependent pricing models, price changes are exogenous to the firm and are determined by the passage of time. A firm set its price every nth period (Taylor, 1980) or randomly (Calvo, 1983). Firms decide to change prices independent of the economic environment. Two of the commonly used time dependant pricing models are based on papers by Taylor (1980) and Calvo (1983).

According to Taylor (1980), firms set prices of goods knowing exactly how long the price will last before they decide to change the price. Prices are kept unchanged for a fixed period of time, and all firms in the industry know when to change their prices. The main weakness of this pricing model is that it ignores the concept of heterogeneity of different firms and cannot be applied to extreme changes in economic conditions. This type of model is more applicable to regulated prices (such as social service delivery, mostly in the education and health sector) in developing countries.

The model introduced by Calvo (1983) highlights the issue of staggered contracts in pricing. The paper postulates that there is a constant probability that firms can set a new price, but however, do not know how long the price spell will last. The response of prices to a shock is spread overtime. The firm faces a probability distribution over possible price spell durations and unlike in the Taylor model where all completed price spells have the same length, there will be at any time a distribution of completed price spell lengths. The major weakness is that Calvo pricing model fall short of standards during periods of extreme changes in economic conditions such as high inflationary environments.

In conclusion, time dependant pricing models have been criticised because of their assumption that price changes are exogenous. They ignore the fact that there is heterogeneity among different firms

and that firms react differently to shocks that affect the economy. This means that firms are not allowed to change their price even if the costs of not changing that price exceed the benefits.

3.2.2 State dependant pricing models

In state dependant pricing models, the decision to change prices is assumed to be endogenous. It is based on changes that are in the market and not related to the passage of time. Firms only change their prices when they experience a shock and there is no routine in which firms change their prices. This means that prices are changed when the benefit of changing a price exceeds the menu cost[3] of changing the price. Each firm faces different costs of changing prices, meaning that in state dependant pricing, the shape of the hazard function is increasing. At the start of each period, there is a separate distribution of firms which changed their prices at different periods in the past. If there happens to be a shock in the economy, the benefit of changing prices would be higher for those firms who last changed their prices further back in time which means that such a firm has a higher probability of changing prices since it would the experience accumulated shocks from the last period it changed prices.

The most prominent model of this type is by Dotsey *et al*. (1999) who develop a dynamic stochastic general equilibrium model of state dependant pricing. In this model, an economy is characterised by monopolistic competition where all firms have common technology and common factor markets, implying that marginal costs are the same between firms. Therefore, all firms face stochastic price adjustments costs which are independently and identically distributed across firms and across time. Firms evaluating their prices weigh the expected benefit of adjusting their prices against the price adjustment costs realised in the current period. This implies that in equilibrium, not all firms will change their prices, but the decision to change prices will depend on the benefit of changing the price and the current value of the costs of changing that price.

(Dotsey et al., 1999) find that the fraction of firms changing prices responds to monetary shocks, that is a positive monetary shock induces more firms to change their prices whilst a negative monetary shock induces fewer firms to change their prices. (Klenow & Kryvtsov, 2008) argue that when more firms adjust their prices, the average size of price adjustment is larger. This in turn means that the endogenous bunching of prices speeds up the price adjustment process and dampen short run effects on real output.

[3] Menu costs are those costs incurred by firms when they change prices.

A more recent model on state dependent pricing models is by Golosov and Lucas (2003) who developed a model of a monetary economy in which individual firms are subject to idiosyncratic productivity shocks as well as general inflation. In this model, firms only change their prices when they incur a real menu cost. The study finds that the average size of the change in the individual prices that are adjusted is much larger than the expected inflation between adjustments. This model is different to the one by Dotsey et al (1999) in that idiosyncratic shocks (shocks that affect productivity) are responsible for most of the price changes. In Dotsey et al. (1999), idiosyncratic shocks affect individual firm's menu cost, and this influences firms that will re-price at a given time. In Golosov and Lucas (2003) model, in contrast, the idiosyncratic shock affects productivity, and affects all firms who re-price the new prices of those who do.

In conclusion, state dependant pricing models predict that economic agents base their behaviour on economic shocks and that the timing of price changes is endogenous. Although literature recommends state dependant pricing models, few studies have been done with the exception of Dotsey *et al.* (1999) and Golosov and Lucas (2003). To conclude, this section gave an analysis of the two theoretical pricing models and how they are used to model price rigidities. Two factors have been introduced which explain the degree on nominal rigidities, and these include idiosyncratic shocks and the existence of menu costs which lead to small price changes.

3.3 Related empirical evidence of price setting

Empirical research using micro level price data has grown rapidly in recent years mostly due to the availability of disaggregated data which is used in the computation of CPI. For example, Bils and Klenow (2004) and Klenow and Kryvstov (2008) analysed prices using disaggregated data for the United States. Evidence for several European countries is also available such as Alvarez and Hernando (2006), Aucremanne and Dhyne(2004, n.d.), Baudry et al (2007). Recent studies for developing countries include Kovanen (2006) for Sierra Leone, Creamer, Farrell and Rankin (2008) for South Africa and Nchake (2013) for Lesotho. These studies have provided new insights to price setting behaviour of firms and there are a number of common findings across these studies.

Firstly, there is substantial heterogeneity both within and across different product categories. In particular, Klenow and Malin (2010) examined at the role of price setting in business cycles using both CPI and PPI data for the United States. The study finds that the frequency of price changes

differs widely across goods, with more cyclical goods exhibiting greater price flexibility. Klenow & Kryvtsov (1997) reported that there is heterogeneity between regular and posted prices while studies by Álvarez & Hernando (2006); Aucremanne et al (2004); Baudry et al.(2007); Creamer et al. (2012) and Nchake et al. (2014) report that there is significant heterogeneity across different product categories.

Secondly, literature finds that price changes are relatively infrequent. Creamer *et al* (2012) finds that individual prices change more frequently than once per year in South Africa. For CPI micro data, the average price duration for South Africa is 5.0 months. Developed countries tend to have lower frequency of price changes (see Álvarez & Hernando (2006); Aucremanne et al (2004); Baudry et al.(2007); Bils and Klenow (2004)) compared to developing countries (see Nchake, Edwards and Rankin (2014); Kovanen, (2006); Gouvea (2007)).

In addition, most studies which have used micro price datasets noted that on average price changes are relatively large, although many small price changes occur. Creamer *et al* (2012) finds that South African micro price data reveal relatively large magnitude of price changes and this assertion has also been supported by Gouvea (2007) and Nchake *et al* (2014b) for developing countries. Klenow & Kryvtsov (2008) and Nakamura & Steinsson (2008) also show that price changes are relatively large for developed countries.

Furhermore, Klenow & Kryvtsov (2008) analysed price setting in the United States using disaggregated CPI data during the period 1988 to 2003. They find that the variance in monthly inflation is explained by fluctuations in the average size of price changes rather than the frequency of price changes in each month. This means that that pricing behaviour in the US is consistent with the assumptions of time dependant pricing model (Klenow & Kryvtsov, 2008). A similar study for Lesotho by Nchake et al. (2014b) find consistent results using the same approach, concluding that variations in inflation are strongly correlated with the average size of price changes.

Álvarez & Hernando (2006) for Portugal, Aucremanne et al (2004) for Belguim and Baudry et al.(2007) for France are all examples of studies that examine the price setting behaviour of European firms using micro level price data. They all use the frequency of price changes, and the size and the probability of price changes to ascertain price setting behaviour of European retailers using CPI data.

The common result from these studies is that they find relatively lower frequencies of price changes and longer price duration spells. In addition, they find that there is marked heterogeneity across product categories and that price do not change more often but do so by a large amount. Overally, there is also evidence of both time dependant and state dependant pricing models across the studies.

Recently, there has been a growing number of similar studies for a number of African countries: (see Nchake, Edwards and Rankin (2014) for Lesotho, Kovanen, (2006) for Sierra Leone, Edwards and Rankin (2012) for African cities, and Creamer et al (2012) for South Africa). These use CPI data to calculate the price setting behaviour of retailers. Specifically Nchake (2014) examined the price setting behaviour of firms in Lesotho using disaggregated data used in the computation of the country's CPI. Furthermore, Creamer and Rankin (2008) and Kovanen (2006) analysed price setting behaviour in South Africa and Sierra Leone respectively using micro price level data. Results from both studies reveals that there is no particular patter in the price setting behaviour across countries, hence the need to conduct country specific studies.

There is a relatively small literature which analyses price setting behaviour for countries who adopt a new currency as a medium of exchange. Pesantes (2005) studied price dynamics before and after dollarization for the case of Ecuador. The paper examined real exchange rates in relative and absolute terms and also the Consumer Price Index (CPI) before and after the adoption of the US dollar and finds that micro-prices are stationary as a panel with half-lives of about twelve months. The paper also found that, after start of dollarization, price levels became more integrated for eleven Ecuadorian cities.

The only other study I am aware of which uses micro price data to examine price adjustment and currency change is Cavallo et al. (2014). This paper examines Latvia, a country which dropped its pegged exchange rate and joined the euro zone, and uses high frequency good level data prices of thousands of differentiated goods sold by Zara, the world's largest clothing retailer. This data is scraped from the website but although covers many differentiated products is only for clothing and footwear. The paper finds that price dispersion between Latvia and Euro countries collapsed swiftly following entry into the euro.

Lastly, literature on price adjustment after high inflationary periods is limited. Angeloni et al (2006) examined the price setting behaviour and inflation persistence before and after the introduction of the euro in 1999 for six euro area countries. The paper argues that the motivation behind joining the euro area for most countries was that of monetary stability, and also moving away from high inflation and exchange rate instability. The study finds no evidence that euro changeover in 1999 brought any change in price setting and inflation persistence. Similar results were also drawn from Hoffman (2006) who provided patterns of price setting behaviour at the retail level in Germany for the period 1998 to 2003 under low rates of inflation. The paper finds that there is no persistence change in individual prices of commodities, but that measures of frequency and size of price changes exhibited serial correlation.

This paper adds on to the growing literature on micro price data sets for low income countries in Africa, albeit in different economic environments. In particular, there is little evidence for countries that adopt a new currency as a medium of exchange and this paper intends to fill in this research gap. In addition the nature of the data and the nature of the shock prior to the change in currency for Zimbabwe are quite different to studies which were done in Latvia and Ecuador.

4 METHODOLOGY AND DATA

4.1 Introduction

This chapter is purely descriptive. The main aim is to calculate the aggregate monthly frequency of price changes, and disaggregate it into within and across product categories. Furthermore, the paper will also calculate the size or magnitude of price changes to calculate how big the price changes are, and if so, analyse and compare it with the CPI monthly inflation for Zimbabwe within that period of analysis. The rest of the chapter will constitute data description, the frequency and size of price changes and concluding remarks.

4.2 Data description

To address the research question, the study uses unique data constructed from primary sources of weekly product prices at the retail outlet level obtained from the National Income and Pricing Commission in Zimbabwe [4](NIPC). The data is unpublished and was obtained directly from the National Incomes and Pricing Commission in Zimbabwe. The raw data consists of 291 products spanning across 21 supermarkets in Harare Metropolitan province for the period January 2012 to February 2015, with 196,199 price records (Table 1). NIPC collects approximately 30 percent of the products in the entire CPI basket. Each individual price record has information on the date; retail outlet; product and brand; quantity; unique codes and prices of individual items. Some of the supermarkets are part of two big retail chains in Zimbabwe. The uniqueness of this data is that it varies by retailer, by product, by unit, by location and by brand. The data is available for a wide range of products. The set of retailers included in this data is largely representative of the Zimbabwean supermarket as a whole since the supermarket industry in Zimbabwe is highly concentrated in Harare. Raw data include weekly prices for a given brand in a given store in different units.

[4] The National Incomes and Pricing commission was established by the government in 2004 to monitor prices of basic commodities in Zimbabwe. It was amended in 2010, with a new primary objective of guiding producers, wholesalers and retailers as well as advising Government on price trends.

Table 1: Price records by major groups

Product class	Price quotes		Product items		Zimstat CPI Weights	CPI Re-weights
	Number	Percent	Number	Percent	Percent	Percent
Food						
Bread and Cereals	31 272	15.94	57	19.59	10.29	34.02
Meat	11 422	5.82	24	8.25	5.26	17.40
Milk, Cheese and Eggs	14 643	7.46	24	8.25	1.86	6.15
Oil and Fats	14 604	7.44	35	12.03	2.30	7.60
Vegetables	16 299	8.31	27	9.28	1.88	6.21
Sugar, jam, honey, chocolate and confectionery	4 896	2.50	15	5.15	2.48	8.20
Other food products	10 835	5.52	8	2.75	0.39	1.29
Coffee, tea and cocoa	8 335	4.25	7	2.41	0.22	0.73
Mineral waters, soft drinks, fruit and vegetable juices	12 880	6.56	19	6.53	0.72	2.38
Beer	2 038	1.04	1	0.34	0.72	2.37
Non-food products						
Household Maintenance	29 310	14.94	34	11.68	2.60	8.60
Stationery	5 540	2.82	6	2.06	0.32	1.04
Other appliances, articles and products for personal care	34 125	17.39	34	11.68	1.21	4.00
Total	**196 199**	**100**	**291**	**100**	**30.24**	**100**

Table 1 shows a summary of the disaggregated data by major product groupings. There are 291 products in the dataset, with food products constituting 75 percent of all the products. In terms of price records, food products constitutes 65 percent of the total price records. Bread and Cereals constitutes the greatest proportion (19.59 percent) of all the products in the dataset, despite having only 31,272 price records (compared to 34,125 price records by other appliances, articles and products of personal care), followed by oils and fats with 12.03 percent (14,604 price records).Other appliances, articles and products of personal care are overrepresented in the sample relative to their share of total product items. Oils and fats are underrepresented (14,604 price quotes) relative to the number of product items (35) in the dataset.

4.3 Specific Data Issues and weighting

Raw data is compiled by National Incomes and Pricing Commission on a weekly basis and comes in excel files. Since there are some missing weeks in the data, data is converted into monthly price data with the middle of the month[5] price as the reference price for that particular month. In the case of a missing price during the middle of the month, the closest price to the range (middle of the month) will be the reference price for that particular month. Products with less than 100 observations are

[5] In this case, the middle of the month is that price between the 12th and the 18th of each month.

dropped from the final dataset since they provide little variation and might be potentially problematic when calculating the monthly frequencies.

In order to compute the aggregate measure of the frequency and size of price changes, CPI weights obtained from Zimbabwe National Statistics are used. Since, in this paper, NIPC data does not constitute all the products in the CPI basket, it is necessary to reweigh. The procedure to calculate aggregate statistics is to set the weight for each individual observation equal to the weight of the CPI category and then divide it by the number of observations in that category. For each product line and category, it is necessary to calculate a new CPI weight. The new CPI reweights are then multiplied by each product line and summed up to obtain the aggregate frequency and size of price changes.

4.4 Methodological Framework

4.4.1 Frequency of Price Changes

The periodicity of price changes by firms is important to analyse price setting behaviour of firms (Álvarez & Hernando, 2006). Generally, there are two ways to analyse the periodicity- the frequency of price changes approach and the duration approach. This paper uses the frequency of price changes approach based on the type of data available for this study.

The frequency of price changes is an indirect method of estimating the duration of price spells[6]. Álvarez & Hernando (2006) define the frequency of price changes as the percentage of none zero price change observations over the total number of observations. An advantage of using the frequency of price changes approach is that it uses all the statistical information available and is less affected by selection bias (Álvarez & Hernando, 2006). In addition, Baudry (2007) argues that the frequency of price changes does not require a long time series of data as the measure is less sensitive to specific events. For example, a certain month can be ignored if it is characterized by an exceptional event (according to Baudry, 2007, one can ignore a specific month characterized by say, an increase in value added tax).This applies to the NIPC dataset used for this paper, as there are two months where data was not collected at all in the dataset.

Furthermore, Baudry (2007) argues that, assuming homogeneity and stationarity in the data set, the inverse of frequency of price changes converges to the mean duration. The mean duration can be used to estimate the average duration of price spells, that is, it gives the precise monthly interval for which

[6] The duration of price spells is calculated as the inverse of the frequency of price changes.

prices change. Under stationarity and homogeneity assumptions, the frequency of price changes gives an indirect estimate of the duration of price spells.

Following Creamer *et al* (2012), the frequency of price changes is defined as the percentage of all non-zero price changes over the total number of observation. To calculate the frequency of price changes, the paper specifies an indicator variable which takes the following form:

$$I_{ijk,t} = \begin{Bmatrix} 1 \; if \; p_{ijk,t} \neq p_{ijk,t-1} \\ 0 \; if \; p_{ijk,t} = p_{ijk,t-1} \end{Bmatrix}$$

Where $p_{ik,t}$ is the log price of product *k* in store *i* and time *t*. The indicator variable is then used to calculate the frequency of price changes. More specifically, the frequency of price changes to be estimated will be as follows:

$$Freq_{ijk} = (\frac{1}{T_{ijk}}) \sum_{t=2}^{T_{ijk}} I_{ijk,t}$$

Where T_{ijk} is the total monthly observations of the price p_{ijkt}. The study assumes that $I_{ijkt} = 1 \; if \; p_{ijkt} \neq p_{ijkt-1}$ and 0 if $p_{ijkt} = p_{ijkt-1}$. After calculating the product specific measure of frequency, the average frequency is then calculated across outlets, with the weighted average frequency finally computed across a sample of products using recalculated weights based on the Zimbabwe National Statistics. These weights are re-calculated (re-weighted) for only the products in the dataset since NIPC collects only 30 percent of the products in the CPI basket.

4.4.2 Measurement of the direction of price change

It is necessary to capture the direction of a price change, which is either the frequency of price increases or price decreases. An indicator of price increases and decreases takes the following specification:

$$I^{+}_{ik,t} = \begin{Bmatrix} 1 \; if \; p_{ijk,t} > p_{ijk,t-1} \\ 0 \; otherwise \end{Bmatrix}$$

$$I^{-}_{ik,t} = \begin{Bmatrix} 1 \; if \; p_{ijk,t} < p_{ijk,t-1} \\ 0 \; otherwise \end{Bmatrix}$$

This indicator variable is then used to calculate the average frequency of price increases and decreases within and across product categories.

4.4.3 Size of price changes

The size of price changes captures the intensive margin whereas the frequency of price changes captures the extensive margin. However, it can also be used as an alternative to the frequency of price changes. This paper will calculate the size of price changes at the store/product level as the month on month log differences in prices such that $p_{ijkt} \neq p_{ijkt-1}$ for every change in price. For each price line, the average of the absolute values for each are taken for each of the log price differences over the period January 2012 to February 2015. The average monthly magnitude of price increases and decreases following Creamer *et al* (2012) will be calculated as follows:

$$M^{+} = \frac{\sum_{i=1}^{N}\left(\ln p_{ijkt} - \ln p_{ijkt-1}\right)}{N}$$

Where $\ln p_{ijkt} - \ln p_{ijkt-1} > 0$ (for the magnitude of price increases) and $\ln p_{ijkt} - \ln p_{ijkt-1} < 0$ (for the magnitude of price decreases). *p* is the magnitude of the price of a specific item in a specific region, and N is the number of observations where price magnitude increase (as price changes of 0 are not included in the calculation of average price change magnitudes).

5 PRICING STYLISED FACTS AND ZIMBABWE

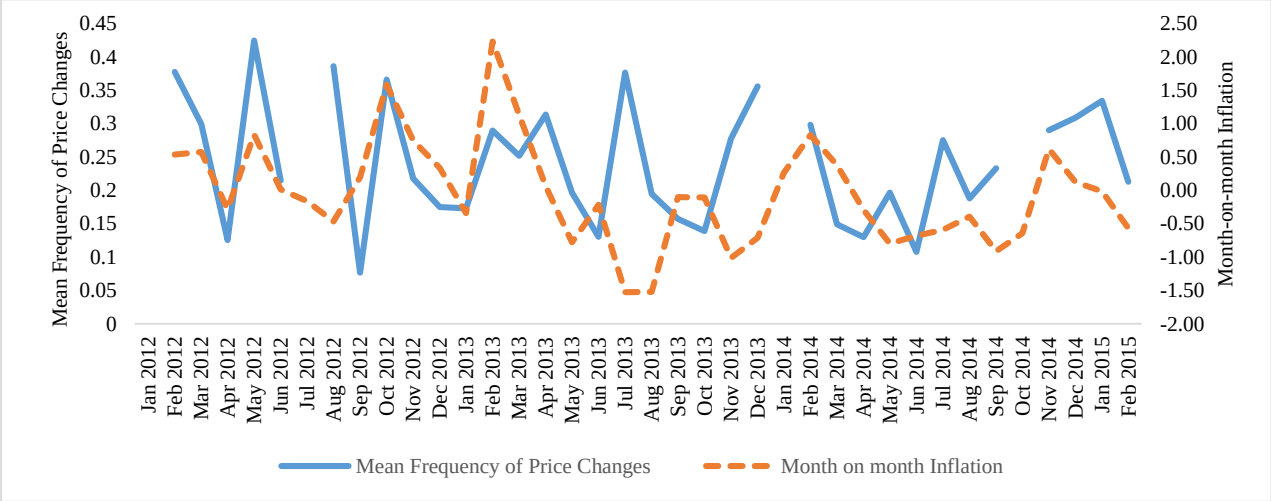
5.1 Introduction

This section will present and analyse the stylised facts that characterise price setting and pricing behaviour by retail outlets in Zimbabwe. In particular, the section will analyse the frequency and the size of price changes within and across product categories. The frequency and size of price changes will be disaggregated into product categories to show heterogeneity across product categories. In addition, the section will examine the relationship between size of price changes and month-on-month inflation computed by the Zimbabwe Statistical Office (Zimstats) for the basket of commodities in the dataset.

5.2 Frequency of price changes

The frequency of price changes is an indirect measure of the average duration of price spells. Assuming stationarity and homogeneity of the data, the inverse of the frequency of price changes indirectly estimates the average mean duration of price spells. On average, in Zimbabwe, prices change more frequently than once per year. Evidence shows that the frequency of price changes varies overtime. This variation of the frequency of price changes can be shown in Fig 1.

Figure 1: Frequency of price changes per month and month-on-month inflation



Note: The month on month inflation rate was calculated for the products only in the dataset using the magnitude of price changes and Consumer Price Index reweights.

Figure 1 shows that the varying frequency of price changes is co-moves together with the month on month inflation. It can be seen that the upward and downward movements in the frequency of price changes mimics the upward and downward movement in the month on month inflation rate.

Over the period from January 2012 to February 2015, the average monthly frequency of price changes is 23.6 percent. This means that each month, an average of 23.6 percent of prices changes across all product categories with an implied duration of 4.24 months (Table 2). After reweighting the data using disaggregated Consumer Price Index (CPI) weights used by Zimbabwe National Statistics (Zimstat) according to various product categories, the average monthly frequency of price changes increases to 25.6 percent with an implied monthly duration of 3.91 months. Reweighting allows for comparability across all product categories, since, for example food products, with high frequencies are overrepresented in the sample.

The data shows varying frequency of price changes with the highest change occurring in May 2012 (42.41 percent) and the lowest frequency of price changes of 7.7 percent occurring September 2012. The highest frequency of price changes, according to Fig 1, is also associated with rising inflation, with the lowest frequency of price changes associated with lower inflation rates.

Table 2: Average frequency of price changes across all products

	Aggregate	**Increases**	**Decreases**
Mean Frequency of price changes (Unweighted)	0.24	0.114	0.123
Mean frequency of price changes (Weighted)	0.26	0.127	0.129

Furthermore, micro price data for Zimbabwe shows that price changes are infrequent and varies across countries. At aggregate level, the weighted average frequency of price changes for Zimbabwe (26 percent) is close to that of the United States (24.8 percent). However, comparing with other African countries, Zimbabwe has significantly lower frequency of price changes compared to that of Lesotho (37 percent) and Sierra Leone (51 percent) with the exception of South Africa which exhibited a lower frequency of price changes (17 percent). Compared to developed countries, particularly the Euro area, Zimbabwe has a significantly higher frequency of price changes as evidenced by the results for Spain (15 percent), France (18.9 percent), Belgium (17 percent) and Euro area (15 percent) (Table 3).

Table 3: Comparison of the frequency of price changes across countries

	Frequency of price changes (%)	Mean Implied Duration
Zimbabwe (2012-2015)	26	3.8
Lesotho (2002-2009)	37.1	2.7
South Africa (2002-2007)	17.1	5.8
Sierra Leone (1998-2003)	51	2.0
United States (1998-2003)	24.8	4.0
Spain (1993-2001)	15	6.7
France (1994-2003)	18.9	5.3

However, the comparison of frequency of price changes needs to be interpreted with caution due to the different ways in which the data is collected and different methodologies used across studies.

5.3 Heterogeneity in the frequency of price changes

There is significant heterogeneity in the frequency of price changes across different product categories, with prices of perishable products, particularly vegetables, changing more frequently than prices of other products in the dataset. Empirical literature has also supported the notion that there is substantial heterogeneity in price setting behaviour across different product categories (Nchake et al (2014b), Creamer et al (2012), (Klenow & Malin, 2010a).

Table 4: Average frequency of price changes by product categories

Product category	Weighted			Unweighted		
	Frequency of price changes	Frequency of price increases	Frequency of price decreases	Frequency of price changes	Frequency of price increases	Frequency of price decreases
Food						
Bread and Cereals	0.227	0.117	0.109	0.256	0.123	0.133
Meat	0.328	0.160	0.168	0.292	0.138	0.154
Milk, Cheese and Eggs	0.234	0.129	0.105	0.222	0.114	0.108
Oils and fats	0.271	0.131	0.141	0.233	0.114	0.120
Vegetables	0.349	0.159	0.190	0.247	0.115	0.132
Sugar, jam, honey, and confectionery	0.215	0.099	0.116	0.164	0.074	0.090
Other food products	0.161	0.085	0.076	0.188	0.096	0.092
Coffee, tea and cocoa	0.204	0.098	0.105	0.204	0.098	0.105
Mineral Waters, soft drinks, fruit juices	0.199	0.087	0.111	0.181	0.081	0.100
Beer	0.289	0.151	0.138	0.289	0.151	0.138
Non Food Products						
Household maintenance	0.247	0.127	0.120	0.276	0.134	0.142
Stationery	0.122	0.044	0.078	0.157	0.068	0.090
Personal Care	0.236	0.113	0.123	0.234	0.112	0.122

Using CPI reweights, vegetables exhibited the highest frequency of prices changes, with 35 percent of vegetable prices changing each month, followed by meat with 33 percent of prices changing each month. Prices of perishable products are more volatile due to the storage costs, and this may cause prices to fluctuate since retailers may want to pass these costs to consumers more quickly to avoid selling below marginal cost (Klenow & Malin, 2010). In addition, the supply of perishable foods is more likely to be affected by variable weather patterns ((Nchake et al., 2014b). Stationery recorded the lowest frequency of price changes throughout the whole period, with 12 percent stationery changing each month. High frequencies for perishable (food) products are also found in (Nchake et al., 2014b) for Lesotho and (Creamer et al., 2012) for South Africa.

5.4 Frequency of price increases and decreases

The aggregate frequency of price changes is the summation of the frequency of price increases and the frequency of price decreases. The disaggregation of the frequency of price changes is important, particularly when they display offsetting movements in response the aggregate shocks in the economy (Nchake et al., 2014b). According to Klenow and Kryvtsov (2008), in Nchake, Edwards and Rankin (2014a), rising inflation raises the frequency of price increases and lowers the frequency of price decreases.

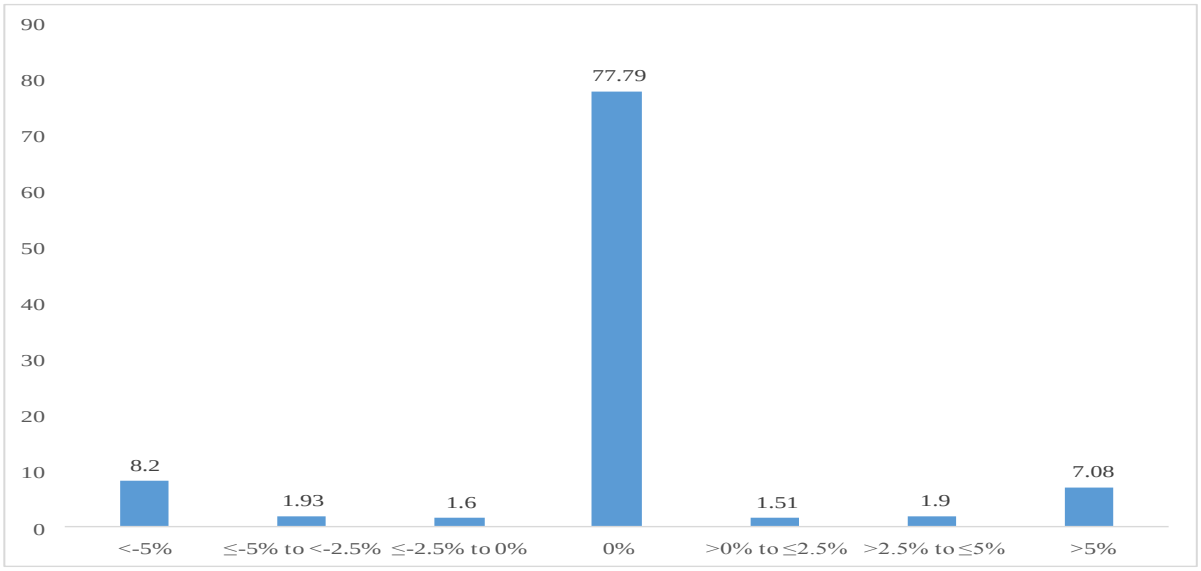
Table 4 shows the weighted and unweighted average frequency of price increases and price decreases across major product categories. Frequency of price decreases are more common than frequency of price increases across all product categories. The weighted average frequency of price decreases is 12.9 percent while the weighted average frequency of price increases is 12.7 percent.

There is substantial heterogeneity in the frequency of price changes across product categories. Using CPI reweights, it can be seen that vegetables exhibited the highest frequency of price decreases of 19 percent followed by meat with a frequency of price decreases of 17 percent. The unweighted data shows that house hold maintenance had the highest frequency of price increases and decreases. This might be because the product category is overrepresented in the sample. Table 4 shows that household maintenance has the second highest total number of price records (29,310) after Bread & Cereals (31,272). Stationery recorded the lowest frequency of price decreases of 8 percent, reflecting sticky prices. The highest frequency of price increases can be found in beer (15 percent) with other food products recording the lowest frequency of price increases of 8 percent. It can also be seen that products with the highest frequency of price decreases also displayed the highest frequency of price increases (see vegetables and meat).

5.5 Size or magnitude of price changes

The size or magnitude of price changes can also be used as an alternative to the frequency of price changes. According to Klenow & Malin (2010b), the size of price changes captures the intensive margin behind inflation while the frequency of price changes captures the extensive margin (how often price changes). Figure 2 shows the distribution of the magnitude of price changes across all product categories.

Figure 2: Histogram of magnitude of price changes



According to Figure 2 most products do not change prices. In the dataset, 77.79 percent of products do not change prices from the previous period. The histogram also confirms the stylized fact that when prices do change, they are big on average as can be witnessed by fat tails. In absolute terms 15.28 percent of the price changes are bigger than 5 percent, although many small price changes also occur. In general, it can be seen that more than 80 percent constitute no price changes and very small price changes although big price changes are also common. One way to explain this is that, during the study period, there were problems with change (lower denominations) in the economy such that if one firm moves to a new price, that would increase the probability of losing customers. This confirms evidence of price stickiness at lower denominations.

Table 5: Size of price increases and decreases by product category

	Weighted			Unweighted		
Product category	**Size of price changes**	**Size of price increases**	**Size of price decreases**	**Size of price changes**	**Size of price increases**	**Size of price decreases**
Food						
Bread and Cereals	-0.005	0.068	-0.071	-0.001	0.076	-0.081
Meat	-0.006	0.102	-0.112	-0.002	0.102	-0.106
Milk, Cheese and Eggs	0.002	0.083	-0.090	-0.001	0.090	-0.103
Oils and fats	-0.005	0.055	-0.060	-0.001	0.079	-0.080
Vegetables	-0.011	0.206	-0.193	-0.002	0.190	-0.183
Sugar, jam, honey, and confectionery	-0.007	0.069	-0.071	-0.002	0.091	-0.097
Other food products	-0.001	0.119	-0.134	-0.001	0.134	-0.152
Coffee, tea and cocoa	0.005	0.161	-0.141	0.001	0.161	-0.141
Mineral Waters, soft drinks, fruit juices	-0.021	0.128	-0.122	-0.003	0.076	-0.091
Beer	0.002	0.149	-0.159	0.000	0.149	-0.159
Non Food Products						
Household maintenance	-0.009	0.089	-0.108	-0.003	0.115	-0.133
Stationery	-0.032	0.222	-0.163	-0.001	0.284	-0.223
Personal Care	-0.010	0.132	-0.139	-0.003	0.130	-0.143

Table 5 shows the size or magnitude of price changes disaggregated at product category level. There is heterogeneity in the size of price changes, although it is not large as compared to the frequency of price adjustments. The highest size of price changes can be found in vegetables, which tend to increase by 20.6 percent and decrease by 19.3 percent. The lowest size of price changes can be found in oils and fats which tend to increase by increase by 5 percent and decrease by 6 percent.

It can be seen that, for most of the observations, price changes are small. The size of price decreases can be seen to be more common than price increases, suggesting downward nominal price rigidity. However, although the size of price decreases are more frequent than price increases, prices nearly fall as often as they increase across all product categories. The weighted size of price changes across all product categories is -0.61 percent, which tallies with the prevailing inflation rates in Zimbabwe.

6 CONCLUSION

This paper presents new evidence of pricing and price setting behaviour to a country that adopts a new currency as a medium of exchange. It gives new insights on the price stickiness of commodities particularly when the country abandons its own currency and adopts a new currency as a medium of exchange. A number of key stylized are highlighted and there seems to be some similarities when comparing to international literature.

Firstly, price changes at least once a year, and there is variation in the frequency of price changes across product categories during the study period. Using the weighted average frequency of price changes, it can be seen that retailers on average change their prices every 3.91 months. In addition, there is heterogeneity in the price setting behaviour across different product categories, with vegetables and meat (perishables) showing a higher frequency of price changes (flexible prices) and stationery exhibiting a lower frequency of price changes (sticky prices).

In addition, it can also be noted that more that 75 percent of the products in the dataset do not change prices from the previous period. If price do change, they are big on average confirming the stylized fact by Klenow & Malin (2010). A way to explain this was the lack of change (lower denominations) such that it was difficult to increase the price as one could face the possibility of losing customers. There is evidence of downward nominal price rigidity as the size of price decreases can be seen to be more common the size of price increases.

Overally, data confirms that there is evidence of downward nominal price rigidity and that the frequency of price changes varies from country to country. There is scope to for further research as it is essential to decompose the variation in the frequency of price changes and to explore the synchronicity in the price setting behaviour within and across retailers.

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