Price setting behaviour in Lesotho: stylised facts from consumer retail prices*

December 2013

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Abstract

This paper documents some of the main features of price setting behaviour by retail outlets in Lesotho over the period March 2002 to December 2009. The sample of data covers 229 product items for 345 retail outlets. The paper has three main objectives. Firstly, it presents key indicators of price setting behaviour such as the frequency of price changes, the average size of price changes and the probability of price changes at the retail outlet level. Secondly, it identifies some of the dynamic features of price changes, including the synchronization of price changes and the relationship between the frequency and size of price changes and the duration of the existing price. Finally, the paper compares the stylised facts on price setting behaviour in Lesotho to other countries and South Africa in particular. The findings of the paper corroborate those in the international empirical literature. Substantial heterogeneity in price setting behaviour is found across products, outlets and time. Variations in inflation are strongly correlated with the average size of price changes, but rising inflation raises the frequency of price increases and reduces the frequency of price decreases. Surprisingly, the frequency and size of price changes in Lesotho differ substantially from those in South Africa, despite the presence of common retail chains and their joint membership in a customs union and common monetary area. Further research is required to unpack the sources of heterogeneity in the setting of prices and the stark differences in price setting behaviour in Lesotho and South Africa.

Key words: Lesotho, price changes, price rigidity, inflation

JEL codes: E31, D40, D21, L21

* We acknowledge financial support from the Private Enterprise Development in Low-Income Countries (PEDL) project, Centre for Economic Policy Research (CEPR).

1. Introduction

Micro price setting behaviour is central to economic theory. Product prices are the equilibrating variables that ensure product markets clear. The adjustment to equilibrium is in turn affected by how firms adjust prices in response to shocks. This adjustment process has an important bearing for both microeconomic and macroeconomic responses to policy and other shocks.

In modern micro-founded macro models, assumptions regarding the stickiness of product prices at the micro-level shape the real (quantity) macroeconomic responses to nominal shocks that strike the economy (Dias *et al.*, 2007). In time-dependent pricing (TDP) models, firms adjust prices every *n*th period or randomly (Klenow and Kryvtsov, 2008). The timing of price changes is therefore exogenous. In contrast, in state-dependent pricing (SDP) models, the timing of price changes is dependent on the external environment and is subject to “menu costs”. Price changes at the outlet level are driven by common or idiosyncratic shocks. Aggregate prices are therefore more responsive to monetary shocks in SDP models than TDP models, as the shock affects the fraction of firms adjusting prices and/or the average size of those price changes (Klenow and Kryvtsov, 2008). The implication is that there are longer lasting real output effects to monetary shocks in TDP models than SDP models.

Price setting behaviour at the micro-level also affects how macroeconomic or aggregate external shocks are transmitted to individuals and firms via prices. As an example, the transmission of border price shocks to prices at the local level critically determines the poverty outcomes of trade shocks via the employment and consumption channels (McCulloch *et al.*, 2001). Consumer gains from trade liberalisation are reduced if lower border prices do not transmit through to lower prices at the local level. Complementary policies in these cases are required to establish markets, improve competition and deepen market integration

(McCulloch *et al.* 2001). Price setting behaviour at the micro-level therefore has an important bearing on the appropriateness and responsiveness of public policies including monetary policy, exchange rate policy and trade policy to economic shocks.

Analysis of firm pricing behaviour using micro price data has grown rapidly in recent years as micro pricing data has become more available (Klenow and Malin, 2011). These studies have drawn on a variety of data sets including the micro price data used to compile Consumer Price Index (CPI) and Producer Price Index (PPI) measures, scanner data and firm survey data. Most studies, however, have focused on advanced economies.[2] With a few exceptions, the challenge for studies on pricing behaviour in emerging economies has been the availability of price data at the micro level.[3]

Yet, price setting behaviour of firms in emerging economies, where economic shocks are frequent, inflation rates are often high and variable, and weak infrastructure, poor distribution networks and 'thin' markets create frictions to price adjustments, can be expected to be very different to firms in advanced economies. Price setting behaviour in emerging economies may therefore challenge established theories of pricing behaviour as well as empirical models used to simulate the effect of policy and other shocks on the macroeconomic and microeconomics environment in these economies.[4]

This study extends the literature on price setting behaviour in emerging countries using a unique database of monthly product prices by retail outlet for Lesotho, a low-income African country. The data, which covers 229 product items over the period March 2002 to December 2009, are collected from 345 retail outlets by the Lesotho Bureau of Statistics

[2] For example, Bils and Klenow (2004) for the U.S; Fabiani *et al.* (2006) for Italy; Álvarez *et al.* (2006) and Álvarez and Hernando(2007) for Spain; Dabusinskas and Randveer (2006) for the Euro area and Estonia; Dyne *et al.* (2006) for the Euro area and the U.S.; Dias *et al.* (2004) for Portugal; Fisher and Koniezcny (2000) for Canada; and Bunn and Ellis (2012) for the UK. See Klenow and Malin (2011) for a review of micro price studies

[3] Current studies on emerging economies include; Creamer and Rankin (2008) for South Africa; Kovanen (2006) for Sierra Leone; Gouvea (2007) for Brazil; Julio and Zarate (2008) for Colombia.

[4] Creamer *et al.*, (2012), for example, use the micro-data-based findings on pricing conduct in South Africa to modify a Dynamic Stochastic General Equilibrium (DSGE) model commonly used to model the impact of monetary policy in South Africa.

(BOS) as part of their Consumer Price Index (CPI) calculations. The dataset used is thus very similar in structure to those used in the studies of other countries mentioned above.

The paper has three main objectives. Firstly, it identifies and presents the stylized facts that characterize the setting of product prices by retail outlets in Lesotho. This includes an analysis of indicators such as the frequency of price changes, the average size of price changes and the probability of price changes at the retail outlet level. Secondly, the paper identifies some of the dynamic features of price changes, including the synchronization of price changes and the relationship between the frequency and size of price changes and the duration of the existing price. Following Klenow and Malin (2011), the dynamic features of the data are used to distinguish between the various theories of price-setting. Thirdly, the paper compares the stylised facts on price setting behaviour in Lesotho to other countries and South Africa in particular.

The remainder of the paper is structured as follows. Section 2 provides a description of the data. This is followed in Section 3 by a discussion of the evidence on the frequency of price changes and in Section 4 by a discussion of the size of price changes. Section 5 explores the dynamic features of price changes, while Section 5 concludes the paper.

2. Description of the data

This study draws on unique data consisting of highly disaggregated micro-level product prices underlying the monthly consumer price index (CPI) in Lesotho. The data are unpublished and were obtained directly from the Bureau of Statistics (BOS).

BOS uses a direct approach to collect price data whereby two enumerators in each district physically pay visits to the same retail outlets every month. Market prices of food and non-food prices are collected in the first two working weeks of the calendar month. Prices of products where there is little variation across the country are collected centrally. These include prices of fuel products such as petrol, diesel, paraffin, electricity and water charges.

BOS also collects prices of some products on a quarterly (transport fares and fuel), bi-annual (school fees, hospital fees) and annual (water and electricity charges) basis.[5] Many of these prices are regulated by the state.[6]

The raw sample of data spans the time period March 2002 to December 2009 (93 months) and contains 398,092 elementary price records. Each individual price record (termed price quote) for an item has information on the date (month and year), retail outlet, district, product (including brand in many cases) and unit codes and the price of that item. This approach therefore makes it possible for the pricing history of individual items, within individual retail outlets, to be traced over a long period of time. Following Klenow and Kryvtsov (2008) we call the longitudinal string of prices for a particular product item at a particular outlet a "quote line".

A limitation of the data is that that no information is provided that allows the identification of price changes associated with temporary promotions and seasonal sales. All price changes in the data are therefore treated as regular changes. The BOS also does not record any price for an item that is temporary out of stock (including seasonal products). The BOS instead imputes the price using the growth rate of the same item obtained from an alternative outlet.[7] An item that is permanently out of the sample may be replaced by a similar product within that outlet. Unfortunately, the database does not contain an indicator signalling product replacements.

The data required extensive cleaning. Price quotes are not available for all product items, outlets and time periods. Some product items lacked descriptions and were consequently dropped. Quote lines were also dropped if they contained less than 6 months of

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[5] Prices of electricity and water charges are not included in the sample, but transport fares, school fees and fuel prices are included.

[6] There is a band within which outlets are to set regulated prices. These include fees for church and community schools, hospital fees and fuel prices. Transport fares are usually fixed. The government announces the changes and publicises the prices to the entire country according to the type, size of the transport mode as well as the route.

[7] The alternative outlet has to have similar characteristics (e.g. location, size, type) as the substituted outlet.

data. Further, to eliminate outliers, price quotes were dropped if they exceeded or were less than 150 log points from the median price quote. The final sample consists of 345 outlets, 229 product items and 366 765 price quotes.[8]

Table 1 presents a breakdown of the price records by aggregated product category (Major Group). The 229 product items are comprised of 80 food products, 39 household furniture and equipment products, 31 clothing and footwear products, 13 fuel products and various other products. The sample also includes services such as medical care and health (11 items), recreation and culture (7 items), transport related services (3 items) and other goods and services (10 items). Altogether, the sample of products included the price database make up 78.9 percent of expenditure in the CPI basket.

Table 1: Price records by major group

Product class	**Price quotes**		**Product items**		**Weighting to CPI**
	Number	**Percent**	**Number**	**Percent**	**Percent**
Goods					
Food	182,090	49.65	80	34.07	35.35
Non-alcoholic beverages	21,062	5.74	8	3.54	0.68
Alcoholic beverages	4,836	1.32	5	2.21	1.00
Tobacco and narcotics	9,094	2.48	3	1.33	0.20
Clothing and footwear	34,407	9.38	31	13.72	15.32
Fuel	20,401	5.56	13	5.75	7.71
Household furniture and equipment	29,644	8.08	39	17.26	5.31
Household operations	24,301	6.63	8	3.54	3.49
Transport equipment	786	0.21	3	1.33	1.50
Communications	87	0.02	1	0.44	0.30
Personal care	14,758	4.02	6	2.65	2.31
Services					
Medical care and health expenses	4,298	1.17	11	4.87	1.92
Recreation and culture	5,262	1.43	7	3.1	1.43
Education	2,249	0.61	2	0.88	1.34
Transport services	663	0.18	2	0.88	0.86
Other goods and services	12,827	3.5	10	4.42	1.15
Total	**366,765**	**100**	**229**	**100**	**79.87**

Notes: Sample runs from March 2002 through December 2009. CPI weights are obtained for 180 product groupings from the Lesotho Bureau of Statistics. The weights are calculated on the basis of the 2002/03 Household Budget Survey and are consistent throughout the whole period.

In terms of price quotes, food products are over-represented making up close to 50 percent of all observations, despite making up only 34.1 percent of product items and 35.4

[8] The raw data covered 12 urban centres and 45 rural centres across the 10 districts of Lesotho. 471 product items were collected across 698 outlets, of which 305 were located in rural areas and 396 in urban areas.

percent of the expenditure in the CPI basket. Price quotes for beverages, tobacco and household furniture and equipment are also over-represented relative to their share of total product items and expenditure shares. In contrast, price quotes of clothing and footwear make up 9.4 percent of all observations, but account for 15.3 percent of expenditure in the CPI basket (13.7 percent of product items in the final sample). Similarly, price quotes for services under-represent their shares in expenditure.

The sample has a wide geographical coverage. Table 2 displays the total number of outlets across districts of Lesotho. The location of the retail outlets is divided into urban and rural areas across the ten districts of Lesotho. There are few outlets in the rural areas (28 outlets), with rural Maseru accounting for half of these. The sample consists of 317 urban outlets, the location of which is also dominated by the Maseru district (78 outlets).[9] The remaining outlets are distributed fairly equally across other districts (with exception of Thaba-Tseka where 18 outlets are located in urban areas).[10]

Table 2: Number of retail outlets per district

	Number of outlets		
District	**rural**	**urban**	**Total**
Maseru	14	78	92
Butha-Buthe	0	24	24
Leribe	1	35	36
Berea	1	32	33
Mafeteng	1	27	28
Mohale's Hoek	1	28	29
Quthing	2	25	27
Qacha's' Neck	0	26	26
Mokhotlong	4	24	28
Thaba-Tseka	4	18	22
Total	**28**	**317**	**345**

3. Frequency of price changes

3.1 Measurement

A key measure of price flexibility is the periodicity with which prices are changed by firms. Two inter-related measures are commonly used: the frequency of price changes and the

[9] Maseru is the Capital city of Lesotho and therefore the biggest of all the districts in terms of commercial activities and geographical size.
[10] See Figure A in the appendix for a detailed geographical map

duration of price spells (Álvarez and Hernando, 2004). In this study, we measure the frequency of price change as the number of non-zero price change observations as a fraction of all price observations for the selected sample.

We calculate the frequency of price change differently depending on the unit of analysis. For example, the frequency of price change for a specific product *k* sold at a specific store *i* over the full period *T* is calculated as:

$$Freq_{ik} = \left(\frac{1}{T_{ik} - 1}\right)\sum_{t=2}^{T_{ik}} I_{ikt} \qquad (1)$$

where T_{ik} is the number of monthly observations of the price p_{ikt} ; $I_{ik,t}$ is an indicator variable equal to 1 if $p_{ikt} \neq p_{ikt-1}$ and 0 if $p_{ikt} = p_{ikt-1}$. Given the frequency of data available, we assume that prices change once within a given month (or within a quarter or year for those products for which data are collected on a quarterly or annual basis). Consequently, we may under-estimate the actual frequency of price changes. For example, Bunn and Ellis (2012) find much higher frequencies of price change for the UK when using weekly scanner data compared to monthly CPI microdata.

We use the product and outlet specific measure of frequency to also compute the average frequency across outlets at the product level over the period *T*, denoted as $Freq_k$. This is calculated as the simple average of $Freq_{ik}$ for each product (*k*). We therefore give equal weight in this calculation to each outlet irrespective of location. Finally, the aggregate frequency across products (*Freq*) is computed as the simple or CPI weighted average of $Freq_k$ across the sample of products.[11]

[11] CPI weights are obtained for 180 product groupings. These product groupings are more aggregated than the elementary product items used in the analysis. Each CPI weight category includes on average 2.3 product items (maximum of 9, minimum of 1) that differ in terms of unit of measurement, brand or product description. For example, the CPI weight category for Maize meal, a key staple food in Lesotho, covers the following products that differ by brand and/or unit of measurement: Chai (2.5kg), Chai (12.5kg), Induna (12.5kg) and other. Other CPI weight categories contain different products; e.g. the category Cereals includes Cornflakes (500g), Weetbix (500g) and Allbran (500g). To calculate weighted average values across product items, the CPI weights are disaggregated to each product item using the number of price records as weights.

Frequency is closely linked to duration of price spells - the higher the frequency of price changes, the shorter the duration. For large samples, the inverse of the frequency of price changes can be used a consistent estimator of the average duration of price spells (Baudry *et al.*, 2004). This is the approach followed in this paper - average duration is measured as the inverse of the average frequency.[12] For individual outlet *i*, the duration of the price spell for product *k* is therefore calculated as:

$$duration_{ik} = \left(\frac{1}{Freq_{ik}} \right) \quad (2)$$

Similarly, average duration across outlets at the product level is calculated as the inverse of $Freq_k$, while aggregate duration across all products is computed as the inverse of *Freq*. An alternative approach is to directly compute the duration of prices spells, but this approach suffers from potential downward bias as short price spells are over-sampled and long price spells are under-sampled (Baharad and Eden, 2004; Dias *et al.*, 2007).[13]

3.2 The frequency of price change

The review of micro price studies by Klenow and Malin (2011) reveals considerable heterogeneity in price setting behaviour at the micro-level.

Table 3 presents summary statistics for the level and variation of aggregate frequency across the 229 products. The simple average frequency across products is 31.2 percent and is very similar to the median frequency of 31.6 percent. Prices change for just under a third of all product items every month. The implied duration is that individual prices change on average every 3.2 months.

[12] The drawback of this approach is that it calculates the inverse of the average frequency of price change instead of the average of the inverse of the frequency of price change (Baharad and Eden, 2004; Baudry *et al.*, 2004 and; Gouvea, 2007). The problem with the latter is that some frequencies of price changes may be close to zero leading to extremely high durations that distort the aggregate duration. The former measure will be smaller or equal to the latter due to Jensen's inequality.

[13] The direct computation of price spells uses only uncensored spells that start and end with a price change. Longer spells are more likely to be censored and hence excluded leading to selection bias.

Also presented in the table is the CPI weighted average frequency, which at 37.1 percent is higher than the simple average. This reflects the greater weight placed on food and fuel products that are characterised by a relatively high frequency of price changes (see later). Duration using the CPI expenditure weights is consequently lower than the simple average at 2.7 months.

Table 3: Summary of the level and dispersion of frequency across products in Lesotho

	Frequency	Standard deviation of frequency across outlets	Implied duration
Mean (simple average)	0.312	0.111	3.204
Median	0.316	0.115	3.166
Mean (Weighted average)	0.371	0.119	2.692
Median (Weighted average)	0.379	0.116	2.639

Note: Frequencies are calculated as the simple average (median) or weighted average (median) of $Freq_{ik}$ across the 229 product items. CPI expenditure shares are used as weights. The standard deviation reflects the simple or weighted average of the standard deviation of $Freq_{ik}$ across outlets within each product item. Implied durations are calculated as the inverse of the mean or median frequency.

Table 4 compares the results of the frequency of price changes and the implied duration of price spells across time for Lesotho against selected other empirical studies drawn. Such comparisons are fraught with difficulties, given differences in methodologies, product composition and periods of analysis. Nevertheless, the results allow for a general comparison of pricing conduct across countries.

Table 4: Comparison of Lesotho data with international evidence

Country	**Frequency of price change (%)**	**Mean duration (in months)**	**Mean inflation rate**
Developing countries			
Lesotho (2002-09)	37.1	2.7	10.1
SA (2002-07)	17.1	5.8	5.3
Brazil (1996-06)	37.0	2.7	7.8
Sierra Leone (1998-03)	51.0	2.0	
Developed countries			
Euro Area (1996-01)	15.1	6.6	2.3
USA (1998-05)	36.2	6.8	2.5
Spain (1993-01)	15.0	6.6	3.4
France (1994-03)	18.9	5.3	1.5
UK (1996-2006)	19.0	5.3	

Source: The results for the Euro Area are obtained from Dhyne *et al.*, (2006); the United States from Klenow and Kryvtsov (2008); Spain from Álvarez and Hernando (2004); France from Loupias and Ricart (2004); South Africa from Creamer et al. (2012); Brazil from Gouvea (2007); Sierra Leone from Kovanen (2006); and UK from Bunn and Ellis (2012). The weighted average based results are presented for Lesotho. Posted prices are used for South Africa, Lesotho, USA, UK, Spain and some of the other Euro Area countries (see Dhyne *et al*. (2006)). The implied mean durations are calculated as the inverse of the frequency.

Evidence from the table reveals that the frequency of price change in Lesotho (37.1 percent) is substantially higher than the frequency of price change in South Africa (17.1 percent) and many of the developed countries including the Euro area (15.1 percent), Spain (15 percent) and France (18.9 percent). The frequency is similar to the US (36.2 percent)[14] and Brazil (37 percent), but is lower than Sierra Leone (51 percent). However, one source behind the relative flexibility of price changes in Lesotho could be inflation. The inflation rate in Lesotho exceeded those of the comparator countries and was close to twice that of South Africa (see final column of Table 4). The link between inflation and price-setting behaviour is explored in more detail later.

Once concern with using aggregate measures of frequency as indicators of price-setting behaviour frequency is that the measure averages out possible heterogeneity in price changes. Two sources of heterogeneity can be considered: (i) heterogeneity in the average frequency of price changes by outlets across products, and (ii) heterogeneity in the frequency of price changes across outlets but within products. Data on each dimension of heterogeneity is now presented.

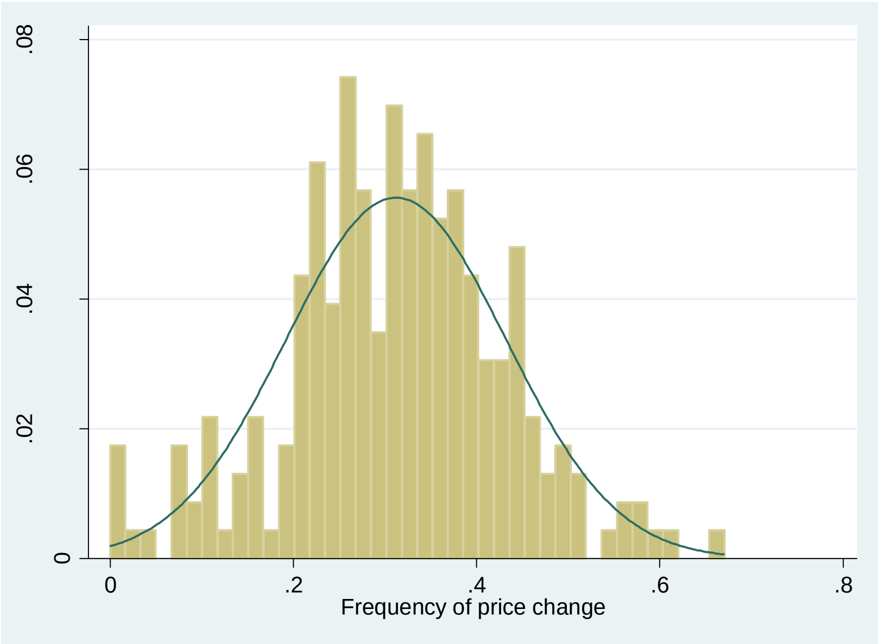
3.3 The frequency of price change across products and locations

These average measures of frequency hide much variation between products and across locations. To illustrate this, Figure 1 plots a histogram of the average frequency of price change for the 229 products over the period March 2002 to December 2009. As is commonly found in other micro price studies (Bils and Klenow, 2004; Dhyne et al., 2006; Malin and Klenow, 2011; Bunn and Ellis, 2012, Creamer *et al*., 2012), there is substantial heterogeneity in price setting behaviour across products. For example, the frequency of price change exceeds 40 percent (implied duration of 2.5 months or less) for a quarter of all product items.

[14] The frequency for regular prices that are posted prices excluding sales prices in the US is 29.9 percent (Klenow and Kryvtsov, 2008).

For 24 percent of all product items, prices change at most once every 4 months (frequency of 24 percent or lower).

Figure 1: Average frequency of price change



Source: Author's calculations using the average frequency of price change (*Freq*$_k$) for 229 product items.

To identify whether frequency of price change differs systematically according to product characteristics, Table 5 presents measures of the frequency of price changes and implied duration of price spells by various categorisations of products and location (urban, rural). Frequencies and duration indicators for Major Groups are presented in Table 6.

Table 5: The frequency of price changes and duration of price spells across product groups and locations

Categories	Mean frequency of price changes (fraction)	Median frequency of price changes (fraction)	Implied mean duration (months)	Implied median duration (months)	Mean frequency of price changes (fraction)	Implied mean duration (months)
	Unweighted				***CPI weighted***	
Aggregate	0.312	0.316	3.204	3.166	0.371	2.692
Goods	0.328	0.321	3.048	3.116	0.386	2.593
Services	0.164	0.123	6.093	8.142	0.125	8.006
Food	0.364	0.363	2.747	2.752	0.432	2.314
Perishable	0.411	0.421	2.434	2.377	0.482	2.074
Non-perishable	0.325	0.329	3.078	3.037	0.409	2.447
Non-food	0.278	0.279	3.600	3.583	0.319	3.135

goods						
Durable	0.268	0.268	3.735	3.732	0.317	3.153
Non-durable	0.333	0.333	3.004	2.999	0.360	2.775
Rural	0.337	0.333	2.972	3.000	0.367	2.724
Urban	0.357	0.356	2.803	2.807	0.406	2.460

Note: Frequencies are calculated as the simple average (median) or weighted average (median) across products. The rural and urban frequencies are based on an overlapping sample of 149 products. The gap is significantly different from zero (based on a regression of outlet by product frequencies on a dummy variable for rural areas and product fixed effects). Implied durations are calculated as the inverse of the mean or median frequency.

Goods prices change more frequently than the prices of services. Using the CPI weighted average indicators the implied mean duration of price changes for goods at 2.6 months is a third of that of services at 8 months. This finding corroborates the international empirical evidence. Klenow and Malin (2011), for example, calculate a mean duration of 9.4 months for services versus 3 to 5.8 months for goods in the US. For emerging economies, Gouvea (2007) calculate an average duration of 6.5 months for services and 2.1 months for the food sector in Brazil, while Kovanen (2006) reports for Sierra Leone a duration of only 0.8 months for food products and 8.7 months for transportation and communication services. Similarly, Creamer *et al.* (2012) find that the frequency of price changes for goods (17 percent) exceeds that of services (14.9 percent) in South Africa, although for both product categories, the frequency levels are substantially lower than in Lesotho.

The stickiness in services can be explained by various factors. Services are mostly non-tradable and are not subject to high transport and distribution costs. Services are also less exposed to external shocks affecting the cost of purchasing and accessing traded goods, including transport costs. Further, the stickiness of services is affected by the inclusion of education services (see frequency of only 8.7 percent) and medical services (13.5 percent) where prices often only change on an annual basis (Table 6).

Table 5 also reveals that prices of food products change on average more frequently (43.2 percent) than prices of non-food goods (31.9 percent). Within the food category, prices of perishable products are more flexible (48.1 percent) than non-perishable food products (40.9 percent). This is anticipated as unprocessed products such as fresh food are subject to relatively high distribution and storage costs that force retailers to pass these costs to consumers more quickly to avoid pricing below the marginal cost (Klenow and Malin, 2011). The supply of perishable foods is also more likely to be affected by variable weather patterns. Relatively high frequencies for food products are also found by Coricelli and Horvath (2010) for Slovakia, Bunn and Ellis (2012) for the UK and Creamer *et al.* (2012) for South Africa.

Within the non-food products, the implied mean duration of price spells for non-durable products (2.8 months) is lower than for durable products (3.2 months). This result contrasts with that of Klenow and Malin (2011) who report a weighted implied mean duration of 3 months for durable goods 5.8 months for non-durables for US consumer prices between 1988 and 2009.

A further dimension for differentiation in price setting behaviour is location. The final two rows of Table 5 disaggregate the frequency and duration indicators according to rural and urban area. The composition of products in rural areas is strongly biased towards the more flexible food products, whereas the composition in urban areas represents a wider range of products. Therefore, to ensure comparison over equivalent consumption bundles, the sample of products is restricted 149 products for which price data are collected in both rural and urban areas.

Prices are found to change less frequently in rural areas (36.7 percent) compared to urban areas (40.6 percent). The difference is small, but is statistically significant (at the 1 percent level).[15] Many factors may account for this difference. High transaction costs associated with poor rural transport and communication infrastructure restrict cross-regional and intra-regional competition enabling retail outlets to segment rural from urban markets. This gives rise to differences in the size and transmission of cost shocks, demand characteristics, firm menu costs and market power in rural and urban areas all of which affect

[15] Based on weighted least squares estimates of the frequency of price change at the outlet/product level ($Freq_{ik}$) on a rural dummy variable, product fixed effects and district fixed effects. The frequency of price change in rural areas is estimated to be 4.4 percentage points lower than in urban areas.

the optimal frequency of price change by outlets in each area. Market power possessed by firms, for example, is shown theoretically (Powers and Powers, 2001) and empirically (Álvarez and Hernando, 2007) to be associated with greater price rigidity.

Table 6: The frequency of price changes by major group

	Unweighted sample				CPI weighted	
	Simple average	Median	sd frequency within products	Implied duration	Simple average	Implied duration
Goods	***0.328***	***0.321***	***0.114***	***3.048***	***0.386***	***2.593***
Food	0.375	0.374	0.125	2.665	0.440	2.275
Non-alcoholic beverages	0.331	0.334	0.120	3.024	0.351	2.851
Alcoholic beverages	0.245	0.266	0.089	4.080	0.228	4.384
Tobacco and narcotics	0.373	0.365	0.144	2.680	0.370	2.704
Clothing and footwear	0.332	0.334	0.100	3.015	0.357	2.803
Fuel	0.391	0.359	0.124	2.557	0.405	2.467
Household furniture and equipment	0.242	0.249	0.103	4.137	0.259	3.867
Household operations	0.364	0.366	0.124	2.745	0.373	2.680
Transport equipment	0.285	0.308	0.046	3.512	0.277	3.607
Communications	0.000	0.000			0.000	
Personal care	0.305	0.309	0.108	3.282	0.314	3.187
Services	***0.164***	***0.123***	***0.074***	***6.093***	***0.125***	***8.006***
Medical care and health expenses	0.138	0.084	0.079	7.254	0.135	7.407
Recreation and culture	0.205	0.229	0.084	4.877	0.218	4.587
Education	0.087	0.087	0.048	11.553	0.087	11.553
Transport services	0.265	0.265	0.033	3.772	0.187	5.345
Other goods and services	0.262	0.218	0.100	3.822	0.293	3.412
Total	**0.312**	**0.316**	**0.111**	**3.204**	**0.371**	**2.692**

Note: Communications is made up entirely of the cost of landline to landline calls. These did not change over the sample period. Aggregate frequencies at the major group level (or higher) are calculated as the simple average (median) or weighted average of $Freq_k$ across products items within that product group.

3.4 Heterogeneity in the frequency of price changes across outlets within product items

The previous section looked at differences in product characteristics as a source of variation in the frequency of price changes by outlets. Looking within products, firm outlet characteristics such as size, ownership, menu costs, are a further source of heterogeneity in price setting behaviour. This section now looks at outlet characteristics as a source of variation in price setting behaviour.

One measure of outlet-level heterogeneity in price setting behaviour is the variation in the frequency of price changes across outlets within product items. The second column of Table 3 presents the mean and median of the standard deviation of the frequency of price changes across outlets within each of the 229 product items. Table 6 presents averages of the same variables for the major groups.

The data indicates that heterogeneity in pricing behaviour across outlets is an important source of the overall variation in the frequency of price changes in Lesotho. The mean (weighted) standard deviation of price changes across outlets within product items is 0.111, or 35 percent of the mean frequency. Across major groups, heterogeneity in price setting behaviour across outlets is greater within goods (standard deviation equals 0.114) compared to services (0.074) and in food (0.125), fuel (0.124), household operations (0.124) and non-alcoholic beverages (0.12) compared to other major groups (Table 6).

The mean (across products) of the standard deviation across outlets is in fact almost identical to the standard deviation of the mean product frequency ($Freq_k$) across product items (equals 0.12). Heterogeneity in price setting behaviour across outlets, therefore, appears to be of equal importance as product characteristics, in explaining the overall variation in the frequency of price change at the outlet/product level ($Freq_{ik}$).

Unfortunately, the database provides no detailed information on outlet characteristics that are commonly associated with price setting behaviour at the outlet level. In Europe, for example, large outlets such as supermarkets and department stores are found to change prices more frequently than small firms (Fabiani *et al.* 2007). Price changes for individual products also appear to be relatively synchronized across stores within the same retail chain compared to across all stores, as is found for the US by Nakamura (2008).

Nevertheless, we are able to measure the number of product items recorded within each outlet. Using this as an (imperfect) indicator of firm size, regression results show a significant positive association between firm size and the frequency of price change at the product/outlet level ($Freq_{ik}$).[16] A 10 percent increase in the size of the outlet is estimated to raise the frequency of price change by 0.003 percentage points, or just over 1 percent of the unweighted mean frequency across products. Alternatively, raising an outlet size from the 25th percentile firm to the 75th percentile firm would raise the frequency of price change by 0.03 percentage points. These results corroborate the similar findings in the international empirical literature.

3.5 Frequency of price decreases and price increases

The total frequency of price changes is simply the sum of two components: frequency of price increases and frequency of price decreases. Analysing each of these components separately is useful, particularly when they may display offsetting movements in response to aggregate shocks. For example, Klenow and Kryvtsov (2008) show for the US how rising inflation raises the frequency of price increases, but lowers the frequency of price decreases.

Table 7 presents the simple and weighted average frequency of price increases and price decreases across product items by major group over the period March 2002 to December 2009.[17] Statistics are also provided for the more aggregated product groups such as perishables and non-perishable foods, durable and non-durable goods, and goods and services.

The data show that the average frequency of price increases dominates the frequency of price decreases across all product categories. The weighted (simple) average frequency of price increases is 22.6 percent (19 percent) whereas the frequency of price decreases is 14.5

[16] The number of products collected from each outlet ranges from 1 to 117 with a mean (median) of 68.2 (78). The estimates control for unobserved district and product characteristics through use of fixed effects. The coefficient on size (in natural logarithm) is 0.033.

[17] Frequency of price increase (decrease) at the product/outlet level is calculated as the share of all positive (negative) price changes within a quote line.

percent (12.2 percent). These results are consistent with findings by Creamer *et al.* (2012) for South Africa who report an 11.1 percent frequency of price increases and a lower 6 percent frequency of price decreases. However, the results do not necessarily imply asymmetry in pricing as these results are not conditional upon the inflationary environment. The frequency of price increases rises in higher inflationary environments, while the frequency of price decreases falls (Klenow and Malin, 2011). These relationships are explored in more detail later.

Table 7: The frequency of price increase and decreases across major group, 2002-2009

	Unweighted sample			**CPI weighted**		
	Frequency of price change	Frequency of price increase	Frequency of price decrease	Frequency of price change	Frequency of price increase	Frequency of price decrease
Food	0.375	0.235	0.140	0.440	0.273	0.167
Non-alcoholic beverages	0.331	0.207	0.124	0.351	0.212	0.138
Alcoholic beverages	0.245	0.157	0.088	0.228	0.147	0.082
Tobacco and narcotics	0.373	0.256	0.118	0.370	0.254	0.115
Clothing and footwear	0.332	0.189	0.142	0.357	0.204	0.152
Fuel	0.391	0.249	0.142	0.405	0.241	0.164
Household furniture and equipment	0.242	0.138	0.104	0.259	0.155	0.104
Household operations	0.364	0.226	0.139	0.373	0.234	0.139
Medical care and health expenses	0.138	0.083	0.055	0.135	0.083	0.052
Transport equipment	0.285	0.178	0.107	0.277	0.174	0.103
Transport services	0.265	0.168	0.097	0.187	0.125	0.062
Recreation and culture	0.205	0.112	0.093	0.218	0.124	0.094
Education	0.087	0.051	0.035	0.087	0.051	0.035
Personal care	0.305	0.187	0.117	0.314	0.205	0.109
Other goods and services	0.262	0.162	0.099	0.293	0.176	0.117
Goods	**0.328**	**0.200**	**0.128**	**0.386**	**0.235**	**0.151**
Perishable food	0.411	0.255	0.155	0.482	0.297	0.185
Non-perishable food	0.325	0.205	0.120	0.409	0.254	0.154
Durable goods	0.268	0.155	0.112	0.317	0.184	0.133
Non-durable goods	0.333	0.200	0.132	0.360	0.218	0.142
Services	**0.164**	**0.102**	**0.063**	**0.125**	**0.078**	**0.047**
Total	**0.312**	**0.190**	**0.122**	**0.371**	**0.226**	**0.145**

Notes: Aggregate frequencies are calculated as the simple average (median) or weighted average frequency across products items.

As found earlier, there is substantial heterogeneity across products. Looking at the aggregated product groupings the highest weighted average frequency of price increases is observed in perishable food products (29.7 percent) and the lowest frequency of price increases in services (7.8 percent). The frequency of price decreases follows a similar pattern to price increases, although at lower levels: 18.5 percent for perishable food and 4.7 percent for services.

While the frequency of price changes differs across products, there is a remarkably close across-product association between the frequency of price increases and decreases (Table 7). Those products with high frequencies of price increases are also those with high frequencies of price decreases (see clothing and footwear, food, beverages). This is evident even at the most disaggregated 229 product item level where a correlation coefficient of 0.8 is estimated between the two variables. This also corresponds with the product subclass level results for Spain by Álvarez and Hernando (2004) and more broadly for the sample of Euro countries analysed by Dhyne *et al*. (2006).

Product specific characteristics such as differences in cost structure are therefore a key determinant of price flexibility. Dhyne *et al*. (2006: 177), for example, find that goods with relatively large inputs of labour (such as services) are subject to lower degree of price flexibility while goods with large intermediate inputs experience more frequent price changes in the Euro Area.

4. Size of price changes

An alternative indicator (to frequency of price change) of price setting behaviour is the size of price changes. The size of price changes captures the intensive margin behind inflation, whereas the frequency measures is indicative of the extensive margin (how often prices change) (Klenow and Malin, 2011).

We calculate the size of price changes at the outlet/product level as the month-on-month log difference in prices where $p_{ikt} \neq p_{ikt-1}$. For each quote line, we then take the average of the absolute value of each of these log price differences over the full period (April 2002 to December 2009). This is denoted as $|dp_{ik}|$ and measures the average size of price changes of product k in outlet i over the period. The average size of price changes at the product item level ($|dp_k|$) is then calculated as the simple average of $|dp_{ik}|$ across outlets. Finally, the aggregate size of price changes across products ($|dp|$) is computed as the simple or CPI weighted average of $|dp_k|$ across the sample of products. The average size of price increases and decreases are calculated following the same procedure, except that the sample of non-zero price changes is restricted to either price increases or price decreases.

Table 8 presents the mean absolute change in prices in Lesotho by major product category over the period April 2002 to December 2009. The data reveal that aggregate price changes are large in absolute terms; the unweighted and weighted mean and of price changes across all products is 15.5 percent and 12.7 percent, respectively. These results are comparable with those of Klenow and Kryvtsov (2008) for the US (14 percent for posted prices) and Gouvea (2007) for Brazil (16 percent), but are slightly higher than for South Africa (10.7 percent) (Creamer *et al.*, 2012) and the Euro area (8-10%) (Dhyne *et al.*, 2006).

Table 8: The size of price changes, price increases and decreases by major product categories (2002-2009)

	Unweighted			**Weighted**		
	Price change	Price increase	Price decrease	Price change	Price increase	Price decrease
Food	0.107	0.103	0.116	0.094	0.088	0.108
Non-alcoholic beverages	0.095	0.087	0.107	0.090	0.084	0.096
Alcoholic beverages	0.160	0.163	0.130	0.158	0.158	0.124
Tobacco and narcotics	0.067	0.068	0.068	0.067	0.068	0.068
Clothing and footwear	0.155	0.132	0.174	0.133	0.124	0.144
Fuel	0.093	0.088	0.110	0.090	0.085	0.107
Household furniture and equipment	0.201	0.202	0.220	0.201	0.180	0.234
Household operations	0.105	0.100	0.111	0.092	0.089	0.098
Medical care and health expenses	0.463	0.470	0.404	0.473	0.475	0.279
Transport equipment	0.104	0.092	0.126	0.111	0.097	0.136
Transport services	0.168	0.152	0.229	0.233	0.205	0.331
Recreation and culture	0.199	0.174	0.226	0.204	0.201	0.210
Education	0.364	0.380	0.363	0.364	0.380	0.363
Personal care	0.119	0.113	0.133	0.100	0.097	0.109
Other goods and services	0.192	0.181	0.219	0.223	0.207	0.250
Goods	**0.135**	**0.129**	**0.147**	**0.113**	**0.106**	**0.127**
Perishable food	0.116	0.112	0.131	0.122	0.116	0.141
Non-perishable food	0.104	0.099	0.103	0.084	0.078	0.093
Durable goods	0.175	0.175	0.188	0.130	0.122	0.143
Non-durable goods	0.137	0.122	0.156	0.129	0.120	0.145
Services	**0.346**	**0.337**	**0.341**	**0.391**	**0.387**	**0.347**
Total	**0.155**	**0.149**	**0.163**	**0.127**	**0.120**	**0.137**

Note: The aggregate magnitude of price changes are calculated as the simple or weighted average of the mean absolute size of price change across outlets within each product item.

There is also substantial heterogeneity in the size of price changes across product items. Most large absolute price changes are found in services (39.1 percent), particularly Medical care and health services (47.3 percent) and Education services (36.4 percent). Price changes for non-food products are also large (around 13 percent) compared to food products (9.4 percent). These findings are broadly consistent with those found by Bunn and Ellis (2012) for the UK.

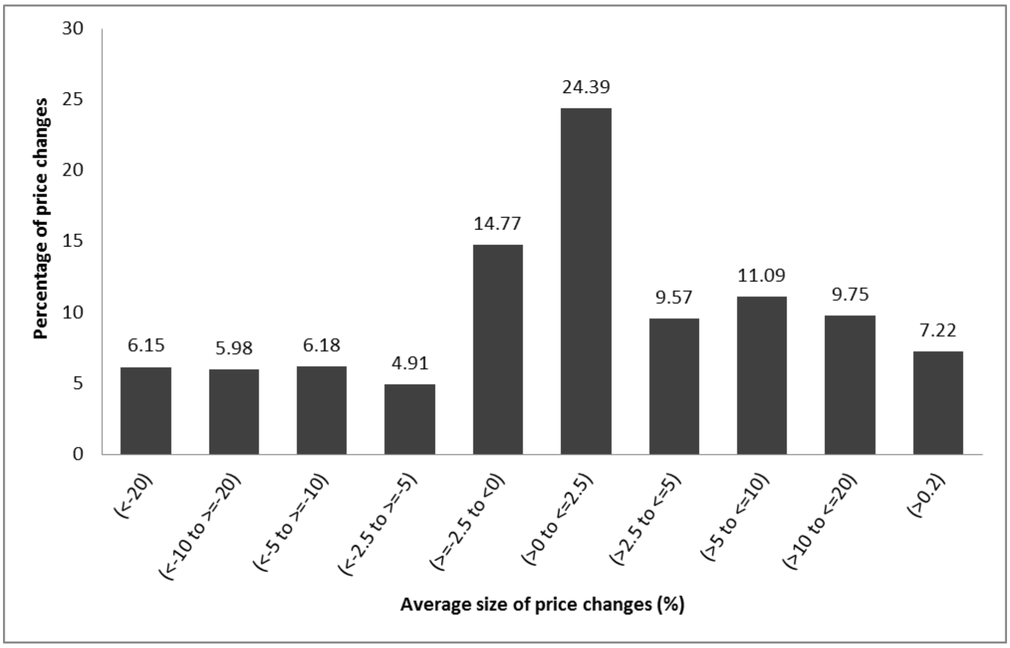
The large average *absolute* size of price change far exceeds the average price change across products (2.2 percent). The explanation is the combination of offsetting price increases and price decreases. As shown earlier, price decreases are very common, although the frequency of price decreases is slightly lower than for price increases. However, the average size of price decreases (13.7 percent) is larger than for price increases (12 percent). This holds for most of the major product categories with the exception of Alcoholic beverages, Medical services and Education services. These results corroborate those in other countries such as the Euro area (Álvarez and Hernando, 2004; Dhyne *et al.*, 2006) and South Africa (Creamer *et al.* 2012).[18]

Figure 2 plots the distribution of price changes between 2002 and 2009 for Lesotho using the average absolute size of price change at the retail/outlet level ($|dp_{ik}|$). The figure reveals that while price changes are on average large, many price changes are small. Nearly 40 percent of absolute price changes are equal to 2.5 percent or less. Over half (53.6 percent) of all absolute price changes are less than or equal to 5 percent. This exceeds the corresponding shares for posted prices in the US (39.8 percent) (Klenow and Kryvtsov, 2008) and Brazil (over 33 percent) (Barros *et al.*, 2009 in Klenow and Malin, 2011: 258) and far

[18] Dhyne *et al*. (2006) report a larger average size of price decreases (10 percent) than price increases (8 percent) for the Euro area. For South Africa, Creamer *et al*. (2012) report average price increases of 10.7 percent and price decreases of 12.3 percent.

exceeds the share for South Africa (19.6 percent) (Creamer *et al*., 2012).[19] The histogram also has relatively fat tails that explains the existence of large average absolute price changes despite the many small price changes that occur.

Figure 2: Distribution of the average size of price changes (April 2002 - December 2009)



Notes: Based on the average absolute price change at the outlet/product level ($|dp_{ik}|$) over the period April 2002 to December 2009.

The combination of large absolute price changes with many small prices changes provides some insight in the various determinants of price change. The large absolute price increases and decreases suggest the presence of substantial idiosyncratic shocks to demand, productivity, marginal costs and/or desired mark-ups (Klenow and Kryvtsov, 2008: 878). These idiosyncratic shocks specific to outlets or industries give rise to offsetting price increases and decreases leading to a lower average price change than the average absolute price change. Idiosyncratic shocks appear to be relatively important compared to aggregate shocks in determining price changes in Lesotho.

[19] The results for South Africa are derived from Figure 2 from Creamer *et al.* (2012) that also include the share of zero price changes.

The presence of many small price changes is indicative of a wide range of menu costs across items and/or time (Klenow and Kryvtsov, 2008). The small and large price changes reflect small and large menu costs, respectively. This heterogeneity in menu costs combined with idiosyncratic shocks to the outlet or product help explain the heterogeneity in the frequency and size of price changes across outlets and across products in Lesotho.[20]

5. Dynamic features of price changes

The above analysis presents a summary of some of the key features characterising price setting behaviour in Lesotho. These features are generally consistent with those found in other countries, including South Africa. In this section, we follow Klenow and Malin (2011) and focus on how prices change over time. The dynamic features of the data also better enable us to distinguish between various theories of price-setting behaviour.

5.1 Decomposition inflation and the variance of inflation

In their review of the literature, Klenow and Malin (2011) find that price changes are typically not synchronized over the business cycle. The frequency of price changes, at least in the US, is relatively stable and only weakly correlated with inflation, whereas the average size of price changes commoves almost perfectly with inflation (Klenow and Kryvtsov, 2008: 885). From a theoretical perspective, this outcome is consistent with time dependent pricing models. An implication for policy is that monetary shocks have more persistent real effects on the economy.

This result, however, is not consistently found across countries. Creamer *et al.* (2012) find a close association between inflation and the frequency of price changes in South Africa.

[20] We also follow Klenow and Kryvtsov (2008) and construct standardized price changes within each product category. As they find for the US, price changes are often small compared to the average size within the same product item.

Gagnon (2009) finds that the extent of synchronization rises in high inflationary environments, as in Mexico in the mid-1990s. We now look at the evidence for Lesotho.

The geometric mean inflation rate in month t is defined as $\pi_t = \sum_k w_{kt}\left(p_{kt} - p_{kt-1}\right)$ where w_{kt} is the sample weight of product item *i* and p_{kt} denotes the log price of product *k* in month *t*. Inflation can alternatively be expressed as:

$$\pi_t = \underbrace{\left(\sum_k w_{kt} I_{kt}\right)}_{freq_t} \underbrace{\left(\frac{\sum_k w_{kt}\left(p_{kt} - p_{kt-1}\right)}{\sum_k w_{kt} I_{kt}}\right)}_{dp_t} \qquad (3)$$

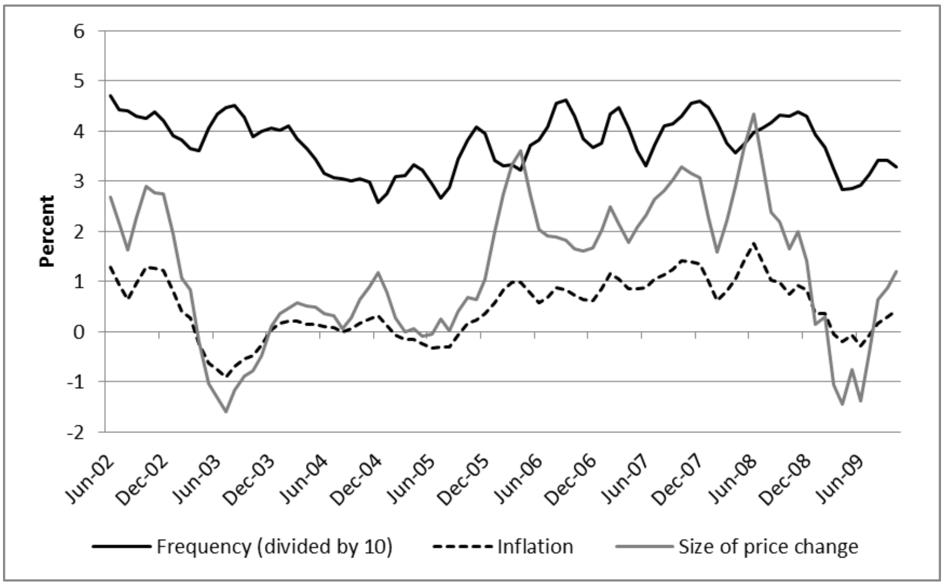
where the first term is the weighted average frequency of price change (extensive margin, EM or $freq_t$) and the second term is the average size of those price changes (intensive margin, IM or dp_t). Changes in inflation are therefore driven by changes in the frequency of price change and/or the size of price changes. This decomposition also provides useful theoretical insights. In the time-dependent pricing models of Taylor (1980) and Calvo (1983) the uniform staggering of price changes is the only possible source of variation in inflation.

Figure 3 plots the 4-month moving average of π_t, $freq_t$ and dp_t while Table 9 presents the summary statistics for price changes from March 2002 to December 2009.[21] Inflation, the frequency of price change and the size of price change all vary over time. The average monthly rate of retail price inflation rate over the entire period is 0.5 percent, but is closer to 1 percent in 2002 and early 2006 to end-2008. The weighted average monthly frequency of price changes (EM) is 37.8 percent with a standard deviation of 12.3 percent. The weighted average size of price change (IM) is lower at 1.3 percent, but it more volatile around this

[21] Monthly frequency of price change ($freq_t$) is computing by taking the simple average across outlets of I_{ikt} for product *k* at time *t*. This value is then aggregated up using CPI weights for each product *k*.

mean with a standard deviation 2.5 percent. This is similar to the finding for the US by Klenow and Kryvtsov (2008).

Figure 3: Extensive and intensive margins of inflation



Note: The figure displays the four-month moving averages for each variable. Product level averages are aggregated up using Lesotho CPI expenditure weights. The monthly product level averages are in turn calculated as the simple average of the outlet-level value.

Table 9: Time series moments for price changes

Variable	Mean (%)	Std dev (%)	Regression on π Coef	Std. Err	P-stat
π	0.50	1.01			
freq	37.81	12.30	1.61	1.74	0.36
dp	1.29	2.54	2.39	0.16	0.00
$freq^+$	23.20	8.17	4.60	0.80	0.00
$freq^-$	14.61	7.67	-2.99	1.11	0.01
dp^+	9.36	6.63	-0.12	0.70	0.86
dp^-	-9.69	7.16	1.45	0.82	0.08
pos = $freq^+ . dp^+$	2.21	1.91	0.54	0.26	0.04
neg = $freq^- . dp^-$	-1.71	1.82	0.46	0.26	0.09

Notes: The entries for means, standard deviation and cross-correlations are estimated from monthly observations. The columns of regressions coefficient and standard errors are obtained by regressing the corresponding variable in column 1 on inflation and monthly seasonal dummy variables. The monthly values of the variables are weighted means across product items. The product item level values are calculated as the simple average of the variable across outlets in each month. The CPI expenditure weights are obtained from the Lesotho Bureau of Statistics.

Changes in the size of price changes are also more strongly correlated with inflation than is the frequency of price change. This is shown in

Figure 3 where the size of price change follows the monthly inflation rate relatively closely, whereas the frequency of price change is more stable and less closely associated with inflation. The simple regressions of frequency on inflation shown in the final three columns of Table 9 corroborate this finding. The coefficient on frequency is not significantly different from zero, whereas the results for the size of price change indicate that at 1 percentage point increase in inflation is associated with a 2.4 percentage point increase in the size of price change.

These results are very similar to those of Klenow and Kryvtsov (2008) for the US and suggest that movements in inflation are driven by variations in the size of price changes rather than variations in frequency of price changes. Álvarez and Hernando (2004) find similar, but weaker, relationships between frequency of price changes and inflation for Spain. The results, however, contrast those of Creamer *et al*. (2012) who find a close positive association between frequency and inflation for South Africa.

Klenow and Kryvtsov (2008) also decompose the variance of inflation over time into an intensive margin and extensive margin using the following decomposition:[22]

$$\mathrm{var}(\pi_t) = \underbrace{\mathrm{var}(dp_t)\cdot \overline{freq}^2}_{IM} + \underbrace{\mathrm{var}(freq_t)\cdot \overline{dlp}^2 + 2\,\overline{freq}\cdot\overline{dp}\cdot \mathrm{cov}(dp_t, freq_t) + \mathrm{O}_t}_{EM} \qquad (4)$$

The first term on the right hand side of the equation denotes the variation in inflation attributable to the variation in the size of price changes, or the intensive margin (*IM*). The

[22] The expression O_t include higher-order terms that are functions of the EM.

second term denotes the extensive margin (*EM*) which captures the variation in the frequency and its covariance with price changes. In the time-dependent staggered price models of Taylor (1980) and Calvo (1983), the intensive margin (*IM*) accounts for all the variation in inflation, whereas in some state-dependent pricing models, the frequency plays a substantial role (Malin and Klenow, 2011).

Table 10 presents the results of the variance decomposition for the period March 2002 to December 2009. The intensive margin accounts for 94.9 percent of the variance in inflation in Lesotho. This is remarkably close to the 94 percent for posted prices in the US found by Klenow and Kryvtsov (2008) and lends further support for time-dependent pricing behaviour in Lesotho.

Table 10: Variance decomposition of inflation (percent)

		Share (%)
IM vs. EM	IM term	94.9
	EM terms	5.1
POS vs. NEG	POS terms	66.0
	NEG terms	34.0

This interpretation of the results, however, is critiqued by Gagnon (2009). He argues that the correlation between frequency and inflation is low as movements in the frequency of price increases ($freq^{+}$) and price decreases ($freq^{-}$) partly offset each other. As inflation rises, $freq^{+}$ increases as firms raise prices, but at the same time $freq^{-}$ falls. This is evident in the Lesotho data presented in Figure 4 where there is a strong co-movement of $freq^{+}$ with inflation and a weaker negative association between $freq^{-}$ and inflation. The regression estimates presented in Table 9 also show that a 1 percentage point increase in inflation is associated with a 4.6 percentage point change in $freq^{+}$, but a 3 percentage point reduction in $freq^{-}$.[23]

[23] Note that no significant relationship is found between the mean size of price increases or decreases and inflation. This is similar to the finding using median frequency and price change values for the US by Nakamura

Changes in the overall frequency, which is the sum of $freq^+$ and $freq^-$, in response to inflation are therefore dampened. Only at high levels of inflation where few firms reduce prices, does overall frequency more closely match the frequency of price increases and hence become correlated with inflation, as was the case for Mexico in the mid-1990s (Gagnon, 2009).

Figure 4: Inflation and the frequency of price increases and decreases in Lesotho

Note: The figure displays the four-month moving averages for each variable. Product level averages are aggregated up using Lesotho CPI expenditure weights. The monthly product level averages are in turn calculated as the simple average of the outlet-level value.

Shifts in the composition of overall frequency also explain part of the close association found between the size of price changes and inflation. As shown in equation (3) $\pi_t = freq_t.dp_t$. With dampened movements in $freq_t$, changes in π_t will be strongly associated

and Steinsson (2008), although in contrast to our finding for Lesotho they find no relationship between the frequency of price decreases and inflation.

with movements in dp_t (Gagnon, 2009: 1238). The relative importance of the intensive margin in explaining changes in inflation, as shown in

Figure 3 is therefore in part attributable to changes in the composition of frequency. Similarly, the offsetting movements in the frequency of price increases and decreases drives some of the variance of the size of price changes (var(dp_t)) that is central to the intensive margin component of the variance in inflation (var(π_t)) in equation (4) (Klenow and Malin, 2011: 259).[24] Movements in the frequency of price changes therefore comprise an important component of inflation variance. Much of the intensive margin effect can actually be attributed to frequency of price changes.

An alternative approach suggested by Klenow and Kryvtsov (2008) is to decompose the variance of inflation expressed in terms of its positive and negative inflation components (i.e. $\pi_t = pos_t + neg_t$, where $pos_t = freq_t^+ . dp_t^+$ and $neg_t = freq_t^- . dp_t^-$).[25] The lower part of Table 10 reports the results for the variance decomposition for the terms of positive and negative prices. 66 percent of the variation in retail price inflation can be traced back to variation in the inflation contribution of price increases. This is similar to the 59 percent share for the US over the period 1988 through 2004 reported by Klenow and Kryvtsov (2008), but lower than the 82% estimated for Mexico for 1994 to mid-2002 by Gagnon (2009), although the latter includes the high inflation period in 1995. The remaining variation in inflation in Lesotho (34 percent) can be attributed to the inflation contribution of price decreases.[26]

In summary, fluctuations in the frequency of price change play an important part of inflation dynamics in Lesotho. Rising inflation is associated with higher frequencies of price

[24] The average size of price changes (dp) = $freq^+ . dp+ - freq^- . dp^-$ where $dp+$ (dp^-) denotes the absolute size of price increases (decreases). Hence, the variation in the average size of price changes can be driven by offsetting movements in $freq^+$ and $freq^-$ even if the size of price increases and decreases remain constant.

[25] $\mathrm{var}(\pi_t) = \underbrace{\mathrm{var}(pos_t)+\mathrm{cov}(pos_t, neg_t)}_{positive term} + \underbrace{\mathrm{var}(neg_t)+\mathrm{cov}(pos_t, neg_t)}_{negative term}$

[26] Note that no significant relationship is found between inflation and the size of price increases and price decreases (see Table 9). Changes in the frequency of price increases and price decrease are therefore the important source of the variation.

increases and lower frequencies of price decreases. These results are not consistent with the predictions of a strict TDP model. The results also highlight the importance of both price increases and price decreases in driving inflation movements. Reductions in prices constitute an important component of pricing behaviour in retail outlets. The final observation is evidence of differences in price-setting behaviour between Lesotho and South Africa, despite the close policy integration within the region. We explore this final point in more detail later in the paper.

5.2 Duration of price spells and hazard functions

A further dynamic is the relationship between the probability of price changes and the age of the price. This relationship is commonly analysed by looking at the shape of the hazard function. A price hazard function represents the conditional probability of a change in price of a product, given the elapsed number of periods since the last price change.[27] An upward sloping hazard function would arise if price changes become more likely the longer they have remained unchanged. If firms have a fixed probability of changing prices in each period, as in the Calvo (1983) model, the hazard function is flat.

The general finding in the literature reviewed by Klenow and Malin (2011) is that hazard rates for individual products are not upward-sloping. For the US, Klenow and Kryvtsov (2008) find evidence of flat hazard rates.[28] This is suggestive of time-dependent pricing behaviour. In state-dependent pricing models, the expectation is that the probability of price changes increases in the age of a price as shocks accumulate and the desired price deviates further from the current price (Klenow and Malin, 2011: 276).

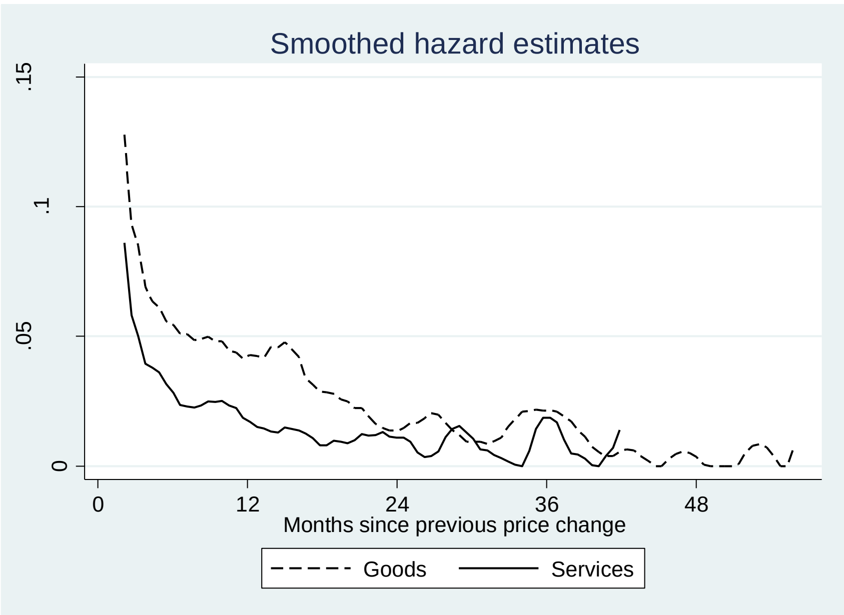
[27] More formally, the hazard rate h (τ) is expressed as the probability that a price (p_t) will change after t periods conditional on it having remained constant in the previous τ -1 periods:

$$h(\tau) =_{\tau \to 0} \Pr\{p_{t+\tau} \neq p_{t+\tau-1} \mid p_{t+\tau-1} = p_{t+\tau-2} = ...p_t\}$$

[28] Their result for the US contrasts those of Nakamura and Steinsson (2008) who find somewhat downward sloping hazard functions for goods and flat hazards with a spike around 12 months for services.

Figure 5 plots the pooled hazard functions for goods and services across retail outlets in Lesotho using uncensored cells. [29] The hazard functions are calculated using uncensored data. The pooled hazard function for goods is downward sloping, with bumps at 12 months and 24 months and a spike at 36 months.[30] The hazard function for the services sector declines more rapidly during the first 18 months and becomes flat thereafter. Downward sloping hazard rates for aggregated product groupings are also found for the US (Klenow and Kryvtsov, 2008; Nakamura and Steinsson, 2008), the Euro area (Álvarez, 2008) and South Africa (Creamer *et al.*, 2012).

Figure 5: Aggregate hazard function for the Lesotho price data



The downward slope, however, reflects survival bias arising from combining firms that are heterogeneous in their price setting behaviour. As the duration horizon increases the

[29] This paper defines t as any given date in the time line, with $t \in [0, +\infty)$. In discrete time, the time line is divided into several periods of the same length. The time line in our case is discrete with an equal size of one month. Following the tradition in statistics, the first observation of a duration is recorded at $t=0$. A period is selected by the date at the end of that period. For example, the 1st period means *(0, 1]*, the 2nd period means *(1, 2]*, and the *n*th period means *(n-1, n]*. Note that the time here means analysis time, rather than calendar time. Duration could begin at any point in calendar time, but it always starts at 0 in analysis time.

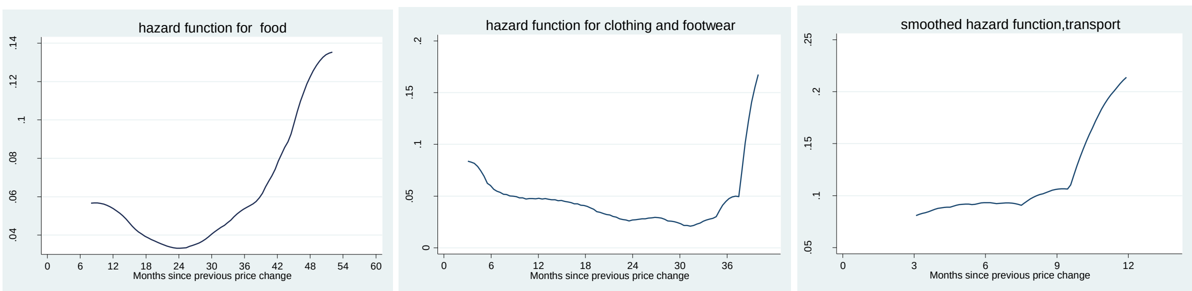
[30] The hazard function of price spells that is characterised by annual durations (of 12, 24, and 36…months), indicates that a substantial fraction of firms review their prices at an annual basis and decide to change them only based on costs and demand developments.

share of price changes corresponding to firms with more flexible pricing behaviour declines resulting in a downward sloping hazard rate (Álvarez *et al*. 2005). Figure 7, therefore, plots hazard rates for selected disaggregated product groups where survival bias is attenuated.

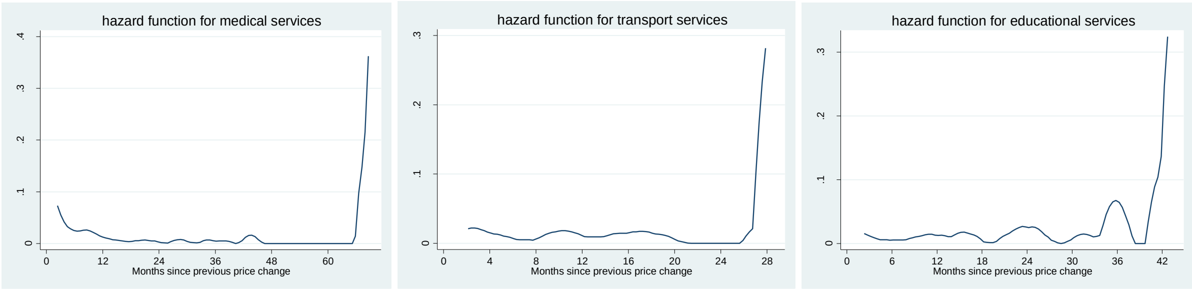
Generally, the hazards for goods are upward sloping, suggesting that the probability of price change for consumer goods increases as more time elapses since the last price change. The hazard for food products and transport equipment are upward sloping while the hazard for clothing and footwear declines slightly in the beginning and then increases. The observed pattern in the clothing and footwear sector may reflect the presence of heterogeneity in price setting behaviour associated with variation in product quality within each group. The disaggregated hazard functions for services are generally flat with a spike at the end of the period.[31]

These results are comparable to those of Creamer *et al.* (2012) for South Africa. Overall they suggest that goods markets are characterised by state-dependent pricing behaviour, whereas services are characterized by time-dependent pricing behaviour.

Figure 6: Hazard functions by product categories



[31] Bunn and Ellis (2012) also find flat hazard rates for services in the United Kingdom.



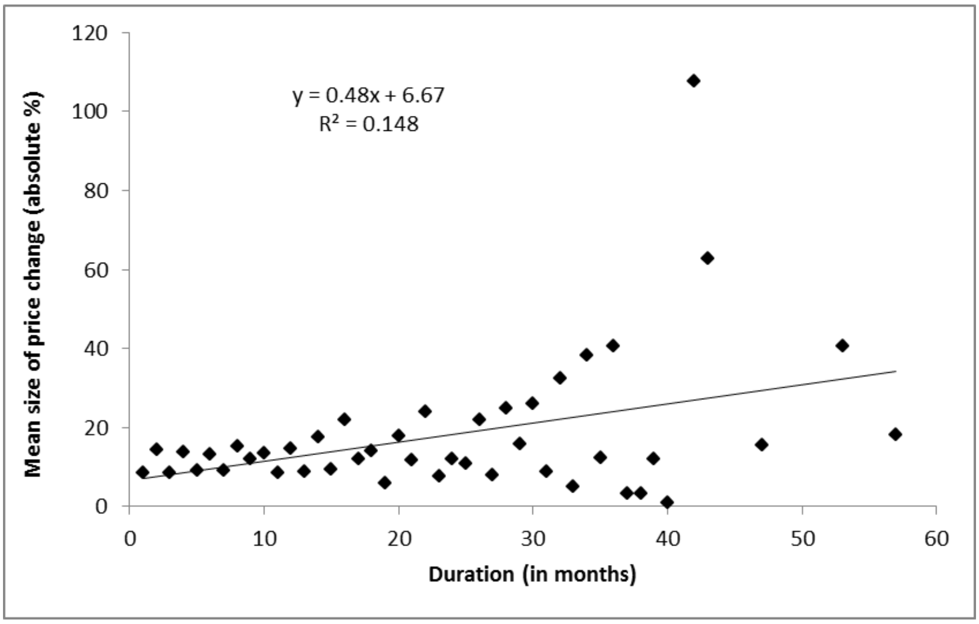
5.3 The size and duration of price changes

Related to the frequency-duration relationship is the relationship between the magnitude of price adjustments and the duration of price spells. In time-dependent models the size of price changes is expected to be increasing in the duration of price spells as more shocks accumulate the longer the spell between price changes (Klenow and Malin, 2011). High menu costs can also drive a positive association between duration and the size of price changes as firms postpone price changes until the desired adjustment is large enough to warrant paying the menu cost (Álvarez and Hernando, 2004: 24).

To evaluate this relationship for Lesotho, Figure 7 plots the simple average size of price changes against the duration of price spell for Lesotho data. The diagram shows a positive relationship between the mean size of price change and the duration of price spells and is similar to the relationship found for South Africa by Creamer *et al*. (2012) and UK by Bunn and Ellis (2012), but contrasts the findings for US and Spain where no relationship is evident (Álvarez and Hernando, 2004; Klenow and Kryvtsov, 2008).[32]

Figure 7: The size of price changes by age (2002-2009)

[32] Looking at the size of price increases and decreases separately, we find a significant positive association between the size of price increases and duration, but no relationship for the size of price decreases.



Note: Each observation reflects the simple (*not* weighted) mean absolute size of price change per duration using the entire sample period.

The association does not reflect survival bias. To test the relationship, regressions of the absolute size of price change on duration using product by outlet level data are estimated.

Table 11 presents the results of these estimates for all products and products categorized according to more aggregated categories. Each estimate includes time fixed effects and product by outlet fixed effects to account for time-invariant heterogeneity across outlets and outlet-invariant heterogeneity over time. A significant positive coefficient for duration is estimated in all estimates with the exception of services. A clear positive relationship is thus found between the magnitude of price adjustment and the time elapsed since the last price change.[33]

Table 11: Estimates of the relationship between size of price change and duration

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	All products	Perishable food	Non-perishable food	Durable goods	Non-durable goods	Services
Duration	0.002***	0.001***	0.001***	0.002***	0.002***	0.001
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)

[33] Álvarez and Hernando (2004) present similar estimates for Spain, but find no significant relationship between size of price change and duration.

Constant	0.047***	0.055***	0.043***	0.071***	0.037***	0.065***
	(0.006)	(0.009)	(0.007)	(0.022)	(0.011)	(0.015)
Observations	134,101	31,143	49,937	18,944	28,594	5,483
R-squared	0.262	0.235	0.218	0.302	0.278	0.420

Note: The dependent variable is the absolute size of price change for each product at the outlet level. Durable and non-durable goods exclude food products. Product by outlet fixed effects and time fixed effects are included. The coefficients on these fixed effects are not shown. Robust standard errors are presented in brackets. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

5. Comparison with South Africa

Product markets in Lesotho are expected to be highly integrated with those in South African. Lesotho is a geographical ‘island’ within South Africa and South African retail chains dominate its supermarket industry. Economic policies in Lesotho are also integrated with those of South Africa. Most importantly, Lesotho is a member of the Southern African Customs Union and the Common Monetary Area where its currency is pegged one-for-one with the South African Rand.

The high frequency of price changes in Lesotho compared to South Africa shown in Table 4 is therefore unanticipated. One possible explanation is that the comparison reflects different time periods and different product compositions. To explore this further, a comparison of price-setting behaviour is conducted using a sample of 126 matched products over the period March 2002 to December 2007. The South African data are obtained from Creamer *et al*. (2012).

Table 12 presents the comparison of the weighted average frequency of price change, price increase and price decrease for the major groups in Lesotho and South Africa. As found earlier, the frequency of price changes, price increases and price decreases in Lesotho exceed the comparative measure in South Africa. Prices according to the sample of products change on average once every 2.4 months in Lesotho (frequency of 41 percent) and only once every

5.9 months in South Africa (frequency of 17 percent). Price changes in Lesotho are revealed to be more flexible than those in South Africa.

Table 12: Comparison of weighted average frequency of price change in Lesotho and South Africa by major group

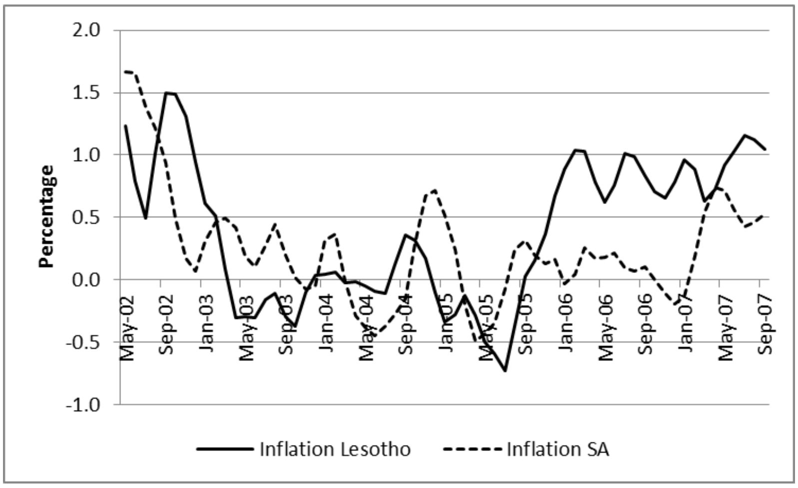
	Lesotho			South Africa		
	Frequency of price change	Frequency of price increase	Frequency of price decrease	Frequency of price change	Frequency of price increase	Frequency of price decrease
Food	0.465	0.290	0.175	0.223	0.126	0.097
Non-alcoholic beverages	0.405	0.243	0.163	0.234	0.119	0.115
Alcoholic beverages	0.271	0.174	0.096	0.102	0.086	0.016
Tobacco and narcotics	0.389	0.275	0.114	0.151	0.134	0.016
Clothing and footwear	0.392	0.224	0.168	0.067	0.033	0.033
Fuel	0.358	0.222	0.136	0.155	0.104	0.051
Household furniture and equipment	0.235	0.130	0.105	0.125	0.069	0.056
Household operations	0.389	0.240	0.149	0.144	0.099	0.045
Medical care and health expenses	0.157	0.067	0.090	0.143	0.099	0.045
Recreation and culture	0.319	0.166	0.153	0.070	0.046	0.024
Education	0.302	0.194	0.108	0.176	0.114	0.063
Personal care	0.335	0.093	0.241	0.150	0.099	0.051
Total	0.410	0.249	0.161	0.171	0.099	0.071

Notes: Weighted average of the product level average over the full period, March 2002 - Dec 2007. Aggregate frequencies are calculated as the weighted average of the product level frequencies. Product level frequencies are calculated as the simple average of monthly average frequency for each product over the period March 2002 - Dec 2007. CPI expenditure shares for Lesotho are used as weights. The sample consists of 126 matched products that together make up 49.7 percent of the expenditure in the CPI basket.

Higher frequencies of price change are observed in Lesotho for all major groups. However, relative frequencies across products are similar in both countries. The simple correlation coefficient across products of the average frequency of price change in both countries is 0.41. If we focus on the frequency of price increases, the correlation coefficient falls to 0.38, but rises again to 0.41 for the frequency of price decreases.

In integrated markets, we would also anticipate a close association between inflation, the frequency of price changes and the size of price changes for product items over time. Some evidence of the inflationary link is shown in Figure 8 that presents the 4-month moving weighted average inflation rate for the sample of 126 matched products for Lesotho and South Africa. From 2002 to mid-2000s, inflation rates fell in both countries. Month-on-month inflations rates then rose in both countries, although the increase was stronger in Lesotho than South Africa.

Figure 8: Four-month moving average of monthly inflation for Lesotho and South Africa



Note: The figure displays the four-month moving average month-on-month price changes in Lesotho and South Africa. Product level averages are aggregated up using Lesotho CPI expenditure weights. The monthly product level averages are in turn calculated as the simple average of the outlet-level value.

We test the robustness of this relationship by regressing aggregate monthly inflation rates in Lesotho at the product-item level on the equivalent variables for South Africa. The results are only illustrative of an association and more formal modelling of the relationship using a dynamic model structure with lags is left for later research. The regression coefficient, shown in Table 13, is positive and statistically significant, but is relatively small. A one percent increase in product-level inflation in South Africa is only associated with a 0.08 percent increase in inflation in Lesotho. Further, only a small share of the variation in average price changes in Lesotho is explained by inflation in South Africa (adjusted R-square equals 0.06), despite the inclusion of product and time fixed effects.

Table 13: Tests of association of price-setting behaviour in South Africa and Lesotho

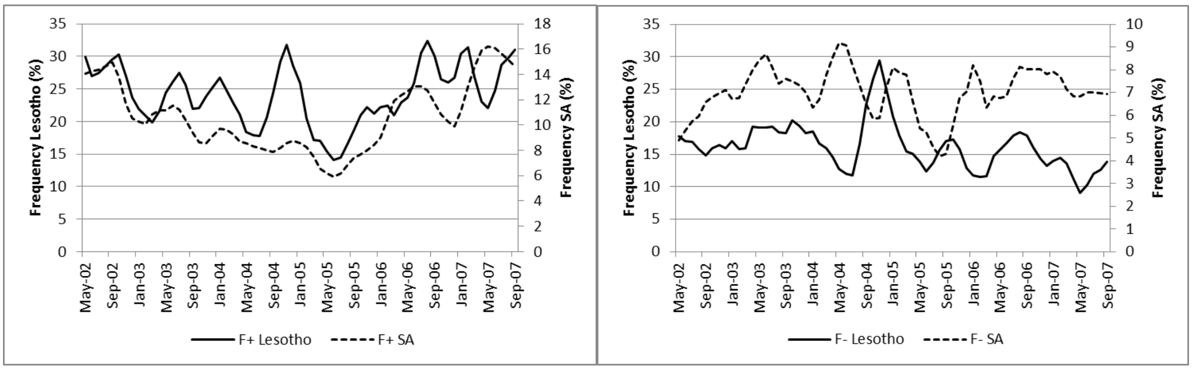
Dependent variable: Lesotho Independent variable: South Africa	Coef	Std. Err	Significance	Adj R2
Frequency price change	0.130	0.024	***	0.42
Frequency price increase	0.187	0.026	***	0.23
Frequency price decrease	0.044	0.033		0.28
Inflation	0.084	0.030	***	0.06
Size price increase	0.086	0.053	*	0.31
Size price decrease	0.008	0.022		0.29

Notes: Estimates are based on a product by time level panel of price-setting indicators. The panel consists of monthly averages for 126 products from March 2002 to December 2009. All regressions include monthly fixed effects and product fixed effects. Each row presents the coefficient, standard error, significance level and adjusted R-square of a regression of the Lesotho variable on the comparator variable for South Africa.

We also look at the association between the frequency of price changes in Lesotho and South Africa. As shown in the regression coefficients presented in Table 13, there is a significant positive association (coefficient equals 0.13) between variations in the product-item level frequency of price changes across the two countries. However, the association is driven by the frequency of price increases, not decreases. This is clearly shown in Figure 9 where the trends in the aggregate frequency of price increases in each country follow each other closely (part a), whereas there is no such relationship for the frequency of price decreases.

Figure 9: Four-month moving average frequency of price increases and decreases for Lesotho and South Africa

a. Price increases b. Price decreases



Note: The figure displays the four-month moving average month-on-month price changes in Lesotho and South Africa. Product level averages are aggregated up using Lesotho CPI expenditure weights. The monthly product level averages are in turn calculated as the simple average of the outlet-level value.

The final two rows of Table 13 present the coefficients of the regressions estimating the link between the size of price increases and decreases in South Africa on those in

Lesotho. None of the coefficients are significant (at the 5 percent level or below). The positive association between inflation in Lesotho and South Africa therefore appears to be driven by co-movements in the frequency of price changes (more precisely increases), rather than the size of price changes.

5. Conclusion and policy implications

This paper presents new evidence on price setting behaviour in Lesotho using micro price data for the period March 2002 and December 2009. A number of stylised features characterising price setting behaviour are identified.

As with the international empirical literature, there is substantial heterogeneity in the frequency of price changes across products, outlets and time. Retailers on average change prices in every 2.7 months, but there is a wide variation in the frequency across products. For example, the average duration across products ranges from 2.6 months for goods to 8 months for services. There is also substantial heterogeneity in price setting behaviour across outlets. Outlet-level characteristics, including outlet size, are therefore an important determinant of price setting behaviour. Further research using outlet survey data is needed to identify the important outlet characteristics.

The frequency of price changes in Lesotho is found to be relatively high compared to other economies, particularly its neighbour South Africa. Using a matched sample of products, product prices in Lesotho change on average once every 2.4 months compared to once every 5.9 months in South Africa. Looking over time, we find a statistically significant association between the frequency of price changes in South Africa and Lesotho, but the relationship is driven by price increases and not price decreases.

Average price changes are found to be large in absolute terms, but many small price changes occur. This finding is consistent with the international empirical evidence and suggests that price changes in Lesotho are driven by a combination of idiosyncratic productivity or cost shocks together with a wide range of menu costs across products and time.

The paper also analyses the dynamics of price changes over time. Fluctuations in the frequency of price change play an important part in the dynamics of inflation in Lesotho. While variations in inflation are strongly correlated with the size of price changes, rising inflation is found to be closely associated with a higher frequency of price increases and a lower frequency of price decreases. The results also highlight the importance of both price increases and price decreases in driving inflation movements.

We also find substantial heterogeneity in the probability of price change. Hazard functions are upward sloping for goods (for example, flour, fruit juice, washing powder) and generally flat for services (for example, school fees, dry cleaning). This is consistent with time-dependent pricing behaviour in services, but state dependent pricing behaviour for goods. The size of price changes also increase with the duration of the price spell, a result that is consistent with many time-dependent pricing models. This relationship, however, differs from much of the international literature, but corresponds with findings for South Africa.

Overall, price setting behaviour in Lesotho broadly corresponds with the stylized facts identified by Klenow and Malin (2011). Nevertheless, the research identifies some important areas for further research. Differences in the frequency of price setting behaviour between South Africa and Lesotho, despite trade and monetary policy initiatives to increase integration, require further analysis. The heterogeneity in price setting behaviour across outlets is an additional avenue for further research. Such research will require information on retail outlet level characteristics that can be obtained from firm surveys. Survey data will also enable researchers to investigate the role of market frictions and distribution networks in driving price differences between markets and regions in Lesotho.

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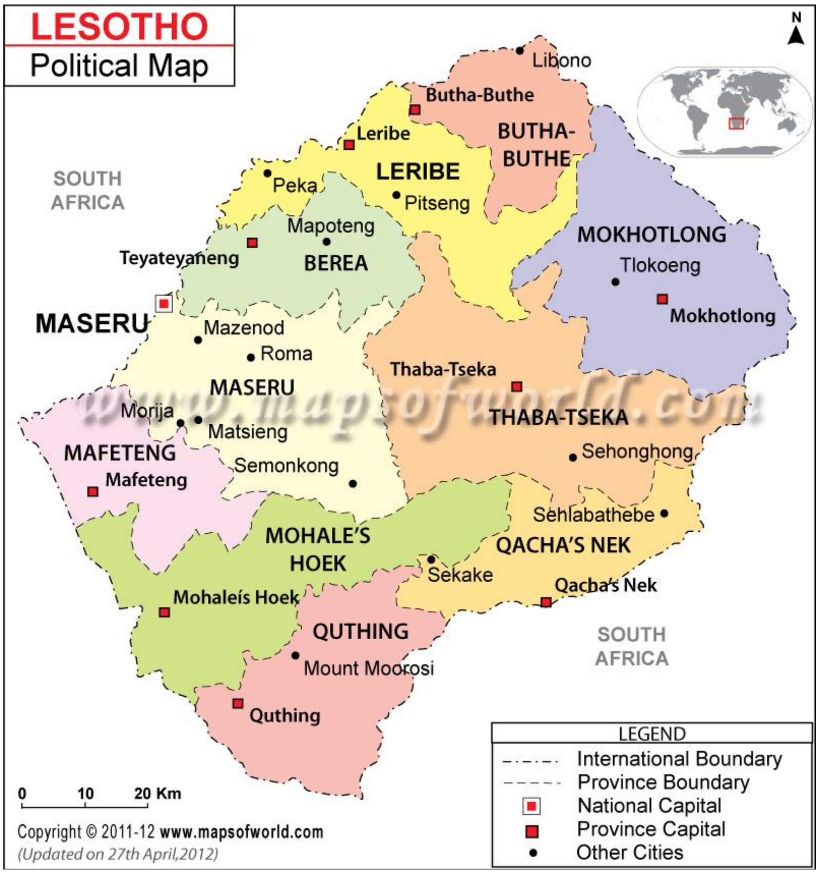
Appendix

Figure A: Map of district areas in Lesotho



Source: www.mapsofworld.com