Product market price integration in developing countries

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Abstract

Widespread empirical evidence of price discrimination in markets for goods and services suggests that national markets should be viewed as segmented rather than integrated. Yet, this research is almost entirely driven by studies of price setting behaviour in developed countries. This thesis extends the empirical literature by providing new evidence on price setting behaviour and product market integration in developing countries using a unique data set of monthly product prices at the retail outlet level or regional level for Lesotho, South Africa and Botswana over the period 2002 to 2009. The thesis is comprised of three main chapters.

The first chapter provides evidence that none of the time-dependent or state-dependent theories of price setting behaviour are entirely consistent with the empirical features found in the data. Therefore, it is difficult to find one theory that can explain pricing behaviour economy-wide. Improvements can be made on the current theories of price setting to incorporate different characteristics of price setting that are specific to developed and developing countries.

The second chapter examines the relationship between inflation and the frequency of price change and suggests that goods are characterised by state-dependent pricing and services are characterised by time-dependent pricing, consistent with the presence of menu costs in goods and not in services. The dominance of South African retail chains in the Lesotho retail sector affects price setting behaviour in Lesotho. Product markets are more integrated, between Lesotho and South Africa, in the more tradable sectors. The differential impact of local, national and regional inflation on price setting behaviour suggests that product markets remain segmented, despite Lesotho’s membership of the Southern African Customs Union (SACU) and the Common Monetary Area (CMA).

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Membership of the CMA does not allow Lesotho to make independent monetary policy decisions to respond to its domestic macroeconomic shocks although it mitigates the effect of external shocks. Given that the state has no control over monetary policy and that price setting behaviour differs in Lesotho from South Africa; Lesotho may need to implement policies that enhance integration to ensure alignment between domestic inflationary conditions and those in South Africa, upon which monetary policy is based.

Chapter three discussed the fact that product markets are clearly not fully integrated. This is despite the fact that Botswana, Lesotho and South Africa have joint membership of the SACU and Lesotho and South Africa are both members of the CMA. However evidence of declining border effects points to increasing market integration over time. The distance equivalent border effect between South Africa and Lesotho was found to be 438 km between 2006 and 2008 while for the same period it was 14, 520 km between Botswana and South Africa after controlling for distance and other factors.

We use a difference-in-difference estimation approach to examine how changes in monetary policy in Botswana impact on the border effect. The results of this investigation suggest that interest rate and exchange rate policy tools are effective channels through which monetary unions can increase integration within the region. The DD estimates indicate that the exchange rate policy change the results in a 2 percentage point decline in the border effect between Botswana and South Africa while the monetary policy change results in a 3.8 percentage point decline in the border effect between these countries. Therefore, this research indicates that monetary unions are appropriate policies to enhance further integration in product markets between these countries).

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Dedication

To my son, Rets'epile Nchake

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1 General introduction

1.1 Background and motivation

The process of integration of national economies is amongst the most widely discussed economic issues in international economics (Knetter, 1997). Integration in product markets globally, regionally, and within countries, through the pursuit of free movement of goods, is an important dimension of economic integration. It contributes to the growth of the economy and also promotes efficient allocation of resources (Frankel and Romer, 1999). Integration reduces volatility of prices, allowing gains from trade based on regional comparative advantages, and facilitates the efficient movement of goods from areas of surplus to areas of deficit. It also expands markets for more efficient firms (see Melitz, 2003) and increased competition and hence overall efficiency in those markets. Integration also creates a larger market place as the total number of varieties produced increases, and consumers benefit from increased selection and lower prices (Krugman, 1979).

However, it is increasingly recognised that product markets remain segmented, even within countries, despite trade and monetary agreements to enhance integration (Knetter and Slaughter, 2001). Lack of integration generates welfare costs for society. Barriers that inhibit the flow of goods prevent specialisation according to comparative advantage. Consequently, gains from trade are not realised and market inefficiency exists. Firms are constrained from adjusting their pricing decisions because of incomplete information between markets, which can lead to inefficient allocation of resources. They are also prevented from selling products in markets that will maximise their profits. Consumers face a limited choice of goods and services, yet at inefficiently higher prices (Lucas *et al.*, 1994; Broda and Weinstein, 2008).

The extent of lack of integration in product markets is expected to be higher in Africa because of high transaction costs and continued use of trade barriers. Many private

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enterprises in Africa are facing high transaction costs because of less-developed infrastructure in many African countries and other market frictions which can limit the transmission of price signals and prohibit market arbitrage (Portugal-Perez and Wilson, 2008).

As shown in the empirical literature, the effect of high transport barriers , poor trade facilitation and trade barriers is a reduction in cross-border trade flows in Africa (Portugal-Perez and Wilson, 2008; Limao and Venables, 2001; Longo and Sekkat 2004; Njinkeu and Fosso, 2006). However, trade flows are imperfect indicator of product market integration. Another indicator that has been challenged in the literature is the use of the magnitude of barriers between national markets such as shipping costs, tariffs and other impediments to movements of goods (Knetter and Slaughter, 2001). The main reason this measure is challenged is that it does not include the cost of prohibitive and all non-tariff barriers and thus may overstate the degree of product-market integration.

The alternative measures follow the law of one price (LOP), as they consider price comparisons in different product markets (Knetter and Slaughter, 2001). One considers prices charged by sellers in different markets. The second considers the relative price structure for goods sold within each country. The third considers relative consumer prices for final goods across all industries within each country.

In order to evaluate product market integration using a price-based approach, appropriate price level data needs to be available. Prices of tradable goods can generate gains to consumers, in terms of a range of improved options due to trade. As these prices match international prices, a country benefits through its comparative advantage in a particular good. Thus trade theory clearly states that an important aspect of goods market integration is world prices of traded goods that a country needs to match.

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To date, very little research on product market integration using price data has been conducted in developing economies, particularly in Africa, primarily because of lack of appropriate retail price level data. This has led to research that is primarily focused on the extent of product market integration using price indices (for example Engel and Rogers, 1996) that are not internationally comparable.

Lack of appropriate price data in developing countries has also constrained researchers from understanding firm price setting behaviour which is an important determinant of product market integration. The ability of firms to exploit differences in demand and costs across markets influences the degree to which markets are integrated or segmented. Consequently, exact determinants of market integration have not been established, even within highly integrated countries.

The effectiveness of economic policies such as regional trade integration and coordination of monetary policies are expected to enhance product market integration. In this thesis, we use price data to complement and provide additional insights to the findings recorded in the existing literature. This approach also allows us to test the conclusions derived from alternative measures.

This study contributes towards a deeper understanding of the extent and determinants of product market integration in developing countries in Africa. Using disaggregated retail price data, it provides new insights into the price setting behaviour of retail outlets in Lesotho, the extent of product market integration within Lesotho and within the Southern African Customs Union and the impact of customs and monetary areas on product market integration in the region.

The following section looks at the theory and evidence of product market integration using the price-based approach.

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Theory and evidence of product market integration

Integrated markets are defined as two or more spatial locations that are connected by trade or have one-for-one price changes. Product markets are assumed to be integrated if there is free flow of goods between markets and a price change in one market leads to an identical price response in the other market.

The literature covers the quantity- and price-based approaches to measuring product market integration. The quantity measure is based on observed trade flows using a gravity model (a quantity based measure of market integration). However, the problem with this indicator is that there are inherent and theoretical difficulties in identifying the degree of integration using observed trade (Parsley and Wei, 2003). Trade volumes reflect price differences, but are also affected by several other factors-such as government expenditure and donor funding-that are not related to factors influencing market integration, (Edwards and Rankin, 2012). Different levels of trade flows can be associated with a single trade cost. The problem therefore is that variations in the volume of trade flows are consistent with the same degree of market integration, thus the true degree of market integration may be lower, even with higher trade volumes.[1] Identification of market integration through trade flows alone is therefore problematic.

Recent literature on this topic has argued that a better measure of market integration is the degree to which price levels are similar in countries and/or the extent to which they co-move or converge (Parsley and Wei, 2003; Edwards and Rankin, 2012).

Price differences are central to classical trade theories where relative price differences drive trade according to comparative advantage. In perfectly integrated markets, product prices should not differ as price gaps are arbitraged away by trade flows. Changes in product market integration will therefore be reflected in prices, whether or not trade occurs, as it is the

[1] Trade occurs as long as the price gap exceeds trade costs. The volume of trade however is then a outcome of demand and supply constraints.

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potential for arbitrage that determines how far prices can diverge. Integrated markets would not allow price differences to persist in the long-run, rather, price movements in one market would change to regain the equilibrium relationships among the prices observed in geographically separated markets. This price-based measure of product market integration is based on the Law of one Price (henceforth, LOP) which states that for any product *k* at time t:

$$P_{k,t} = E_t P^*_{k,t} \qquad (1a)$$

Where $P_{k,t}$ is the price of product *k*, denominated in domestic currency; E_t is the nominal exchange rate at time *t* between the two countries; and $P^*_{k,t}$ is the price of product *k* denominated in foreign currency at time *t*. Prices of similar products expressed in the same currency should, under competitive conditions, be equal across all locations, nationally and internationally. This is referred to as the absolute version of LOP. An alternative measure of price integration is the relative version of LOP which states that for any product k:

$$\Delta p_{k,t} = \Delta e_t + \Delta p^*_{k,t} \qquad (1b)$$

The small letters denote the natural logarithms of the upper case letters in equation (1a) and Δ refers to the first differences. This means that the changes in the relative prices in local currency are offset by changes in the nominal exchange rate. Relative LOP tests whether prices tend to remain apart from each at a constant level and it relaxes the assumption that prices must converge to the same level.

Recently, the LOP has provided a useful benchmark for the dynamics of relative prices in international economics literature. Deviations from the LOP arising due to trade costs and other border-related policies, or due to transaction costs such as poor transportation and communication infrastructure, result in incomplete price information available to economic agents and may lead to decisions that contribute to inefficient outcomes. Consequently, changes in world market prices cannot be fully transmitted to domestic prices,

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resulting in economic agents adjusting partly (if at all) to shifts in world supply and demand (Sexton, Kling and Carman, 1991; Badiane and Shively, 1998). LOP deviations across domestic markets can arise from large marketing margins due to marketing power, differences in product specifications, service levels and transaction costs that prohibit arbitrage (Foad, 2010). A firm that has strong market power (monopoly power) has an incentive to increase prices above the marginal cost without fear of losing its customers. However, the firm that has many competitors in the market does not have market power and thus needs to set prices equal to marginal costs because each firm takes into consideration the price charged by its competitors.[2]

Several studies have evaluated product market integration using prices. The general conclusion is that deviations from LOP persist between countries and across cities within the same country. However, most of these studies of product market integration have been applied to developed countries. For example, Engel and Rogers (1996); Atkeson and Burstein (2008); Gopinath and Rigobon (2008) find large deviations from LOP between the US and Canada, while Engel and Rogers, (2001, 2004), Crucini *et al.* (2005) and Bergin and Glick (2007) find LOP deviations between European Union countries. Similarly, LOP deviations are found between the US and Japan (Parsley and Wei, 2001); and Japan and Korea (Baba, 2007). The LOP is found not to hold even for identical goods sold at the same location, as long as these goods are denominated in different currencies (Asplund and Friberg, 2001). Other studies explain deviations from LOP in terms of changes in the real exchange rates. Engel (1999) find deviations from LOP, between US and Japan, as explained by movements in the real exchange rates (caused by movements in prices of non-traded goods). However, Parsley and Popper (2010) argues that deviations from LOP depends on the tradability of the intermediate inputs.

[2] Any market structure that has market power is characterised by a downward sloping demand curve, these are; monopoly, monopolistic competitive and oligopolistic market structures. The only market structure that has no market power is perfect competition and this thus has a horizontal demand curve.

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The results of the few existing studies on LOP deviations within and between African economies corroborate these findings. For example, Versailles (2012) finds LOP deviations among the five Eastern African Community (EAC) member states for the period 2004 to 2008 while Aker *et al.* (2010) find LOP deviations between the two neighbours, Niger and Nigeria. Similarly, Edwards and Rankin (2012) find LOP deviations among 12 African cities.

Literature gap

Nevertheless, a number of gaps remain in the empirical literature. In order to be able to gain insight into how markets of identical goods within and across borders are integrated/ segmented, one needs to use price comparisons that requires the use of disaggregated micro-level price data. But most studies use price indexes and aggregate prices of products that may not be identical internationally, to infer the extent of product market integration. Studies that use disaggregated micro-level price data have mostly been carried out in industrialised countries (Broda and Weinstein, 2008; Atkinson and Burstein, 2008; Gopinath and Rigobon, 2008; and Goldberg and Verboven, 2001). Aggregation of individual products' prices can be problematic as it amplifies deviations from LOP across countries (Broda and Weinstein, 2008).

Micro-foundation of macroeconomic variables and macroeconomic theory need to address the following issues: Firstly, is about micro dynamics of macro level economic indicators such as inflation should be examined. Inflation as an aggregate variable may disguise different underlying patterns of price changes, such as price rigidities, that can drive the degree to which markets are integrated. Secondly, micro level responses to macroeconomic policy should be examined. Analysing prices at a unit level facilitates an understanding of actual pricing conduct at the most basic level (Creamer and Rankin, 2008).

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Finally, the micro-foundations of macroeconomic theory need to be covered. Most studies do not find a consistent prediction of theoretical models and the empirical data.

Contributions to the theoretical literature have attempted to resolve the inconsistency between the micro and macro facts on price changes. Various conclusions have been drawn about the possible causes of rigidities in price setting behaviour. But no specific model has been found appropriate to fully explain the empirical characteristics of price setting across different countries, particularly in Africa. It is important to build macroeconomic models that better incorporate the characteristics of economic agents at the micro level.[3]

Product markets can integrate within country markets as well as between countries. Product market integration within a country implies that when trade takes place between the two regions, the price of a product in the importing region should equal the price in the exporting region inclusive of the distribution costs. For several decades, scholars have investigated these phenomena (Rogoff, 1996; Goldberg and Knetter, 1997; Knetter and Slaughter, 2001). They found evidence of price differences between national markets for final goods – even within national markets. That is, the LOP does not hold due to the magnitude of barriers that have increased the costs of movements of goods between national markets.

This necessitates the need for more research on sources of market segmentation between countries. Many studies have confirmed that national borders substantially segment markets, but the source of the border effect remains unclear, particularly in Africa where studies on border effects are few. Transport costs are high in Africa due to poor infrastructure and geography (Limao and Venables, 2001). If transport costs are high, then prices will also be inflated, resulting in higher final prices to consumers. As Rodrik, (2000) points out, *"National borders create political and legal demarcations that segment markets in much the*

[3] One group of studies points to models of idiosyncratic disturbances (for example Dotsey *et al.*, 2005) and sector specific heterogeneity among price setters (Cavallo, 2006). Another group argues that rational firms direct their focus on sector-specific disturbances rather than aggregate conditions (for example, Mackowiak and Wiederholt, 2009).

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same way that transport costs or border taxes do. Exchanges that cross national jurisdictions are subject to a wide array of transaction costs introduced by discontinuities in political and legal systems".

Empirical evidence shows some support for the positive impact of trade and monetary union on product market integration. Few studies use disaggregated prices to identify the impact of monetary union (Rose and Engel, 2002; Parsley and Wei, 2003; and Cavallo *et al.*, 2013). Studies that look at the effect of monetary unions in Africa but do not use prices include those of Tsangarides *et al.* (2006) and de Sousa and Lochard (2005). Some studies on Africa (and many other emerging economies) evaluate the impact of monetary union using gravity-style models (Rose, 2000; Rose and van Wincoop, 2001; Glick, 2001; Glick and Rose 2002; Nitsch, 2002). This leads to a number of identification problems as they do not analyse how changes in policy lead to changes in product market integration. Other studies in Africa use a dummy variable to estimate the impact of monetary union (Rose and Engel, 2002; Parsley and Wei, 2003), thereby failing to address the common problem of omitted variable bias and this will be dealt with in detail later in the thesis.

A few studies have unpacked the the exchange rate and interest rate channels through which monetary unions affect price integration. Some studies analyse how fixed exchange rates affect price integration (Cavallo *et al.*, 2012) and others investigate currency unions or the use of common currencies influence price integration (Engel and Rogers, 2004; and Martin and Mejean, 2012). Honohan (1992) investigated how currency unions influence convergence in consumer prices and interest rates of smaller members in comparison to an anchor country in Africa. However, this study focuses on macro variables that do not give insight into the extent of integration in product markets at micro level. To the best of our knowledge, no study has analysed how both channels affect product market price integration in Africa.

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In summary, several gaps in the literature have been identified. These are related to the measurement of integration, the price setting behaviour of agents and how this affects integration, the impact of policies, the focus of developed economies and the data limitations. This thesis extends this literature using unique disaggregated product price data to provide new evidence for developing countries, in particular in Africa.

1.2 Objectives of the thesis

The main objective of the thesis is to empirically examine the price setting behaviour and product market integration within the context of developing countries. To evaluate this, the thesis is structured around three specific objectives.

Objective 1

The first objective is to analyse stylised facts that characterise price setting behaviour of retail outlets in Lesotho, distinguishing between the two main theories of price setting behaviour (state-dependent and time-dependent) and examining their consistency in explaining the empirical characteristics found in the data.

To address this objective, the thesis draws on a unique database constructed from primary sources of monthly product prices at the retail outlet level. The uniqueness of this data is that it varies by product item, by retail outlet and by location. The data is available for a wide range of products (over 150 product items for the Lesotho data) which helps analysis over a broader spectrum of sectors but can also raise the problem of market segmentation because of differences in quality.[4] Products are defined in terms of unit of measurement (for example, 750ml of Sunflower oil; 1kg of rump steak) and some of the products by brand (for example 750 ml of All Gold tomato sauce; 750ml of Croswell & Blackwell mayonnaise); over a period of time (from March 2002 to December 2009) on monthly frequency, allowing for time series analysis of product market integration across regions (for example, Maseru,

[4] Tables 1.1 and 1.2 in Appendix for Chapter 1 presents a sample of the data on selected products

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Johannesburg, Gaborone) within countries. This also allows comparison of prices of identical products within and across regions and helps isolate price differences that are associated with product market segmentation across locations.

The analysis is structured around the aforementioned objective of documenting the characteristics of price setting behaviour in Lesotho. In particular, characteristics such as the frequency of price changes, the size of price changes, and the probability of price changes are documented. These are calculated across a number of disaggregated product categories, and outlets and across time.

Next the price data is used to distinguish between the two standard theories of price setting behaviour (state-dependent and time dependent pricing theories) to explain the empirical characteristics of the data. This comparison enables identification of the model which more closely reflects the true underlying price adjustment process in the economy of Lesotho. The alternative theories have different implications for price stickiness and hence understanding of which model is applicable and relevant to policy makers who wish to understand the transmission mechanism of monetary policy and the extent to which price shocks transmit throughout the economy. Finally, the results found in the case of Lesotho are compared to similar results found in other countries.

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Objective 2

The second objective of this research is to understand the extent to which price setting behaviour within individual firms is related to local, national and regional inflationary dynamics. The analysis is structured as follows.

The first analysis tests state-dependence in price setting through the relationship between the frequency of price change and retail price inflation in Lesotho. The second identifies the differences in the relationship between price setting behaviour and retail price inflation in Lesotho, distinguishing between local and national inflation. In doing so, the extent to which price setting behaviour is determined by local and/or national shocks is examined, providing insight into the extent to which local markets are integrated into national markets. The third establishes the extent to which regional price dynamics influence price setting behaviour in Lesotho, using data on price setting behaviour and inflation in South Africa. Finally, these relationships are analysed according to different product categories to reveal whether pricing behaviour differs according to product markets.

Objective 3

The third objective of this thesis is to investigate the effect of national borders and monetary unions on product market price integration among Botswana, Lesotho and South Africa. This analysis is central to the thesis as it focuses on policy factors that affect market integration between countries.

This objective is addressed in the following ways. The first establishes the extent of product market price integration using data for Lesotho, South Africa and Botswana. Second, we evaluate and compare different methods for estimating the role of borders and transport costs in defining price differences. Finally, we establish how monetary unions alter border effects between these countries by analysing the micro impact of monetary union on product market integration. These three objectives define the three main chapters of the thesis.

1.3 Relevance and contribution of the thesis

While recent studies have made progress in understanding price setting behaviour and explaining product market integration within and across countries, sources of market integration are not yet well understood. This implies particularly in the context of developing countries where appropriate price level data is not available. This thesis thus makes several important contributions.

First, is the construction of a unique integrated dataset consisting of product by retail level monthly price data. This data set is collected by statistical agencies in the selected

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countries for the construction of the CPI. The data enables research that goes beyond the analysis of price integration within a country, to the analysis of the determinants of price setting behaviour at the retail outlet level, and also allows for analysis of price changes of products at retail outlet level. The selection of three countries (Lesotho, Botswana and South Africa) enables research that explores product market integration between countries, within the context of regional integration. The results of this study will therefore advance the understanding of product market integration in developing countries, providing a comparative perspective of price integration in Africa, and the effectiveness of regional integration on product market integration.

Secondly, the data allows for the identification of the main stylised features that characterise the price setting behaviour of retail outlets in Lesotho. The results of this analysis will contribute to aligning the predictions of theoretical models of price setting behaviour and evidence from the data, within the context of developing countries.

Thirdly, the results also have implications for macroeconomic policy. Price setting behaviour differs across products, implying that macroeconomic policy, such as monetary policy, affects sectors of the economy differently. The availability of product level data enables a critical evaluation of the micro-foundations of macro theory and aggregate inflation indicators. For example, analysis based on the data can provide insight into changes in the transmission of monetary policy to retail level price behaviour. The retail price response to monetary policy is of particular relevance to Lesotho, which as a member of the Common Monetary Area (CMA) and effectively adopts the monetary policy of the dominant partner, South Africa.

Finally, the analysis of the effect of unobserved border-related costs (border effect) and monetary union on price integration between these countries gives insight into the degree of market segmentation within a highly integrated area. The expectation from theory is that

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the border effect between countries that are highly integrated should be zero. However, empirical literature has revealed of the border effect between integrated countries such as the US and Canada (Engel and Rogers 1996; Parsley and Wei 1996 and; Parsley and Wei, 2001). The three selected countries make an interesting case study because they are all members of the Customs Union and Lesotho and South Africa are also members of the Monetary Union. This selection of countries enables an analysis of the impact of monetary union using the difference-in-difference method, which is able to isolate the true effect of policy changes. The results contribute towards an understanding of the importance of trade and monetary agreements in facilitating product market price integration within the SACU. This thesis is therefore of interest to both academics and policy makers, and is intended particularly to address issues of development.

As a contribution to research, the results of this study provide insight into the extent of market integration within the context of developing countries, focusing on the relationship between trade costs, national borders, and price differences across countries. The results will also provide a better understanding of the theory of price setting behaviour within the context of developing countries, in particular, small landlocked low income countries where location of the retail outlets within one country can influence the price setting behaviour differently.

From a policy perspective, the results of this research show the extent to which product markets are integrated among the three countries as well as some of the constraints to product market integration within and between the countries. This thesis is therefore of relevance for policy makers who wish to influence market integration/segmentation both within and between countries.

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1.4 Structure of rest of thesis

The structure of the remainder of the thesis is as follows: Chapter 2 links product market integration and price setting behaviour within a country. Firstly, the main stylised features that characterise price setting behaviour across retail outlets in Lesotho are documented. Secondly, the empirical facts are compared to the various time-dependent and state-dependent models of price setting behaviour to test the consistency between theory and the data.

Chapter 3 extends the analysis of price setting behaviour by testing the prediction of state-dependent pricing models on the relationship between the frequency of price changes, price increases and price decreases on retail price inflation in Lesotho. This relationship is also linked to the external influence conditions in South Africa.

Chapter 4 extends the analysis of product market price integration across countries by including Botswana in the analysis. First, the degree of product integration is established within and between the three countries. Secondly, the role of political borders is analysed and the appropriate mechanism to estimate the border effect is identified. Finally, the impact of monetary union on product market integration is analysed to establish the extent to which policy reforms in Botswana have altered border effects between Botswana and the CMA countries.

Chapter 5 concludes the thesis. The implications of the findings for policy are discussed for policy, and potential future research options are suggested.

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2 Price setting behaviour in Lesotho: evidence from consumer retail price data

2.1 Introduction

Widespread empirical evidence of price discrimination in markets for consumer goods has offered insights into the importance of firm behaviour in the setting of prices. Yet, this research is almost entirely driven by studies in developed countries. This chapter extends the literature by considering price setting behaviour of retail outlets in Lesotho, a small and highly open low-income country.

Price setting behaviour forms an important part of economic theory. It is a starting point in modern micro-founded macro models because it is viewed as a major determinant of the response to nominal shocks that strike an economy (Dias *et al.*, 2007). Despite the rich theoretical literature, there is almost no empirical evidence that directly measures the extent of price stickiness across countries, particularly in Africa.[5] The challenge has been the availability of price data at the micro level.

This chapter expands the scope of this literature on developing countries using highly disaggregated price data for Lesotho, a small, landlocked, low-income African country. Studying price setting behaviour in Lesotho will add knowledge to the underlying patterns of price changes at the most disaggregated level and provide a better understanding of micro-foundations of macro models in a case of the developing country such as Lesotho.

A study on price setting behaviour using micro data offers many insights about the validity and importance of macroeconomic theory. It enables a critical evaluation of the micro-foundations of macro-theory and aggregate inflation indicators. For example, analysis based on the data can provide insight into the transmission of changes in monetary policy to retail level price behaviour. Further, the micro-data-based findings on pricing conduct can be

[5] Current studies include; Creamer and Rankin (2008) for SA; Kovanen (2006) for Sierra Leone; Gouvea (2007) for Brazil; Julio and Zarate (2008) for Colombia.

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used to modify existing models (such as the Dynamic Stochastic General Equilibrium (DSGE) models) commonly used to model the impact of monetary policy (as in Creamer *et al.*, 2012). Therefore, understanding the extent of pricing conduct at a micro level facilitates an understanding of actual pricing conduct (Creamer and Rankin, 2008). The retail price response to monetary policy is of particular relevance to Lesotho, which as a member of the Common Monetary Area (CMA) effectively adopts the monetary policy of the dominant partner, South Africa.

The main objective of this chapter is to present the first empirical evidence of the microeconomics of price setting behaviour in retail outlets in Lesotho. The analysis is structured around the following specific objectives.

- To analyse the main stylised facts that characterise price setting behaviour of retail outlets in Lesotho.
- To distinguish between the two theories of price setting behaviour (state-dependent and time-dependent pricing theories) and examine their consistency in explaining the empirical characteristics found in the data.

The remainder of the chapter is structured as follows. Section 2.2 reviews theoretical models of price setting behaviour while section 2.3 reviews the relevant empirical literature. Section 2.4 discusses the methodological framework and section 2.5 presents the empirical results. Section 2.6 concludes the chapter.

2.2 Theoretical insights

Economic literature describes theoretical models that explain nominal rigidities in price setting behaviour as time-dependent and state-dependent. There are several key differences between the two models.

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2.2.1 Time-Dependent Pricing Models

In time-dependent pricing, the price change is a function of a calendar time. The timing of a price change is exogenous to the firm since it is determined by the passage of time. Prices are set by multi-period contracts that administer some fraction of prices, in each period. The expiration of these contracts is determined by the passage of time (and not economic developments), after which they must be renewed. Time-dependent pricing models reflect exogenous staggering of price changes across firms in the economy and therefore there will be constant fraction of firms adjusting their prices in each period. Two leading models of time-dependent pricing have been introduced by Taylor (1980) and by Calvo (1983). Extensions of these models were developed by Wolman (2000)[6] and; Taylor (1993, 1999).

Taylor (1980) assumes staggered contracts in which prices are fixed for the duration of the contract. Taylor-contracts therefore have a pre-determined length where prices are only changed at the beginning of the contract and not revised during the life of the contract. Prices are kept unchanged during a fixed period of time, which is common for products with regulated prices. Since prices are fixed for H periods, the hazard rate is 100 percent at particular times and zero percent for all other times.

The drawback of this model is that it does not take into account heterogeneity in the price changes (the frequency and the duration), thus generating zero hazard rates, except in the H^{th} period, which contrasts with most empirical evidence. The assumption of the deterministic timing of price changes in the Taylor model fails to produce a variable duration of price changes within sectors or products.

Alternatively, Calvo (1983) assumes that prices are set randomly. In the Calvo approach as distinct from the Taylor model firms are shown as subject to random shocks to prevent them from making continuous price changes. In Calvo-contracts, prices therefore

[6] This model is also called the truncated Calvo model as it encompasses both Taylor’s and Calvo’s models

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have random durations - such that the number of periods that a price is fixed is stochastic. This process of administering price changes operates independently of other factors that affect the economy.[7] In each period, a fixed proportion of firms are able to change prices while the remaining firms keep their nominal prices fixed. The probability of being able to change prices is the same for all firms, regardless of when last they changed prices. This implies that there is a constant fraction of prices that change at any instant, and thus a constant hazard rate.

The major drawback of the Calvo (1983) model is that Calvo pricing is sub-optimal under menu costs. One of the reasons is that its assumption of constant price changes implies that firms cannot respond between price changes even during periods of extreme changes in economic conditions such as high-inflation environments.

Overall, time-dependent pricing models have been criticised because of their assumption of exogenous timing of price changes. The models assume a fixed fraction of firms that change prices, allowing the average size of price changes to reflect price responses to shocks. The implication of this assumption is that firms are not allowed to respond even if the cost exceeds the benefit of keeping the price constant. This makes it difficult to know whether the qualitative effects of monetary shocks in these models are the result of nominal rigidities per se or of the exogenously imposed pattern of price changes. Nevertheless, the possibility of such models being able to provide an accurate picture of the overall economy should not be completely excluded beforehand.

2.2.2 State-Dependent Pricing Models

State-dependent pricing models assume that price changes are a function of an economic environment. The timing of price changes is endogenous as it is chosen by firms themselves to maximise profit. There is no routine in price setting and firms only change their prices

[7] The assumption is that there is a constant probability that a given price setter will change their price at any instant.

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when they experience some form of shock. Price changes may be grouped or spread out, depending on the importance of aggregate or idiosyncratic shocks. Prices are therefore fixed until there is a sufficiently large shift in market conditions to justify a change. The leading state-dependent pricing models that are discussed in this chapter are introduced by Dotsey, King and Wolman (1999) and Golosov and Lucas (2007). Other more recent state-dependent models include; Midrigan (2006, 2011); Gertler and Leahy (2009); and Caplin, Dotsey, King and Wolman (2009).

Dotsey, King and Wolman (1999) develop a general equilibrium model with identically and independently distributed (*iid*) menu costs across firms and over time.[8] In their model, firms are monopolistically competitive and face a range of menu costs, such that firms that change prices all choose the same price. These menu costs are randomly distributed across firms in a continuous manner, but are independent across time for a given firm.[9] 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. The frequency of price change varies with the monetary shock. A positive monetary shock (for example, an increase in inflation rate or money supply) affects the individual firm's costs of changing prices and thus increases the fraction of firms that change prices in a given period and vice versa. Thus, a firm that faces these costs will change its price less frequently than an otherwise identical firm without such costs.

Because each firm faces, in each period, different costs of changing prices, the model predicts that the shape of a hazard function is increasing. At the start of each period, there is a discrete distribution of firms which changed their prices at different periods in the past. If, for

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[8] The menu costs are categorised into; physical adjustment costs, managerial costs and customer costs. Physical costs involve the actual implementation of a price change while customer costs consist of the time spend conveying price changes to customers, time spend negotiating prices with customers and costs associated with loss of sales because of antagonizing customers. Managerial costs are also known as menu costs because they are usually assumed to be fixed (independent of the magnitude of price change). They include personnel time in decision making, recording, calculating and posting new prices. These costs are assumed to have an upper bound to make the model finite (Dhyne *et al.*, 2009)

[9] Random menu costs induce a discrete change by individual firms, while allowing for an adjustment rate that responds smoothly to aggregate state of the economy.

example, inflation is positive, the benefits of changing prices would be higher for firms whose prices were last changed further back in time. This therefore translates into higher probability of price change for such a firm since it would then suffer a higher accumulated inflation. Hence, the hazard rate increases.

The main contribution of this model is that it considers the dynamic responses of changes in money and compares them with a time-dependent approach. The limitation of this model is that it assumes *iid* menu costs across firms and time but does not include idiosyncratic productivity shocks that give rise to a distribution of positive and negative price changes.

Golosov and Lucas (2007) develop a model of a monetary economy in which firms are subject to idiosyncratic productivity shocks and a single large menu cost. Any individual price will be constant most of the time and then occasionally jump to a new level. A positive monetary shock may result in a higher average size of price changes but not the frequency at which firms change prices. The shock induces firms that charge the lowest prices to increase their prices by a large magnitude, while at the same time it offsets negative idiosyncratic shocks such that a fraction of firms that would have decided to reduce their prices would rather choose to wait. The net effect of the shock is then reflected in an increase in aggregate price levels. This result contrasts with the time dependent Calvo and Taylor-type models, in which firms change prices at exogenously determined moments in time.

Due to the relative size of idiosyncratic and aggregate shocks in relation to marginal costs, the probability of changing prices will increase with the time elapsing between the two price changes, resulting in a positively sloped hazard function. An upward sloping hazard

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function would imply that marginal costs are random, due to factors such as inflation. On the other hand, idiosyncratic shocks yield flat and even upward sloping hazard functions.[10]

The main contribution of the Golosov and Lucas (2007) model is that it considers menu costs and idiosyncratic productivity shocks. However, the limitation of this model is that it does not account for large heterogeneity in the size of price changes and therefore does not generate many small price changes and many large price changes (see Klenow and Kryvtsov, 2008; and Midrigan, 2006, 2011).

In general, state-dependent pricing models predict that either the size or the fraction of price change respond to a shock, or both. The literature suggests that the appropriate approach to analyse the effect of nominal rigidities at the micro level is to use state-dependent pricing models as they assume that economic agents base their decisions on a cost-benefit analysis. However, only few studies have based their analysis on state-dependent pricing models at the micro level.

In conclusion, the synthesis of this section is that different models of price setting behaviour have important implications in modelling price rigidities. Two key features that contribute to the successful matching of price setting models and micro-data are noted. The first is large idiosyncratic shocks that produce large absolute price changes commonly found in the micro-data. The second is an array of menu costs that generate many small price changes and variable price spells to reflect the heterogeneity that is common in micro data.

2.3 Related empirical evidence

In recent years, the use of micro data that examined individual retail price level data has offered many insights into the characteristics of price setting behaviour. A number of studies have provided comprehensive empirical microeconomic evidence on price setting

[10] Temporary shocks flatten the hazard function because they only result in temporary price changes that are quickly reversed. Such price changes occur when the shock is large enough to warrant a temporary price change to an “abnormal” level even though it will soon change back (Nakamura and Steinsson, 2008).

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behaviour.[11] These include Blinder (1998); Bils and Klenow (2004); Klenow and Kryvtsov (2008); Nakamura and Steinsson (2008) for the US; Dhyne *et al.* (2006, 2009) for the Euro area; Alvarez and Hernando (2005) and; Dias *et al.* (2005) for Portugal.[12] Recent studies for developing countries include; Kovanen (2006) for Sierra Leone; Gouvea (2007) for Brazil; Creamer and Rankin (2008) and Creamer, Farrell and Rankin (2012) for South Africa.

Comparing these empirical features to theoretical models of price setting, the literature shows that none of the time-dependent or state-dependent pricing models matches all the empirical features found in their data. The following are the key findings from empirical studies of price setting behaviour.[13]

The first finding is that consumer price changes are infrequent. The literature shows that the frequency of price changes varies substantially across countries. Studies that used the data from developed countries, (for example Klenow and Kryvtsov, 2008); Nakamura and Steinsson, 2008); Bils and Klenow, 2004; Alvarez, 2007; and Dhyne *et al.*, 2006) find relatively lower frequencies of price changes the frequency of price changes found by studies that used datasets from the developing countries (Gouvea, 2007; Kovanen, 2006; and Creamer *et al.*, 2012).

The second finding from the literature is that there is substantial heterogeneity across various products. The general conclusion is that price duration varies significantly across various products and products groups. Some studies report significant heterogeneity between regular and posted prices (Klenow and Kryvtsov, 2008) while some studies report significant heterogeneity across different product groups (Gouvea, 2007; Kovanen, 2006; Creamer *et al.* 2012). The common finding across these studies is that services (such as transportation and

[11] Klenow and Malin (2011) and Romer (2012) give a summary of most of this microeconomic evidence on price setting behaviour.
[12] Other studies include Aucremanne and Dhyne (2004, 2005) for Belgium; Fabiani *et al.* (2006) for Italy; Lunnemann and Matha (2005) for Luxembourg; Kaufmann (2008, 2010) for Switzerland; and Coricelli and Horvath (2010) for Slovakia.
[13] The stylised facts discussed in this section closely follow the results presented in table 2.1 but include facts found in other prominent studies in the literature.

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communication) have higher duration than the food products. For South Africa, Creamer *et al.* (2012) also find heterogeneity between imported, exported and locally produced products.

The other empirical stylised feature is that price changes are large in absolute terms. This finding is common across a number of studies report large price changes using datasets from developed and developing countries (Klenow and Kryvtsov, 2008; Nakamura and Steinsson, 2008; Kovanen, 2006; Creamer and Rankin; 2008).

Most studies also find that the empirical data contains a large proportion of small price changes, for example Klenow and Kryvtsov (2008) and Wulfsberg (2010). However, little empirical evidence is available from developing countries. To our knowledge, only the study by Creamer *et al.*, (2012) provides such evidence for SA.

The other empirical finding is related to the probability of price changes. The aggregate hazard is downward sloping for many studies (Klenow and Kryvtsov, 2008; Creamer *et al.*, 2012) and flat for other studies with annual spikes (Nakamura and Steinsson, 2008). For individual product categories, empirical evidence shows the increasing hazards for goods (Creamer *et al.*, 2012) and flat hazards for services (Bunn, 2009).

Another finding in the literature is about the relationship between price duration and the size of price change. Some studies, mostly in the developed countries, found no relationship between size and age (Klenow and Kryvtsov, 2008; Eden, 2001; and Alvarez and Hernando, 2004) while other studies find increasing size of price changes with age (Creamer *et al.*, 2012).

The empirical evidence also shows that not all prices change in any given period. Many studies use different methods to analyse the degree of synchronisation (or uniform staggering in price setting) using different methods. Some studies find that price changes are mostly driven by the average size of price changes (intensive margin) (Klenow and Kryvtsov, 2008) while other studies find that the variance of inflation while the average frequency of

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price changes (extensive margin) drives the variation in inflation (Creamer *et al.*, 2012; and Kovanen, 2006).[14] Other studies analyse synchronisation at the product group level using the Fischer and Konieczny index proposed by (2000). The general conclusion is that the degree of synchronisation is low across product groups (Dhyne *et al.*, 2006; Baumgartner *et al.*, 2005), but there are exceptions who find higher degree of synchronisation (Lunnemann and Matha, 2005).

Finally, Gagnon (2009) emphasise the importance further decomposing inflation into terms due to price increases and decreases. The general finding in the literature is that the frequency of price increases and price decreases correlates more strongly with inflation Klenow and Kryvtsov (2008; Nakamura and Steinsson, 2008; Creamer *et al.*, 2012).

We can summarise this literature in two key features. First, there is no particular pattern that is provided by the current literature that distinguishes price setting behaviour between particular groups of studies and countries. This suggests that the outcome of empirical findings is case-study specific, hence the need to conduct a country-specific studies on price setting.

Second, the empirical literature is also limited in the context of developing countries. Many studies are conducted based on data from the developed countries. Hence why, in this chapter, we contribute to the literature by considering a specific case study of Lesotho, where the study of this nature has not been done before. This chapter intends to identify the stylised facts associated with Lesotho price setting behaviour and assess whether these are consistent with other countries. We evaluate the empirical evidence against theory to identify which theory of price setting behaviour characterises the pricing behaviour of retail outlets in Lesotho.

[14] Creamer et al (2012) used the basic regression model $F_t / M_t = a + \sum_{i}^{12} B + \kappa CPI_t + \varepsilon_t$ where F_t is the frequency of price changes, increases and decreases and M_t is the size of price changes, increases and decreases, while Klenow and Kryvtsov (2008) decomposed the variance using Taylor series.

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2.4 Methodological framework

2.4.1 Description of the data and sources

This study draws on unique data consisting of highly disaggregated micro-level product prices underlying the consumer price index (CPI) in Lesotho. This data is unpublished and are obtained directly from the Lesotho 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. The sampling procedure followed is representative for product items and specific outlets are pre-selected. Market prices of food and non-food prices are collected in the first two working weeks of the calendar month.

Prices of products that are similar across the country are collected centrally. These include prices of fuel products such as petrol, diesel, paraffin, electricity and water charges. BOS collects prices of products at different frequencies. Some products are collected on monthly basis, some on quarterly (transport fares, fuel) and some bi-annually (school fees, hospital fees) and once a year (water and electricity charges) and most these prices are regulated.

Each individual price record for an item has information on the date (month and year), retail outlet, district, product category and unit codes and the price of that item. This classification of the data makes it possible for the pricing history of individual items to be traced over a long period of time. However, for ethical considerations, which include confidentiality requirements, numeric codes are given to outlets according to the districts they are located in, and the names of outlets are not revealed.

Using product level price data has the advantage of explicitly controlling for terms of trade and other aggregation effects that can impact on convergence estimates. This kind of data also allows for direct measurement of the average frequency and the magnitude of individual retail price changes in each month. It also gives the researcher the ability to

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analyse price setting behaviour at the most disaggregated level and makes it possible to estimate the long-run levels of price differentials in different locations within Lesotho. Further, the specificity of prices by product definition enhances price comparability and minimises the bias from aggregating heterogeneous products, outlets and districts. Table 1 displays the total number of outlets across the districts of Lesotho.

Table 1: 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**

The location of the retail outlets are divided into urban and rural areas across the ten districts of Lesotho. There are fewer outlets in the rural areas, with Maseru accounting for 50 percent of all rural outlets. Urban outlets are also dominated by the Maseru district which makes up 25 percent of all urban outlets in the data.[15]

The CPI basket of goods and services contains around 229 basic items. Table 2 presents the number of products as they are classified according to different groups.

Table 2: Number of products by product category (2002-2009)

Product category	**Number of Products**
Food	91
Non-food	138
Total	**229**
Sub-product category	
Perishable	41
Non-perishable	50
Durable	59
Non-durable	56
Services	23
Total	**229**

The data show that 40 percent of products comprise food items while 60 percent are non-food products, making a total of 229 items. Food items are divided into 41 perishable goods and 50

[15] Maseru is the Capital city of Lesotho and therefore the biggest of all the districts in terms of commercial activities and geographical size.

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non-perishable goods. Non-food items comprise 59 durable goods, 56 non-durable goods and 23 services. We further divide the data into 16 sub-categories as indicated in table 3.

Table 3: Price records by product category (2002-2009)

Product class	Number of price records	Percent	Number of products	Percent	Weighting to CPI	Duration (in months)
Food	182,090	49.65	80	34.07	37.0	2.9
Non-alcoholic beverages	21,062	5.74	8	3.54	1.1	3
Alcoholic beverages	4,836	1.32	5	2.21	1.0	5.4
Tobacco and narcotics	9,094	2.48	3	1.33	0.2	2.8
Clothing and footwear	34,407	9.38	31	13.72	17.4	3.1
Fuel	20,401	5.56	13	5.75	6.7	2.9
Household furniture and equipment	29,644	8.08	39	17.26	4.4	4.2
Household operations	24,301	6.63	8	3.54	5.0	3
Medical care and health expenses	4,298	1.17	11	4.87	1.9	12
Transport equipment	786	0.21	3	1.33	3.6	3.2
Transport services	663	0.18	2	0.88	4.9	8.7
Communications	87	0.02	1	0.44	1.2	
Recreation and culture	5,262	1.43	7	3.1	2.4	5.7
Education	2,249	0.61	2	0.88	2.8	10.8
Personal care	14,758	4.02	6	2.65	3.2	3.7
Other goods and services	12,827	3.5	10	4.42	7.2	3.7
Total	**366,765**	**100**	**229**	**100**	**100**	**3.3**

The data comprises mostly food items, which account for 35 percent of the total items (80 items), followed by household furniture and equipment which account for 18 percent of the total (39 items) and then clothing and footwear (13 items or 14 percent of all items) and personal care (6 items). Services comprise medical care and health (11 items), recreation and culture (7 items), and transport related services (3 items) while 10 items are listed under other goods and services.

2.4.2 Method of analysis

This section outlines the different measures that are used to integrate the theoretical foundations of price setting behaviour with empirical findings in the case of Lesotho. These include the frequency of price change, the size of price change and the probability of price change.

Sample definitions

In this context an observation $P_{ij,k,t}$ is a price quote of an elementary product, that is, a particular product or a service that is sold in a retail outlet, for example, maize meal. A

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product category then becomes a representation of elementary products that belong to the same broad category, for example, food.

To assess the frequency of price changes, the duration of a price spell needs to be estimated. The duration of a price spell can be estimated using two approaches; the direct approach and the frequency approach. In this study, we use the frequency approach. This approach first computes the frequency of price changes as a proportion of the times a price for a product in a retail outlet is changed over T observation periods and then derives the measure of an 'implied' duration of price spells. The price spell is referred to as the time interval between two price changes. The duration of the price spell is then measured as the number of months between the two price changes.

The advantage of using this approach is that for large samples, the inverse of the frequency of price changes is a consistent estimator of the average duration of price spells. 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 and Tarrieu, 2004 and; Gouvea, 2007). This causes the former measure to be smaller or equal to the latter due to Jensen’s inequality. However, the studies that have calculated both measures arrived at a similar order of magnitude for the downward bias (Gouvea, 2007).

We do not use the duration approach because it is restricted for use with uncensored spells only. But the exclusion of censored spells leads to downward bias and long-lasting spells are more likely to be discarded (Baharad and Eden, 2004).

Measurement of the frequency of price change

The frequency of price change, in this study, is defined as the percentage of prices that change as a fraction of all price changes for a specific outlet and product over T observation

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periods. To calculate the frequency of price change at the product level, we first create an indicator variable that accounts for price change as:

$$X_{ik,t} = \begin{cases} 1 \text{ if } p_{ik,t} \neq p_{ik,t-1} \\ 0 \text{ if } p_{ik,t} = p_{ik,t-1} \end{cases} \tag{1}$$

i= 1,......, I; k = 1, ..., K; t = 1,.........,T

Where $p_{i,\,k,t}$= log price of product k, in outlet i, in month t

We then use the indicator variable to compute the average frequency of price change for product k in retail outlet i over the full period T as:

$$Freq_{ik} = \left(\frac{1}{T_{ik}-1}\right)\sum_{t=2}^{T_{ik}} X_{ik,t} \tag{2}$$

Where $Freq_{ik}$ is the frequency of price changes of retailer i for product k ; T_{ik} is the number of observation of the price of product k sold by retailer i and $p_{ik,t}$ is the price of product k charged by retailer i in period t.

This is the frequency of price change for specific product sold at a specific outlet (how frequently does retailer i changes the price of product k). There are two advantages of using this method. The first is that it uses the maximum possible amount of information without removing incomplete spells due to censoring. The data used here is not affected by the non-randomness of the sample since the data is for products that are sold in the outlet, and not the price spells, which are observed over a period of time. The second is that we assume homogeneous population, the information about the average spell duration can easily be recovered from the frequency of price changes, while simultaneously also avoiding the inefficiency and bias that is inherent to the direct use of the duration.[16] We use the unweighted average in computing the aggregate frequency of price changes across products.

[16] For further explanation, see Dias and Dias (2008)

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However, the drawback of this method is that this method is likely to over-estimate the highly weighted products such as food in this case.

Measurement of duration of price spells

The measures for the average duration of price spells are used to estimate the average length of period between the two price changes. We therefore calculate the average duration of price spells using the frequency approach as:

$$duration = \frac{1}{Freq_{ik}} \quad for\ \ all\ \ i = 1,.......I; k = 1,..........K; \tag{3}$$

Where F_{ik} is the average using frequency of price change for product *k* and outlet *i*

Measurement of the direction of price change

To capture the direction of price change, we use the measure of the share of price increases and price decreases. First we compute the indicator for positive and negative price changes:

$$X^{+}_{ik,t} = \begin{cases} 1\ if\ \ p_{ik,t} > p_{ik,t-1} \\ 0\ otherwise \end{cases}$$

$$X^{-}_{ik,t} = \begin{cases} 1\ if\ \ p_{ik,t} < p_{ik,t-1} \\ 0\ otherwise \end{cases} \tag{4}$$

Cases where $P_{ik,t} = P_{ik,t-1}$ are ignored because it means there was no price change.

Second we use the indicator variable in equation (4) to compute the average frequency of price increase and price decrease for product k in retail outlet *i* over the full period *T* as:

$$Freq^{+}_{ik} = X^{+}_{ik,t} \tag{5}$$

$$Freq^{-}_{ik} = X^{-}_{ik,t} \tag{6}$$

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Where $Freq_{ik}^{+}$ is the frequency of price increases of retailer *i* for product *k* and $Freq_{ik}^{-}$ is the frequency of price increases; T_{ik} is the number of observation of the price of product *k* sold by retailer *i* and $p_{ik,t}$ is the price of product *k* charged by retailer *i* in period *t*.

2.5 Empirical results

In this section, we present and discuss the stylised facts that characterise the price setting behaviour of retail outlets in Lesotho and also relate these empirical features to theories of price setting (time-dependent and state-dependent).

2.5.1 Frequency of consumer price changes

Figure 1 plots a histogram of the average frequency of price change at the product by outlet level using $Freq_{ik}$ for the period March 2002 to December 2009. The diagram indicates that there is substantial heterogeneity in the frequency of price changes among different products and retail outlets in Lesotho.

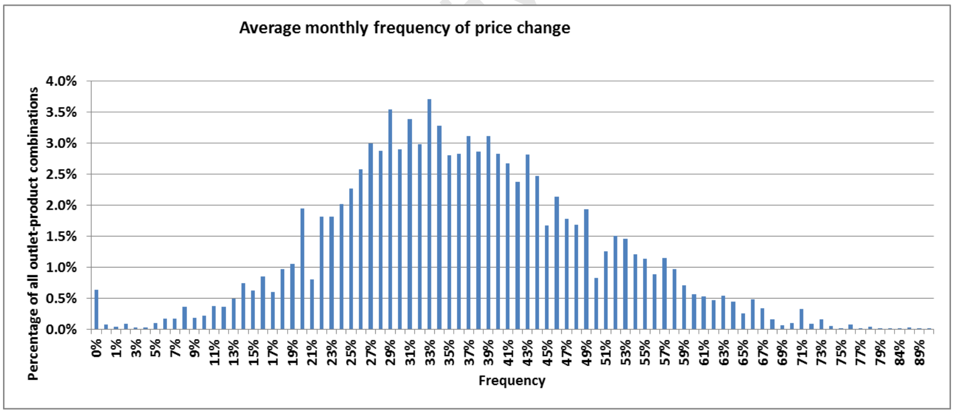

Figure 1: Average frequency of price change
Note: The histogram is constructed using the product by outlet level measure. The distribution therefore reflects differences of price change across products and across outlets within product items.

The estimated median frequency of price changes between the two concurrent months at the product-outlet level is 35.6 percent, while the mean frequency is 36.4. The implied mean duration suggests that more than 50 percent of products have their prices changed every 3.3

months. 25 percent of all items change prices once every 2.2 months while 75 percent change every 3.6 month.

These results are comparable with other countries. However, due to adoption of different methodologies, different product composition and differences in the periods of analysis, not all results are strictly equivalent, making direct cross country comparisons difficult. However the results may allow for general comparisons of pricing conduct in a number of economies. Thus, we interpret the results of comparisons with other countries with caution because of differences in product composition and duration of years between countries. Table 4 presents the results of the frequency of price changes and the implied duration of price spells across time for Lesotho and other countries, using data based on studies that use micro economic evidence of price setting behaviour.

Table 4: Comparison of Lesotho data with international evidence

Country	Frequency of price change (%)	Mean duration (in months)
Developing countries		
Lesotho (2002-09)	**36.4**	**2.7**
SA (2001-07)	**16.8**	**5.0**
Brazil (1996-06)	37.0	2.7
Sierra Leone (1998-03)	51.0	2.0
Developed countries		
Euro Area (1996-01)	15.1	6.6
USA (1998-05)	29.9	3.8
Spain (1993-01)	15.0	6.6
France (1994-03)	18.9	5.2

Note: The results for Lesotho are based on the current data used in this study. The estimates for the Euro Area are obtained from Dhyne *et al.,* (2006); and for the United States from Klenow and Kryvtsov (2008). The estimates for Spain were obtained from Alvarez and Hernando (2004); and Loupias and Ricart (2004) for France; Brazil from Gouvea (2007) and Sierra Leone from Kovanen (2006). The data on implied mean durations are author's calculation based on the measurement used in this study. The estimates for SA are obtained from Creamer et al., (2012).

The literature shows that the frequency of price changes differs strongly across countries, with a much higher frequency in developing countries than in developed countries. The frequency of price changes in Lesotho (36.4 percent) is much higher than the frequency of price changes in South Africa (16.8 percent). This shows that prices in South Africa are less flexible than prices in Lesotho. In fact, the frequency of price changes in Lesotho is almost twice that of price changes in South Africa. The average frequency of price changes in Lesotho is also higher than for the US (29.9 percent) and the Euro area (15.3 percent). The

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frequency of price changes is much higher in other developing countries. Sierra Leone shows the highest average frequency of price changes (51 percent). Only Brazil's prices are directly comparable to Lesotho's prices.

2.5.2 Price durations across products categories

The data also show evidence of substantial heterogeneity across product categories. Table 5 presents the mean and median frequency of price changes and the implied mean and median duration of price spells by product categories and location. The results indicate that the frequency of price changes also varies across the cross-sections.

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

Categories	Mean frequency of price changes (%)	Median frequency of price changes (%)	Implied mean duration (in months)	Implied median duration (in months)
Aggregate	36.4	35.6	3.3	2.8
Goods	36.9	35.7	3.1	2.8
Services	28.4	28.9	6.3	3.4
Food	38.9	37.6	2.9	2.6
Perishable	44.3	43.7	2.6	2.3
Non-perishable	36.1	35.6	3.1	2.8
Non-food	33.3	33.0	3.8	3.0
Durable	31.6	30.0	3.8	3.3
Non-durable	35.7	35.2	3.1	2.8
Rural	33.6	33.2	2.9	3.1
Urban	35.7	35.7	2.8	2.8

Note: We compute these using the frequency of price change for each product group and location. This is given by

$f_G = \frac{1}{N_G} \sum_t \sum_{k \in G} \sum_{i=1}^{I} X_{ik,t}$ where N_G is the number of observations of $X_{ik,t}$ in product group G.

The prices of goods change more frequently than the prices of services. The mean and median frequency of price changes for goods (36.9 and 35.7 percent) is found to be higher than for services (28.4 and 28.9 percent). These results are consistent with empirical evidence that prices for services are generally stickier than prices for goods. Klenow and Malin, (2011) find that for US CPI data, the mean duration of prices was 9.4 months for services and 1.1 months for raw goods. Creamer *et al.* (2012) find a lower frequency of price change for goods (17.0 percent) and for services (14.9 percent). The stickiness in services may be caused by the fact that services are mostly non-tradable and are not subject to high transport and distribution costs. The lower frequency of price changes for services could also reflect the

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lower volatility of consumer demand for them. That is why it is easier for retailers to absorb increases in the production costs of services, at least in the short run, to avoid frequent price changes. Further, the stickiness of services may be caused by administered prices which change at least once a year. Finally, it may be due to the fact that services mostly cover a wide range of heterogeneous products.

The data also show that prices of food products change more frequently (38.9 and 37.6 percent) than prices of non-food items (33.3 and 33 percent). Among food products, the frequency of price change is higher for perishables (44.3 and 43.7 percent) than for non-perishables (36.1 and 35.6 percent). Prices of perishable food products are more flexible than other food product prices because unprocessed products such as fresh food are normally subject to higher distribution and storage costs, which forces retailers to pass these costs on to consumers more quickly to avoid pricing below the marginal cost (Klenow and Malin, 2011). This suggests that distribution costs are more volatile than other costs because a retailer cannot keep these products for long and needs to sell them quickly. Coricelli and Horvath (2010) also found higher frequency of price change (60 percent) for fruits and vegetables and the lowest frequency of price change (15 percent) for services using data for Slovakia.

With regards to non-food products, prices of non-durable products, the implied mean and median duration (3.1 and 2.8 months) are lower than for durable products (3.8 and 3.3 months). Klenow and Malin (2011) reported that the weighted implied mean durations for posted prices in the US CPI data from 1988 to 2009 for durable products (3.0 months) was lower than for non-durables (5.8 months) and services (9.4 months).

The Lesotho data also varies across locations. The results show that the duration of price spells is also variable across locations. The results shown in Table 6 reveal that prices in urban areas change more frequently (36 percent) than prices in rural areas (33 percent). These results may reflect differences in market structure where prices in urban areas, characterised

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as more competitive areas, are more likely to change more frequently than prices in rural areas, which are characterised as non-competitive areas (see Alvarez and Hernando, 2007).[17]

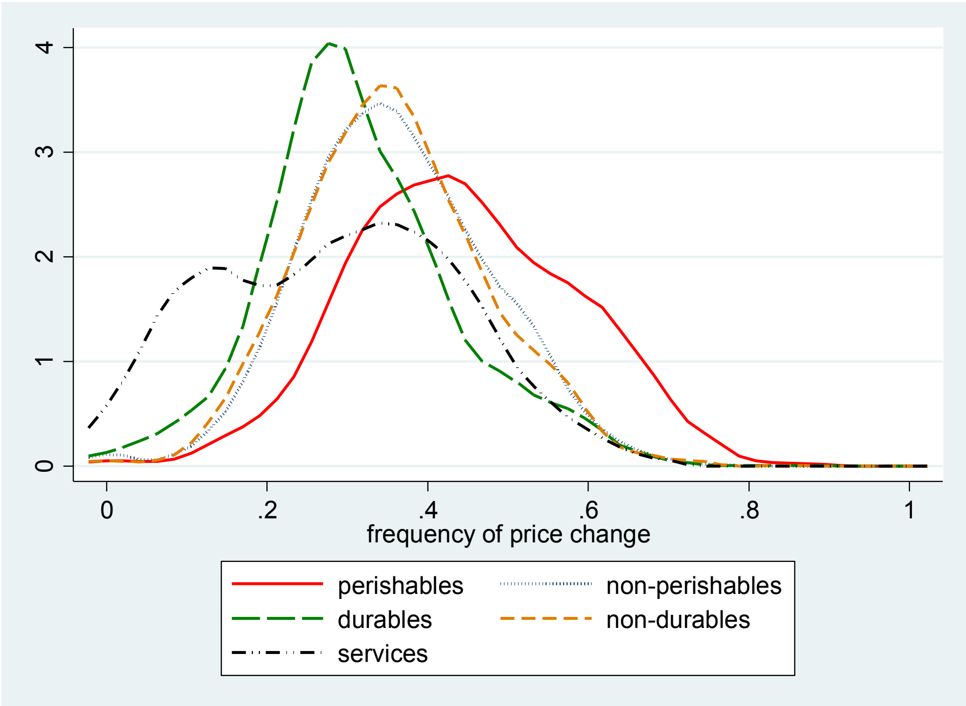

Figure 2: The frequency of price change by product category (2002-2009)

We can also explain price setting behaviour in terms of the degree of dispersion within product groups. Figure 2 shows that not only is there price dispersion across product categories, but also within those categories. The wide dispersion suggests heterogeneity in price setting behaviour within product categories. The density function for services displays substantial heterogeneity across products and within products. Heterogeneity in price setting behaviour within and across products suggests that aggregation of these products should not be considered as it is likely to produce biased estimates.

The predictions of state-dependent pricing models are more consistent with these results because of their assumption of endogenous timing of price changes. The Golosov and Lucas (2007) model succeeds in predicting variable durations due to random shocks across sectors and the model of Dotsey *et al.* (1999) succeeds because of its range of menu costs.

[17] See appendix for the detailed table of types of outlets by location.

Both time-dependent pricing models fail to predict variable durations because of their exogenous timing of price changes.

2.5.3 Frequency of price decreases and price increases

The importance of considering the positive and negative price changes is to see if they offset each other. Hence the need to the frequency of price changes, distinguishing between price increases and price decreases. Figure 3 plots the frequency of price increases, price decreases and inflation rate for all products during the period of analysis (2002-2009).

The frequency of price increases is higher than the frequency of price decreases throughout the sample period. The higher proportion of price increases is consistent with the inflationary environment as it is necessary to preserve real returns. The relationship between inflation and the frequency of price increases and price decreases is explored in more detail later.

Price increases also co-move with inflation throughout the period. The highest frequency of price increase (44 percent) was observed in July 2003 while the lowest frequency of price increase (3 percent) was observed in December 2006. The data show that 22.1 percent of prices were changed upwards each month, while only 13.5 percent of prices were changed downwards. This also suggests that in general, firms are less likely to reduce prices than to increase them because of increasing inflation, suggesting evidence of downward price rigidity.

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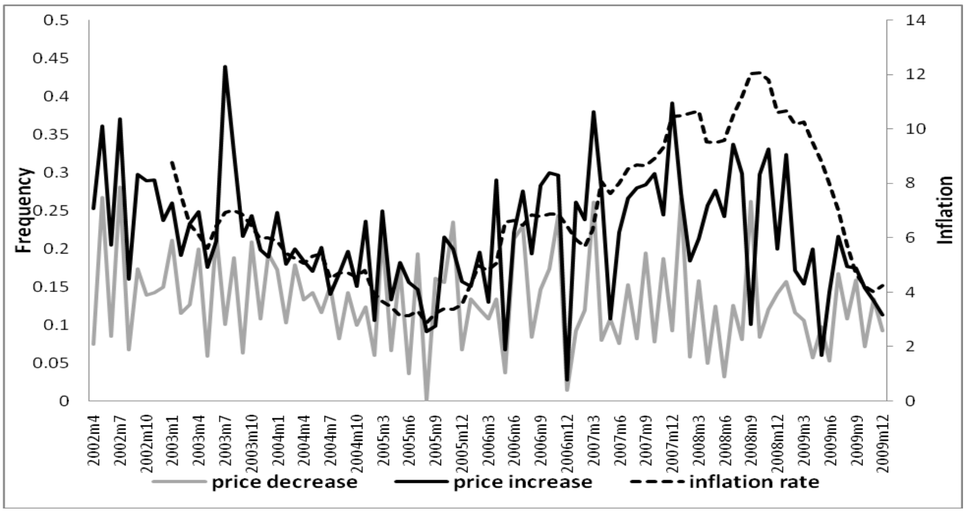

Figure 3: Average frequency of price increases and price decrease

Note: Monthly frequency is calculated as the simple average across outlets and products of $X^{+}_{ik,t}$ and $X^{-}_{ik,t}$

Table 6 presents the frequency of price increases and price decreases across more disaggregated product categories for the period (2002-2009).

Table 6: The frequency of price increase and decreases across product categories

Product category	Frequency of price increase (%)	Frequency of price decrease (%)
Food	24.4	14.3
Non-alcoholic beverages	21.9	13.3
Alcoholic beverages	16.9	9.0
Tobacco and narcotics	26.5	11.7
Clothing and footwear	20.3	15.1
Fuel	24.9	14.0
Household furniture and equipment	15.0	11.3
Household operations	22.6	14.1
Medical care and health expenses	14.0	9.4
Transport equipment	19.2	11.8
Transport services	9.7	5.4
Recreation and culture	13.3	10.9
Education	5.6	3.9
Personal care	18.2	11.6
Other goods and services	20.0	12.2
Perishable	27.2	16.1
Non-perishable	22.4	13.1
Durable	18.2	12.6
Non-durable	21.4	13.5
Services	17.0	10.8
Total	**22.1**	**13.5**

Note: This is based on the average frequency of positive and negative prices for each product group across outlets. This is given by $f_G^{+/-} = \frac{1}{N_G}\sum_t \sum_{k\in G}\sum_{i=1}^{I} X^{+/-}_{ik,t}$ where N_G is the number of observations of $X_{ik,t}$ in product group G.

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The data shows that across all product categories, the average frequency of price increases dominates the frequency of price decreases. This result is consistent with the earlier finding that in the environment of positive inflation, price increases exceed price decreases.

The highest frequency of price increases is observed in perishable food products (27.2 percent) and the lowest frequency of price increases is in services (17.0 percent). Price decreases follow a similar pattern to price increases; the highest frequency of price decreases is observed in clothing and footwear (15.1 percent), while the lowest is found in education (3.9 percent). The high frequency of price decrease in clothing and footwear may be explained by end-of-season sales which are common in that product category (Dhyne *et al.*, 2006).

Overall, the frequency of price increase (22.1 percent) is greater than that of price decreases (13.5 percent) across all product categories. These results are consistent with findings by Creamer *et al.* (2012) who also find a higher frequency of price increases (11.1 percent) than price decreases (6 per cent).

2.5.4 Average size of price changes

The size of price change is an alternative measure (to the frequency of price change) of price setting behaviour. We define the mean absolute size of price changes for product k in outlet i over a defined period as:

$$S_{ik,t} = \frac{1}{N}\sum_{i}^{N} I_{ik,t} \times \left|dp_{ik,t}\right|$$

Where $dp_{ik,t}$ is the log change in price, $I_{ik,t}$ is an indicator variable equal to 1 if $dp_{ik,t} \neq 0$ (0 otherwise) and N is the number of observations of non-zero price changes. The average magnitude of price changes across product groups G (defined as S_G) is calculated as the simple average of $I_{ik,t} \times \left|dp_{ik,t}\right|$ over the subset of products in category G for the defined period.

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Table 7 presents the average size of price changes across various categories in Lesotho over the period 2002 to 2009. The results reveal substantial heterogeneity across products. The mean absolute size of price change is 11 percent for the whole period. These results are comparable with those found by other studies. Klenow and Kryvtsov (2008) report larger mean absolute changes for posted prices (14 percent) and for regular prices (11percent) for the US. Creamer *et al.* (2012) also report large absolute mean price changes (13 percent) for South Africa.

Table 7: The absolute size of price changes by product categories (2002-2009)

Categories	Mean absolute size of price changes (%)
Aggregate	10.5
Goods	10.4
Services	13.0
Food	9.0
Perishable	9.7
Non-perishable	8.7
Non-food	12.7
Durable	14.6
Non-durable	11.5
Rural	9.7
Urban	10.6

Note: Values are based on the absolute value of the average size of price change at the product by outlet level for each product group

The absolute size of price changes are also observed across various categories in the data. Table 7 shows that the largest price changes are observed in services (with a mean of 13 percent and a median of 5 percent). Price changes for non-food products are also large (15.5 percent) compared to food products, (9.1 percent). The large proportion of price changes in non-food products are in non-durable products (17.9 percent) and for food products this is for perishable products (10.4 percent).

Figure 4 presents a histogram of all the non-zero price changes (in absolute value) at the outlet by product level over the period April 2002 and December 2009. The shape of the diagram provides three key features about the distribution of price changes in Lesotho. First, the distribution of the size of price changes has a unimodal shape, suggesting many small price changes present in the data. Around 54 percent of price changes are smaller than 5 percent in absolute value and 40 percent are smaller than 2.5 percent. These results are

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comparable to Klenow and Kryvtsov (2008) for the US who also report that around 44 percent of regular absolute price changes are smaller than 5 percent, 25 percent are smaller than 2.5 percent and 12 percent are smaller than 1 percent. In contrast, Creamer *et al.* (2012) report fewer small price changes for South Africa; only 19 percent are less than 5 percent in absolute value.[18]

The existence of many small price changes reflects a wide range of small menu costs (costs of changing prices) across products and/or time as predicted by Dotsey *et al.* (1999). Small idiosyncratic shocks therefore result in many firms changing prices.

The second feature is that distribution has relatively large tails, suggesting that large price changes are also significant in the data. Around 46 percent of price changes are more than 5 percent in absolute terms, 29 percent are more than 10 percent and 13 percent are more than 20 percent. These price changes are relatively large compared to those of SA (18.9 percent).

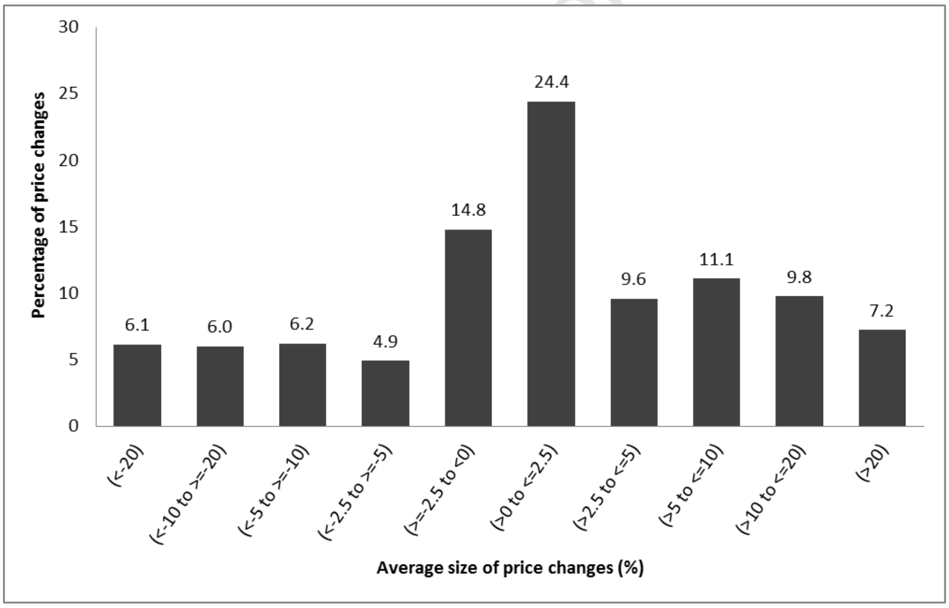

Figure 4: Distribution of the average size of price changes (2002-2009)

[18] In calculating this value, we exclude the zero price changes they report in their figures.

Finally, the shape of the distribution of prices shows that small price increases are more common than price decreases. Around 8.7 percent of price increases are smaller than 2.5 percent, while 5.3 percent of price decreases are smaller than 2.5 percent. This finding however, may reflect a positive association between price increases and inflation. This relationship will be explored later.

Overall, the results reveal substantial heterogeneity in the magnitude of price changes across products and outlets in Lesotho. The distribution of price changes for Lesotho is characterised by a distribution of common small price changes, but large on average. The combination of large and small price changes suggest that idiosyncratic shocks are important in price setting in Lesotho.

2.5.5 The size of price decreases and price increases

The other characteristic that is related to the distribution of price changes in Lesotho is based on the size of price decreases price increases.

Figure 5 plots the average size of price decreases and price increases with inflation over the period (2002 to 2009). The results show that the average size of price decreases is 11.8 percent and the average size of price increases is 9.7 percent. Dhyne *et al.* (2009) report a slightly lower average size of price decreases (10 percent) and size of price increases (8 percent) for the Euro area. Creamer *et al.* (2012) report higher price increases (10.7 percent) and price decreases (12.3 percent) for South Africa.

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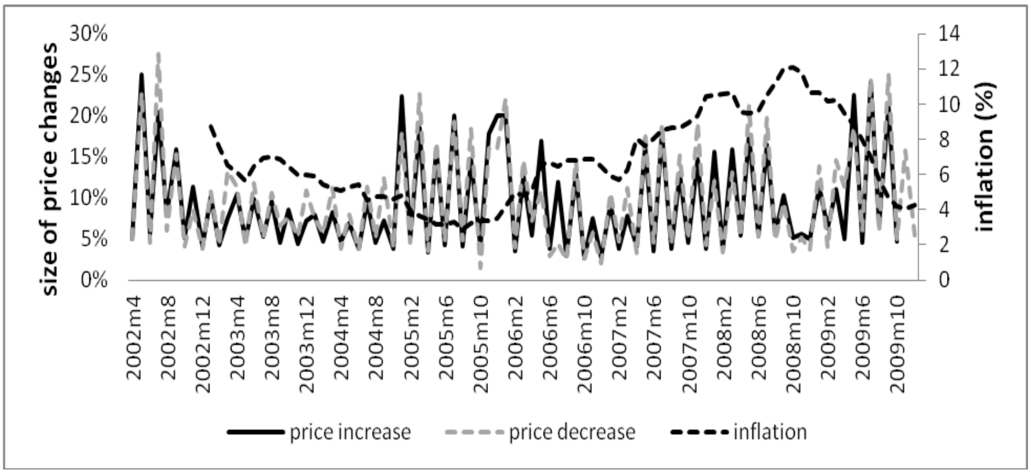

Figure 5: Average size of price increases and price decreases (2002-2009)
Notes: Monthly values reflect the simple average of the product by outlet level price increase or price decrease for that month. Inflation is the year inflation obtained from the Lesotho Bureau of Statistics.

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Table 8 presents the average size of price increases and the average size of price decreases by product category. The data shows that price decreases are also larger than price increases across product groups. The largest average price increases, for example, are found in the category of education (34.4 percent), while the smallest average price increases are in tobacco and narcotics (6.1 percent). On the other hand, the largest reported price decreases are found in the services sector in education (35.9 percent), and the smallest reported price decreases are found in tobacco and narcotics (6.9 percent). Dhyne *et al.* (2009) found the smallest price decreases in energy and the largest price decreases in perishable food products.

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

Product category	Size of price increase (percent)	Size of price decrease (percent)
Food	8.5	10.2
Non-alcoholic beverages	8.2	9.7
Alcoholic beverages	11.4	11.8
Tobacco and narcotics	6.1	7.3
Clothing and footwear	12.9	15.0
Fuel	8.6	10.2
Household furniture and equipment	18.3	21.7
Household operations	8.8	10.2
Medical care and health expenses	17.4	20.3
Transport equipment	8.2	12.8
Transport services	20.6	33.2
Recreation and culture	17.9	20.2
Education	34.4	35.9
Personal care	11.7	14.1
Other goods and services	11.1	13.5
Perishable	8.9	11.1
Non-perishable	8.2	9.6
Durable	13.5	16.2
Non-durable	10.5	13.0
Services	12.2	14.3
Total	**9.8**	**11.9**

Note: Values reflect the simple average of positive and negative price changes at the product by outlet level for each product group across over the period 2002-2009. This is given by $S_G^{+/-} = \frac{1}{N_G} \sum_{k \in G} \sum_{i=1}^{I} S_{ik}^{+/-}$ where N_G is the number of observations of S_{ik} in product group G.

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2.5.6 Hazard rates for individual products

Another stylised fact that has been documented in the literature concerns the shape of the hazard function. Heterogeneity is introduced into micro-price setting through the estimation of the price hazard function.[19] A price hazard function represents the conditional probability of changing a price of the product, given the period since the last price change. The output of the hazard function is the hazard rate which shows the probability of a price change in period *t* conditional on the event that the price was fixed for the previous *t-1* periods.[20]

More formally, the hazard rate h (τ) is expressed as the probability that a price (P_t) will change after t periods conditional on the fact that P_t will remain fixed in the previous τ -1 periods:

$$h(\tau) = \lim_{\tau \to 0} \Pr\{p_{t+\tau} \neq p_{t+\tau} / p_{t+\tau-1} = p_{t+\tau-2} = \dots\dots\dots = p_t\} \qquad (7)$$

[19] The slope of the hazard function indicates heterogeneity in price setting behaviour.

[20] 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 period means *(n-1, n]*. Note that 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.

Where the price is assumed to reset at date t

Aggregate hazard function

Figure 6 plots the pooled hazard functions for goods and services across retail outlets in Lesotho.

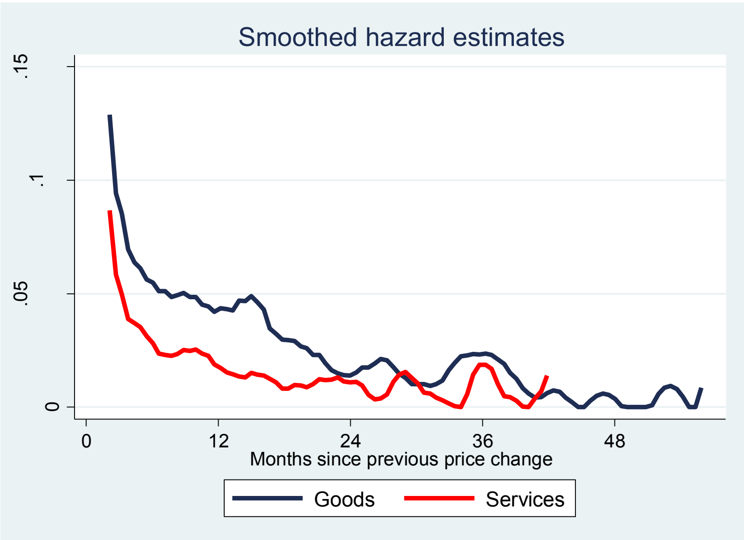

Figure 6: Aggregate hazard function for the Lesotho price data

The pooled hazard function for goods is downward sloping, with bumps at 12 months and 24 months and a spike at 36 months. This implies that the probability of price change decreases in relation to the length of time since the last price change of consumer goods. The declining pooled hazard suggests a combination of heterogeneous hazards, which is the survivor bias. By contrast, the hazard function for the services sector declines in the first six months and becomes flat thereafter. The flat pattern in the longer period reflects regulated prices and lack of competition for prices of services. This pattern could also be evidence of time-dependent price setting behaviour in the services sector as predicted by Calvo (1983).

These results are consistent with other studies in the empirical literature. Klenow and Kryvtsov (2008), for example, find a monotonically declining pooled hazard for all goods, with bumps every six months and a spike at one year. Nakamura and Steinsson (2008) also estimated aggregate hazard functions for each major group and find that the hazards are

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downward sloping for the first few months and flat thereafter. Alvarez (2008) finds a similar pattern for the Euro Area. Creamer *et al.* (2012) also find a declining aggregate hazard for both CPI and PPI data for South Africa.

Overall, the shapes of the aggregate hazard functions show that the presence of heterogeneity in price setting behaviour in Lesotho is more pronounced in the goods sector than in the services sector. Heterogeneity can be a result of combining heterogeneous price setters and thus an aggregation of flat hazard functions, leading to a downward bias in the slope of the hazard function. Consequently, aggregation of hazard functions leads to incorrect interpretation of results. This indicates that there is a need to estimate hazard function at a more disaggregated level.

Figure 7 plots the disaggregated product groups. Overall, the hazards for goods are upward sloping, suggesting that the probability of price change for consumer goods increases in relation to time since the last price change. The hazard for food products and transport equipment are upward sloping while the hazard for clothing and footwear slightly declines initially and then increases. The observed pattern in the clothing and footwear sector could reflect the presence of heterogeneity because of differences in quality. The upward sloping hazards suggest evidence of strong dominance of price setters who follow state dependent pricing behaviour. The disaggregated hazard functions for services are generally flat with a spike at the end of the period, indicating evidence of time-dependent pricing behaviour.

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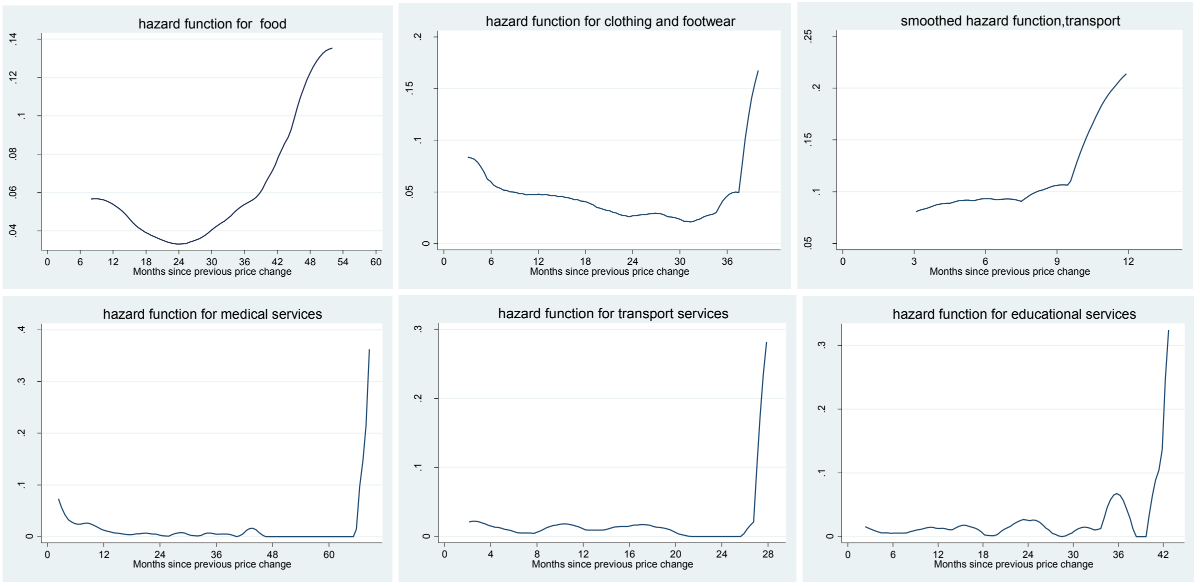

Figure 7: Hazard functions by product categories

The hazard functions for the selected individual products are also estimated, as shown in Appendix 2.3 (figure 2.5). The results reveal that the hazards for goods are upward sloping. This suggests that within a specific time frame, the probability of price changes increases with the length of the last price change. This pattern shows evidence of state-dependent pricing behaviour. These results are comparable to the results by Creamer *et al.* (2012) who also find upward sloping hazards for individual goods for South Africa.

The hazard functions for services are generally flat, implying that there is a constant probability that a given price setter in this sector will change the price at any instant. This result suggests evidence of time-dependent pricing behaviour. Several empirical studies also find flat hazards for services (for example, Bunn and Ellis, 2009).

In conclusion, the cross-sectional heterogeneity in the aggregate hazard function is evident and significant across product categories but less significant across individual products. Consumer goods generally display upward sloping hazard functions, consistent with state-dependent pricing behaviour while services display flat hazard functions which is consistent with time-dependent pricing behaviour.

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2.5.7 The size and duration of price changes

In this section, we explore the relationship between the duration of price spell and the size of price changes. State-dependent pricing theory argues that there is little association between the size of price changes and duration as the spell length is endogenous to accumulated shocks. On the contrary, time-dependent theory predicts a positive relationship between size and duration based on the argument that more shocks accumulate as the duration of price spell becomes longer. Figure 8 plots the average size of price changes with the duration of price spell for Lesotho data.

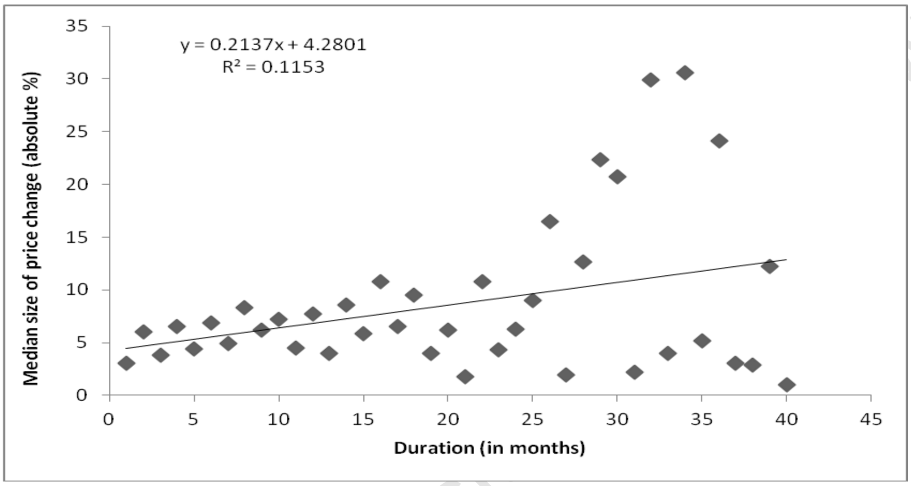

Figure 8: The size of price changes by age (2002-2009)
Note: Each observation reflects the median size of the absolute value of price change using product by outlet level observation, using full sample.

The diagram shows a positive relationship between the size of price changes and the duration of price spells.[21] Price changes start out small (at 3 percent for 1 month's duration) and increase to 7 percent for a duration of 6 months and to 9.5 percent at 18 months duration, consistent with time-dependent pricing behaviour. This result implies that as more shocks accumulate, the price spell becomes longer between price changes. This result provides sufficient evidence to suggest that there are some constraints that prevent retailers from changing prices frequently and therefore prices are set only at infrequent intervals. These

[21] Similar results are obtained using the mean absolute size of price changes (see appendix 2.4)

constraints could include fixed length contracts or menu costs. We should also note the rising dispersion in the size of price changes as duration increases, which could suggest that, in the case of Lesotho, as shocks accumulate, the median size of price changes becomes very different in each period (large in some period and small in some period).

Other studies that find a positive relationship between the size of price changes and duration include Creamer *et al.* (2012) and Bunn and Ellis (2009) for the United Kingdom. However, Klenow and Kryvtsov (2008) and Eden (2001) find no relationship between the average absolute size of price changes and time since the last price change for the US and Israel respectively.

2.5.8 Synchronization in price setting

In this section, we characterise price dynamics using micro level price data for Lesotho. The objective is to determine the degree of synchronization of price changes.

There are a number of different methods in the literature of evaluating the degree of synchronization in the data. We use the measure proposed by Fisher and Konieczny (2000). Because of The advantage of using this measure, over simple measures of standard deviations of price changes is that it provides a relative measure of synchronization Dhyne and Konieczny (2007). However, its limitation is that it is difficult to interpret if the values are not zero or one, as values between zero and one are ambiguous (Margues and Silva, 2004). We complement this measure by adopting the method used by Klenow and Kryvtsov (2008). Other methods in the literature include the standard deviation and the serial correlation of the monthly frequency of price changes (see Lach and Tsiddon, 1992); cross-sectional dependence tests such as Pesaran, 2005).

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Fisher and Konieczny (2000) introduced the Fisher and Konieczny index, hereafter the FK index, to measure the extent to which price changes are synchronized.[22] The FK index is computed as follows:

$$FK_j = \sqrt{\frac{\frac{1}{\tau - 1}\sum_{t=2}^{\tau}\left(F_{jt} - F_j\right)^2}{F_j\left(1 - F_j\right)}} = \frac{\sqrt{S_{F_{jt}}^2}}{\sqrt{F_j\left(1 - F_j\right)}} \tag{8}$$

Where τ is the number of observations for which the ratio is computed; F_{jt} is the frequency of price changes for product category j for all periods t and $F_j = \frac{1}{\tau - 1}\sum_{t=2}^{\tau} F_{jt}$ and $S_{F_{jt}}^2$ are the empirical means and standard deviation of F_{jt}, respectively. The index takes the value of 1 under the assumption of perfect synchronization. This suggests that all prices are simultaneously adjusted (the proportion of firms that change price in a given month is either zero or one) and the standard deviation is $\sqrt{F_j\left(1 - F_j\right)}$. Alternatively, the index can take the value of zero under the assumption of perfect staggering. This suggests that the proportion of firms that change prices in each month is constant and equal to the average proportion of price changes in the data and the standard deviation is zero.

The computed average synchronisation index for price changes for all products is 51 percent, which suggests the intermediary degree of price synchronisation. Therefore, Baumgartner et al (2005) also find similar results (42 percent) for Austria. However, evidence found in the previous sections is that there is substantial heterogeneity across products and product groups. Thus, the aggregate index may not be the appropriate measure

[22] Many other studies have used this index. For example, Aucremanne and Dhyne (2004) and Dhyne and Konieczny (2007) for Belgium; Veronese *et al.* (2005) for Italy; Baumgartner *et al.* (2005) for Austria and Dhyne *et al.* (2006) Dhyne *et al.* (2006) for the Euro area and US.

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of synchronisation as it disguises the heterogeneity across sectors and products. We therefore compute the index by product groups. The results are presented in table 9.

Table 9: Synchronisation of price changes (2002-2009)

Product group	Price changes	Price increases	Price decreases
food	49.8	48.7	47.5
non-alcoholic beverages	44.7	43.4	45.3
alcoholic beverages	56.8	51.4	51.5
tobacco and narcotics	43.1	41.9	46.5
clothing and footwear	62.6	57.9	58.1
fuel	56.8	56.9	56.2
household furniture and equipment	70.9	63.4	59.8
household operations	44.9	39.9	42.2
medical care and health expenses	63.6	62.0	58.0
transport equipment	81.1	77.9	77.0
transport related services	85.5	85.5	80.8
recreation and culture	60.5	54.1	56.0
education	81.3	64.6	58.3
personal care	49.3	44.2	44.7
other goods and services	55.3	49.6	48.9
Aggregate	**51.0**	**70.3**	**63.4**

The results reveal two important insights. First, the degree of synchronisation differs greatly across product groups: from 43 percent for tobacco and narcotics to 85 percent for transport services. Second, the degree of synchronisation is higher for services than for household consumption goods. Transport services (such as fares), medical services and education services are regulated to a large extent in Lesotho while transport equipment consist of mainly durables whose prises take time to change as indicated in the previous sections. Food products alcoholic beverages have lower synchronisation ratios (49 and 44 percent respectively). Third, the degree of synchronisation differs between price increases and price decreases. The synchronisation index if higher for price increases (70 percent) than for price decreases (63 percent).

In general the results reveal that when we consider the overall price changes, there is no strong evidence that point to some degree of synchronisation. However, high degree of synchronisation is observed when price increases and price decreases are considered separately. This provides evidence that the importance of the state of the economy, which is the common factor, in price changes is more pronounced for price increases and price decreases, but not for the frequency of price changes.

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Klenow and Kryvtsov (2008) explain synchronisation in terms of the role of intensive and extensive margin for aggregate inflation dynamics. The extensive margin (EM) is the frequency of price changes while the intensive margin (IM) is the average size of price changes. In this case, price changes are synchronised if they all decide to change their prices due to changes in the state of the economy and they are staggering if not all change their price in a given period. The role of the frequency of price changes (EM) on aggregate inflation is used as a measure of the extent of synchronisation in price setting. The time variation provides evidence for distinguishing between time-dependent and state-dependent pricing models. High degree of synchronisation implies evidence of state-dependence in price setting and vice versa.

Klenow and Kryvtsov (2008) to decompose the variance of the rate of inflation into terms that involve a variation in the intensive margin (time-dependent terms) and the terms that involve variance in the extensive margin (state-dependent terms). The geometric mean inflation rate in month t is defined as:

$$\pi_t \approx \sum_k \omega_k \left(p_{kt} - p_{kt-1}\right) \tag{9}$$

The inflation rate above can then be decomposed into the product of EM and IM as follows:

$$\pi_t = \underbrace{\sum_k \omega_k X_{kt}}_{freq_t} * \underbrace{\frac{\sum_k \omega_k \left(p_{kt} - p_{kt-1}\right)}{\sum_k \omega_k X_{kt}}}_{dlp_t} = EM_t * IM_t \tag{10}$$

Where, ω_k is the consumption expenditure weights for 165 products weighted using the CPI weights (as provided by the BOS) and; X_{kt} is the indicator variable for price change in month t as explained in equation (1).[23] The first component of equation (10) is the weighted average

[23] Since the dataset contains only information concerning the CPI weights at the product level and not product unit level, we use 165 product types. For example, bread instead of brown bread. The assumption is that this slight aggregation will not change the results.

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frequency of price changes (EM) while the second component is the weighted average size of price changes (IM). Table 10 presents the summary statistics for price changes from March 2002 to December 2009.

Table 10: Time series moments for price changes (2002-2009)

Variable	Mean	Standard deviation	Cross correlation	OLS regression on inflation(π) Coefficient	standard error
Inflation (π)	0.6%	1.0%			
EM	37.9%	14.6%	0.58	3.247***	(0.251)
IM	1.7%	3.4%	0.89	7.016***	(1.267)
Fr_plus	22.8%	10.0%	0.75	8.090***	(2.277)
Fr_minus	13.9%	8.8%	-0.25	-6.021***	(1.012)
Dp_plus	2.0%	3.9%	0.63	1.662***	(0.565)
Dp_minus	-1.3%	4.6%	0.56	2.956***	(0.848)
positive	0.6%	1.7%	0.72	0.803***	(0.270)
negative	-0.4%	1.8%	0.71	1.278***	(0.346)

Notes: The entries for means, standard deviation and cross-correlations are estimated from monthly observations. The columns of OLS regressions coefficient and standard errors are obtained by regressing the corresponding variable in column 1 on inflation. The monthly values of the variables are weighted means across products. Data weighted by CPI expenditure weights at product level obtained from BOS

The monthly retail price inflation rate is 0.6 percent (or if annualised, 7.2 percent). The weighted average monthly frequency of price changes (EM) is 37.9 percent with a standard deviation of 14.6 percent. The weighted average size of price changes (IM) is 1.7 percent with a standard deviation of 3.4 percent. Klenow and Kryvtsov (2008) for the US data find a mean IM of 0.98 percent (with a standard deviation of 1.19 percent) and the mean EM of 26.6 percent (with a standard deviation of 3.2 percent).

Another finding from the data is that the relationship between inflation and the average size of price changes (0.89) is stronger than the relationship between inflation and the average frequency of price changes (0.58). Klenow and Kryvtsov (2008) also found a stronger correlation between IM and inflation (0.99) than between EM and inflation (0.25) while Wulfsberg (2009), using data for Norway, found that EM was strongly correlated with CPI inflation (0.91) while IM was negatively correlated with CPI inflation (-0.12). Creamer *et al.* (2012) used regression analysis and found that the frequency of price changes was positively and significantly associated with current CPI inflation and with the CPI inflation rate after a three-month lag.

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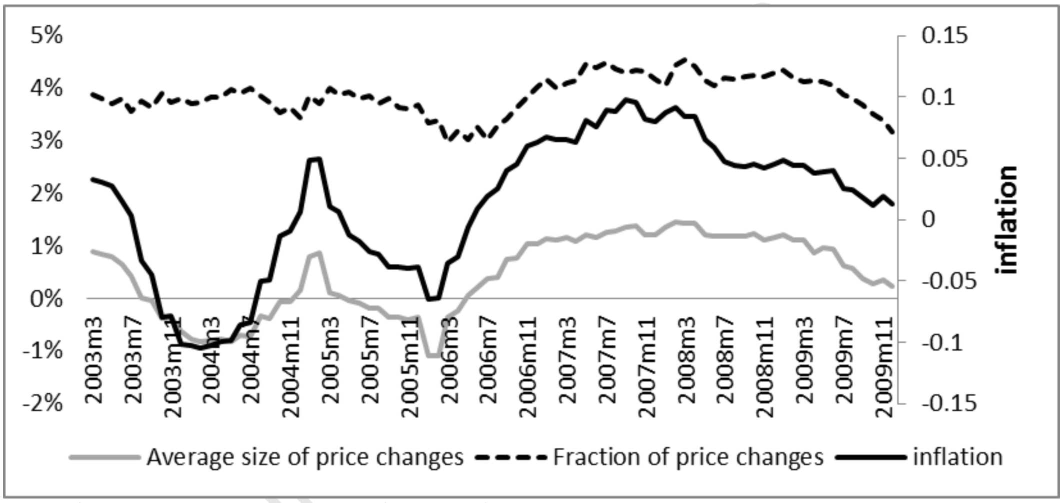
The Golosov and Lucas (2007) model predicts that it is mainly the size of the price changes that respond to the inflation shock while the frequency remains unaffected. Models with exogenous timing of price changes also predict a strong correlation between the size of price changes and inflation. In contrast, Dotsey *et al.* (1999) predict that it is the frequency that responds to inflation shock and not the size.

To evaluate these relationships, the 12-month moving averages for retail price inflation are plotted against IM and EM, as shown in Figure 9. EM (the average fraction of price changes) is constant compared to the fluctuating IM (the average size of price changes). This diagram shows that the correlation between inflation and IM is stronger than the correlation between inflation and EM in the case of Lesotho.



Note: Inflation (RHS) and average size and frequency of price changes (LHS)

Figure 9: Intensive and extensive margins of inflation [24]

Gagnon (2009) argues that the average magnitude of price changes correlates strongly with inflation because it is sensitive to movements in the relative shares of price increases and price decreases. As the average frequency of price changes is divided into the frequency of price increases and price decreases, the correlation with inflation become stronger (0.57 and -0.35 respectively) than the correlation with the size of price increases and price decreases

[24] The fraction of price changes was divided by 10 for easy comparison. All the variables are across product groups' 12-month weighted moving averages.

(0.17 and -0.28 respectively). Further, the regression results from simple OLS regression, as shown in the fifth column (in table 2.7) reveal a significant relationship between inflation and all the variables. Average frequency of price increases and price decreases are more strongly associated with inflation than the size of price increases and price decreases, in terms of the statistical significance and the means. A 1 unit increase in inflation is associated with a 0.57 (-0.37) unit change in the frequency of price increases (decreases) and a 0.07 (-0.16) unit change in the size of price increases (decreases).[25] These results provide evidence of state-dependent pricing.

Klenow and Kryvtsov (2008) and Nakamura and Steinsson (2008) also find a closer correlation between inflation and the frequency of price increases and price decreases than between inflation and the size of price increases and price decreases.

2.5.9 Intensive and extensive margins in low and high inflation periods

The next empirical question that we answer in this section is whether the strong correlation between IM and inflation is consistent in different levels of inflation.

Theoretical models with endogenous timing of price changes provide consistent predictions at different levels of inflation. However, time-dependent pricing models are not able to make plausible predictions as they assume that price changes are constant over time. To answer this empirical question in the case of Lesotho, we distinguish between periods of low and high inflation by separating the full sample into three sub-samples. It is important to distinguish between different levels of inflation because the small amount of inflation variability prevents drawing firm conclusions regarding how price adjustments co-vary with inflation.

Gagnon (2009) provides insight into the relationship between inflation and price setting behaviour using data covering periods of high and low inflation in Mexico. He found

[25] Similar statistics were also estimated for the subsamples for low inflation period and of high inflation periods

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that IM was strongly correlated with inflation during periods of low inflation and not during periods of high inflation.

In this chapter, we draw from the same argument to analyse the relationship between inflation and IM and EM during periods of high and low inflation using the Lesotho data. We consider a low-inflation period to be where the CPI inflation rate is below 6 percent which is between 2004m1 to 2006m12. A high inflation period is where the inflation rate is between 6 and 10 percent and runs from 2002m3 to 2003m12. The third sub-sample includes a period of high and volatile inflation (where inflation is above 10 percent) between 2007m1 to 2009m12.[26]

Table 11: Time series moments for price changes in different sample periods

	high inflation period (2002-2003)			**low inflation period (2004-2006)**			**high inflation period (2007-2009)**		
Variable	Mean	Standard deviation	Cross correlation	Mean	Standard deviation	Cross correlation	Mean	Standard deviation	Cross correlation
inflation	0.7%	0.7%		0.3%	1.2%		0.8%	1.0%	
EM	38.1%	10.7%	0.24	37.3%	18.6%	0.03	38.3%	12.1%	0.58
IM	1.9%	1.7%	0.92	1.6%	4.7%	0.41	1.8%	2.7%	0.89
Fr_plus	22.5%	6.2%	0.48	20.7%	10.9%	0.02	24.9%	12.4%	0.75
Fr_minus	17.3%	8.8%	-0.04	14.5%	9.9%	-0.02	11.7%	6.9%	-0.25
Dp_plus	1.0%	1.0%	0.43	2.4%	6.0%	-0.59	2.1%	1.8%	0.54
Dp_minus	-2.3%	4.8%	-0.09	-1.8%	5.9%	-0.46	-0.3%	2.6%	0.40

Note: The entries for means, standard deviation, and cross-correlations are estimated from monthly observations. The columns of OLS regressions coefficient and standard errors are obtained by regressing the corresponding variable in column 1 on inflation. The monthly values of the variables are weighted means across products.

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Periods of high inflation are associated with a higher mean of inflation (0.7 percent in 2002-2003 and 0.8 percent in 2007-2009) and a higher IM (1.9 percent in 2002-03 and 1.8 percent in 2007-2009). While the average annualised retail price inflation is 7.2 percent for the full period, it reaches 9.6 percent in the period 2007-2009. This could be due to sharp increases in global food prices that during that period. Including this period in the sample leads to a larger average frequency of price changes (38.3 percent) compared to the full sample.

Alternatively, the frequency of price increases is more strongly correlated with inflation than the size of price changes in all periods. The correlation between inflation and the frequency of price increases is much larger (22.5 percent for 2002-2003 and 24.9 percent

[26] The last subsample also includes the period of global financial crisis. Table 11 presents the summary statistics for the three subsamples.

in 2007-2009) and the correlation with inflation is much stronger (0.48 percent for 2002-2003 and 0.75 percent in 2007-2009) during the periods of high inflation. By contrast, the frequency of price decreases is much lower (11.7 percent) and weakly correlated with inflation (-0.25) during the period 2007-2009. These results are comparable to previous studies of inflation dynamics and its components during low and high inflation periods. For example, Gagnon (2009) and Wulfsberg (2010) also report high correlation coefficients between variables during high inflation periods for Mexico and Norway respectively.

To determine the importance of the EM and IM to the variance of inflation, Klenow and Kryvtsov (2008) decomposed the variance of inflation into the variance of the average price change, the variance of the fraction of products with price changes and their covariance.[27] The first order Taylor series expansion around the sample means of equation (10) gives the following variance decomposition:

$$\operatorname{var}(\pi_t) = \underbrace{\operatorname{var}(IM_t) * \overline{EM}^2}_{IM\ term} + \underbrace{\operatorname{var}(EM_t) * I\overline{M}^2 + 2 * I\overline{M} * \overline{EM} * \operatorname{cov}(EM_t, IM_t) + O_t}_{EM\ terms} \qquad (11)$$

The IM term involves the variance of the intensive margin, while the EM terms include the variance of the extensive margin as well as the covariance of the extensive and intensive margins.[28] In standard time-dependent pricing theory, the IM terms account for all the variation in inflation, while in state-dependent pricing models, the EM terms account for a relatively large fraction of the variability in inflation. However, some state-dependent menu-costs models such as Golosov and Lucas (2007), for example, predict that the IM component is more important than the EM component. Table 12 presents the results of the variance decomposition for full sample and three different sub samples.

[27] Variance decomposition refers to the breakdown of the forecast error variance for a specific time horizon. It indicates whether EM or IM have impact on the variance of inflation; the percentage of the variation in inflation attributable to IM and to EM at a specific time horizon.
[28] The expression O_t include higher-order terms that are functions of the EM.

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Table 12: Variance decomposition of inflation (percent)

Variable	*Full sample* **2002-2009**	*High-inflation* **2002-2003**	*Low inflation* **2004-2006**	*High- inflation* **2007-2009**
IM term	0.68	0.47	0.92	0.44
EM term	0.32	0.53	0.08	0.56
positive term	0.54	0.86	0.48	0.76
negative term	0.46	0.14	0.52	0.24

For the entire period, the IM term represents a large proportion of the variance of inflation (68 percent) and the EM term is less important for the variance of inflation (32 percent). The share of EM terms increases to 73 percent during high-inflation periods. However, when the data is restricted to low-inflation periods, the share of the EM terms declines to 8 percent. This finding clearly indicates that when inflation is high, the variation in the average frequency of price changes drives the variation in inflation and when inflation is low, the variation in the average size of price changes drives most of the variation in inflation. This conclusion is consistent with Gagnon (2009) who also found that IM terms drive variations in inflation in low inflation periods and EM drives inflation variations in high inflation periods for the case of Mexico.

Overall, the analysis in this section reveals the following: Firstly, there is a strong correlation between IM and inflation when we consider the entire sample. Secondly, the frequency of price increases and price decreases correlates more with inflation than does the size of price increases and decreases. Thirdly, evidence reveals key differences in price setting behaviour between periods of low and high inflation. When inflation is high (above 6 percent), most of the variation in inflation is driven by the variation in the average frequency of price changes but when inflation is low, most of the variation is driven by the variation in the size of price changes. At high levels of inflation, price increases are more common than price decreases and at low inflation periods, price decreases are common than price

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decreases. There is a higher frequency of price increases during high inflation periods and a declining frequency during low-inflation periods.

The results discussed in this section show that the correlation between IM and EM and the variation of inflation differs with the level of inflation. During periods of high inflation, the results are consistent with state-dependent pricing behaviour, and during periods of low inflation, the results point to evidence of time-dependent pricing. However, the correlation between inflation and frequency of price increases and price decreases clearly points to evidence of state-dependent pricing and not time-dependent pricing. These results confirm the earlier finding that the degree of synchronisation is more pronounced when we consider price increases and price decreases and different levels inflation.

2.6 Conclusion and policy implications

In this chapter, new evidence on price setting behaviour is documented using disaggregated price data for the period March 2002 and December 2009 for Lesotho. A number of stylised features that characterise price setting behaviour are documented for Lesotho.

There is substantial heterogeneity in the frequency of price changes across retailers and across products in Lesotho. Retailers on average change prices every 2.7 months, but there is a wide variation in the frequency across products. For example, the average duration of price changes across products ranges from 3.1 months for goods to 6.3 months for services.

Price changes are more frequent in Lesotho (36 percent) than in South Africa (22 percent) and developed countries such as those in Euro area (15.7 percent), but are less frequent than in other developing countries such as Sierra Leone (51 percent). This result is consistent with other findings on the frequency of price changes.

In inflationary environments, the frequency of price increases should be higher than the frequency of price decreases to preserve the real returns. On average, the frequency of

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price increase is 22 percent and of price decreases is 13.5 percent. But there is also a wide variation in price increases and price decreases across products. For example, the average frequency of price increase ranges from 27.2 percent for perishable products to 17 percent for services. In contrast, the average frequency of price decreases ranges from 15.1 percent for clothing and footwear to 3.9 percent for education services.

Price changes are large in absolute terms. The average size of price change is 10.6 percent in absolute terms and 18. 8 percent of price changes are more than 5 percent in absolute terms. Large absolute price changes indicate that aggregate shocks are important for price setting in Lesotho.

The results also reveal that many price changes are small. On average, 62 percent of prices do not change in a month while 14 percent of price changes are less than 2.5 percent in absolute terms. This indicates that price changes in Lesotho are more determined by small idiosyncratic productivity shocks rather than to large aggregate shocks.

There is substantial heterogeneity in the probability of price changes. Aggregate hazard functions for goods are downward sloping while hazard functions for services initially decline but become flat after 12 months. At a disaggregated level, there is wide variation across products. 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).

The results also reveal that the size of price changes increases with duration. Price changes range from 3 percent at one month's duration to 9.5 percent after 18 months, suggesting that as shocks accumulate, the price spell becomes longer between price changes.

Another important insight from the results is that the strength of the relationship of the dynamics of price changes such as synchronisation of price changes. For example, when the inflation rate is high (greater than 8 percent) price changes are more synchronised (the

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frequency of price changes drives most of the variation in inflation) but when inflation is low, prices become less synchronised (the size of price change dominates the variation of inflation). However, the frequencies of price increase and price decreases strongly drives the variation in inflation irrespective of the level of inflation.

This chapter also compares the empirical features found in the data to time-dependent and state-dependent theories of price setting behaviour, and examines their consistency in explaining the empirical characteristics found in the data.

The results reveal that none of the time-dependent and state-dependent pricing models matches all the empirical features found in the data. Frequent price changes as found in the data for Lesotho provide evidence of both time-dependent and state-dependent pricing. Prices of goods provide evidence for state-dependent pricing while prices of services provide evidence for time-dependent pricing models. The fact that the size of price changes increases with duration is consistent with time-dependent pricing models. Large price changes and many small price changes are generally found in state-dependent models, as evidence that retailers respond more to small idiosyncratic shocks than large aggregate shocks. Golosov and Lucas (2007) use this explanation as a motivation for their state-dependent pricing model with idiosyncratic shocks.

Finally, movements in inflation are strongly explained by movements in the frequency of price change in high inflation periods but not in periods of low inflation. However, the frequency of price increases and price decreases move with inflation in all levels of inflation, suggesting evidence of state-dependence in price setting.

From these stylised facts, it is apparent that both time-dependent and state-dependent features exist in price setting behaviour in Lesotho. Indeed the heterogeneity found in price setting behaviour across different product groups and outlets suggests that there may be no single theory that can explain how all prices are set in Lesotho. Some theories can better

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explain price setting behaviour in some sectors than in others and therefore it may be difficult to find one theory that can explain pricing behaviour economy wide.

However, further improvements can be made on the current theories to incorporate different characteristics of price setting behaviour that are peculiar to developing countries such as varying menus costs and idiosyncratic shocks. High menu costs ensure that price changes are infrequent and lumpy while low menu costs generate frequent and small price changes. The concurrent presence of positive and negative price changes even within disaggregated product categories suggests that idiosyncratic productivity shocks are important in driving price changes in Lesotho. Therefore, macro models that incorporate short durations of price changes and allow for more prudent (for example less persistent) macroeconomic policies, for example, might be more appropriate to developing countries.

Nonetheless, the ambiguity about the frequency of price changes and inflation at different levels of inflations implies that we cannot judge the ability of the theoretical models to match the average frequency and the magnitude of price changes at various levels of inflation. In the next chapter, we use the relationship between the frequency of price changes and inflation to establish which theory dominates when heterogeneity and other factors are accounted for.

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3 Price setting behaviour and retail price inflation dynamics in Lesotho

3.1 Introduction

The results of the study discussed in the preceding chapter suggest that stylised facts of price setting behaviour do not allow us to uniquely identify which theory is applicable in the case of Lesotho. In this chapter, we analyse the relationship between inflation and the frequency of price changes to better identify the relationship between theory and empirical facts. This relationship is important for a number of reasons. First, it provides important theoretical insights on which theory is applicable. Time-dependent models predict that the frequency of price changes is not dependent on economic conditions and is not related to inflation because the timing of price changes is exogenous. Alternatively, state-dependent pricing models predict that the frequency of price changes is related to inflation because of endogenous timing of price changes.

Secondly, the relationship is important in the understanding of micro-adjustments of macroeconomic shocks. There is a general conclusion in the literature that higher aggregate inflation, as well as higher sectoral inflation, increases the frequency of price changes (for example, Aucremanne and Dhyne, 2005). On the other hand, higher inflation raises the frequency of price increase and lowers the frequency of price decrease (Álvarez and Hernando, 2004; Baumgartner *et al.*, 2005; Fougère *et al.*, 2007 and; Benkouskis *et al.*, 2012). This result provides important insight into how markets respond to inflationary shocks and for determining the microeconomic foundations of macroeconomic fluctuations (Reinsdorf, 1994).

The major drawback in the existing literature is that while many studies provide a careful description of individual prices movements, they do not distinguish between sector-specific and aggregate sources of these price changes (for example Bils and Klenow, 2004;

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Klenow and Kryvtsov, 2008). It is therefore not possible to infer from these studies the frequency in which sectoral prices respond to inflation shocks. Such distinctions would, however, provide important insights into the determination of price setting behaviour and guidance for the development of appropriate macroeconomic models.

Thirdly, this relationship is important for policy because monetary policy targets aggregate inflation. Therefore, we need to understand how changes in price setting behaviour underpin or respond to changes in inflation. Finally, this relationship is important for product market integration. The role of local, national and regional inflation dynamics in price setting behaviour provide important insights into product market integration. If regional markets are integrated, for example, we may anticipate that regional inflation dynamics dominate local dynamics in driving price setting behaviour, but if regional markets are not integrated, then local inflation dynamics dominate regional dynamics.

While factors that influence the firm's behaviour concerning price setting are critically important to understand the workings of the market economy, empirical evidence on this issue remains scarce in developing countries, where inflation is very unstable. This chapter investigates the extent to which the frequency of price changes of individual firms is associated with inflation, distinguishing between local, national and regional inflationary dynamics in the case of Lesotho. The analysis is structured around addressing the following specific objectives:

- To explore the relationship between the frequency of price change and inflation in Lesotho, distinguishing between state-dependent versus time-dependent theories of price setting behaviour.
- To identify the differences in the relationship between the frequency of price changes and inflation at the local and national level.

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- To empirically test the theoretical contribution of these relationships when they are analysed according to different product categories.
- To analyse the importance of regional determinants of the frequency of price change in Lesotho, using data on price setting behaviour in South Africa.
- To explore the extent to which product markets are integrated within Lesotho and between Lesotho and South Africa.

Given the foregoing, this chapter makes the following contributions. First is the use of a unique dataset for Lesotho, which captures both periods of low and high inflation, to evaluate evidence in support of state-dependent versus time-dependent pricing behaviour among retailers in Lesotho. In addition, this chapter also uses the mapped monthly data for Lesotho and South African retail product prices for the period of 2002 to 2007 to analyse price setting behaviour in Lesotho, and links this to price setting behaviour in South Africa, its major trading partner. The relationship between inflation and price setting behaviour may be different in Lesotho in relation to South Africa compared to other countries given its size, membership of the SACU and CMA, and the geographical proximity with South Africa.[29] Hence there is a need to isolate the relationship between price setting behaviour and regional and national inflation.

The distinction between local, national and regional inflation is also an important indicator of how product markets are integrated between and within countries. If local and national inflation influences price setting, then this is an indication that markets are integrated within Lesotho. Similarly, if regional inflation influence price setting, then this suggests that markets are integrated between Lesotho and South Africa. To our knowledge, no other study to date in the literature has looked at how regional conditions influences national price setting behaviour.

[29] Lesotho is completely surrounded by South Africa (see appendix 4.5).

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The structure of the remainder of the chapter is as follows. Section 3.2 reviews the theoretical models that explain the relationship between the frequency of price changes and inflation while section 3.3 reviews the relevant empirical literature. Section 3.4 discusses the data used for analysis while section 3.5 outlines the method of analysis and presents the empirical results. Section 6.6 outlines the methodological framework for the analysis that includes inflation dynamics from South Africa and presents the empirical results. Section 3.7 concludes the chapter.

3.2 Theoretical insights

Time-dependent and state-dependent theories predict different relationships between inflation and the frequency of price changes. This allows us to identify which of these theories are appropriate.

Time-dependent theory assumes that firms do not change their prices in response to changes in macroeconomic conditions (such as inflation). This implies that movements in the frequency of price increases completely offset movements in the frequency of price decreases, leaving the frequency of price changes unaffected, irrespective of the level of inflation. This assumption has been criticised as not being able to describe the degree of price stickiness and is therefore hardly credible for monetary policy analysis particularly in an environment with shifts in trend inflation (Bakhshi *et al.*, 2007). Therefore, there is general agreement that, state-dependent pricing theory is more appealing than purely time-dependent pricing models because it has stronger micro-foundations (Klenow and Kryvtsov, 2008).

Models with state-dependent pricing have been preferred due to their assumption of endogenous timing of price changes. In these models, the frequency of price changes is dependent on macroeconomic conditions (such as inflation). The relationship between inflation and the frequency of price changes under state-dependent pricing is based on the assumption that price changes are infrequent because firms face a range of physical menu

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costs (fixed costs of changing prices).[30] State-dependent pricing models will therefore only be optimal if the only friction that prevents price changes from changing is menu costs.

The model proposed by Sheshinski and Weiss (1977) is one example of menu cost models under state dependent pricing.[31] The model predicts that in the presence of positive inflation, the optimal policy for firms is to follow the (s, S) rule. This implies that higher inflation does not necessarily imply higher frequency of price changes.

For example, a firm that sells a single product and faces a constant rate of inflation will change the nominal price based on a menu cost which is independent of how frequently or how much the price is changed. The optimal policy for the firm is to set two real price bounds, *s* and *S*. Nominal price is kept constant and inflation erodes the real price until it reaches the lower bound, (*s)*; the nominal price is then increased so that the new real price is equal to the upper bound, (*S).* Higher inflation leads to a lower *s* and a higher *S* and lowers the frequency of price changes. This implies that if menu costs are high, the frequency of price changes will fall while inflation increases. The only situation where inflation will be positively related to the frequency of price changes is if menu costs are low enough to allow frequent price changes.

Another example of a menu cost model was proposed by Dotsey, King, and Wolman (1999) who developed a state-dependent pricing model with random menu costs. In this model, an individual firm decides whether or not it wants to change its nominal price based on the expected benefit from changing that price against the fixed costs they have drawn in the current period. Depending on the current costs of changing prices, some firms do change prices while others do not, but all firms that decide to change their prices will set the same

[30] These costs are categorised into: physical adjustment costs and customer costs. Physical costs involve the actual implementation of a price change while customer costs consist of the time spend conveying price changes to customers, time spend negotiating prices with customers and costs associated with loss of sales because of antagonizing customers.

[31] Sheshinski and Weiss (1983) extents this literature to show that expected inflation can also affect the frequency of price changes because a price setter contemplates the future evolution of inflation. The optimal policy is to set prices discontinuously according to an (S, s) pricing rule. Therefore, the distribution of inflation and, in particular, expected inflation affects the frequency of price changes.

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price. A firm that has not changed its nominal price for a long time is more likely to change it because its deviation from the target price is large. A firm that has changed its nominal price recently will change it only if it draws a small menu cost. A firm that by mistake increased its nominal price by 'too much' will correct this mistake by increasing it by a relatively small amount at the next nominal price change opportunity. The size of menu costs in changing nominal prices therefore encourages the firm to change or not change its nominal prices. This implies that even though firms face different menu costs, there is a positive relationship between inflation and the frequency of changing price for all firms. When inflation increases, the frequency of price change should be higher for firms with lower costs of changing prices because inflation causes the benefit of changing prices to increase overtime.

Overall, it is apparent that in state-dependent pricing, menu costs are important for the relationship between inflation and the frequency of price changes. These models predict that menu costs are variable across products and retail outlets (according to Dotsey *et al., (*1999) or constant (according to Sheshinski and Weiss, 1977). This means that the only case where inflation does not affect the frequency of price changes is in the absence of menu costs which is where firms follow time-dependent pricing.

Based on the foregoing, the chapter tests for evidence of state dependence pricing behaviour based on the following hypotheses. First, the frequency of price changes is positively associated with average retail sector price inflation. Second, retail price inflation is positively associated with the frequency of price increases and negatively associated with the frequency of price decreases. Finally, the relationship between inflation and the frequency of price changes is different across sectors due to differences in menu costs.

3.3 Review of related literature

A number of studies have analysed the relationship between the frequency of price change and inflation. Some studies have used substantial variation in frequencies along different

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dimensions to identify important determinants, while others have asked price-setters to assess the importance of various theories of price stickiness. The general conclusion in the literature is that the relationship between price inflation and the frequency of price changes differs across countries, between different levels of inflation (aggregate and sector-specific), across different products and product groups and, between price increases and price decreases.

The empirical evidence on the relationship between inflation and the frequency of price change differs among countries due to differences in price collection methodologies and the composition of products that are collected, and differences in levels and volatility of inflation, (Klenow and Malin, 2011). Some countries reflect a much stronger relationship between inflation and the frequency of price changes than others. For example, using regression analysis, Klenow and Kryvtsov (2008) find that the correlation between inflation and the fraction of firms changing prices is 0.69, while Nakamura and Steinsson (2008) find a lower correlation of 0.56, including sales. However, studies conducted using European data show different results for the correlation between inflation and the frequency of price changes compared to those found using the US data. Alvarez and Hernando, (2004), for example, analysed and reported a much lower correlation of 0.006 for Spanish firms. Carstensen and Schenkelberg (2011) find stronger evidence of state-dependence for Germany (coefficient of inflation is 6.86). Other studies in the Euro area (for example Austria, Belgium, Portugal) also reported evidence of state dependence in the relationship between inflation and the frequency of price change using both graphical analysis and correlations. Dhyne *et al.* (2006) use regression analysis and find no correlation between the frequency of price change and inflation for the European data.

Few studies analyse the relationship between inflation and the frequency of price changes in developing countries. Kovanen (2006) is an exception. He analyses the frequency of price changes and some macroeconomic variables including monthly inflation, exchange

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rate, and changes in money supply in Sierra Leone. Using simple OLS regression analysis, the correlation between inflation and the frequency of price changes was found to be 1.26, revealing much stronger evidence of state-dependent pricing among firms in Sierra Leone compared to most developed countries. In contrast, a study by Creamer *et al.* (2012) finds a lower association between overall inflation and the frequency of prices changes (0.005) for South Africa. They use a basic regression model to analyse the relationship between the frequency of price changes and CPI inflation for South Africa.

Despite the differences across countries with regard to the importance of inflation on firm price setting behaviour, studies that analyse this relationship are limited for developing countries. This is of particular concern in Africa where countries experience greater macroeconomic uncertainty due to volatile inflation rates.

The relationship between inflation and the frequency of price changes also differs across different levels of aggregation of inflation. Nakamura and Steinsson (2008), for example, used aggregate CPI inflation computed as the log change for 12 months while Fielding and Mizen (2000) used price index data from 10 EU countries over the period 1986 to 1993. They find evidence of a negative relationship between inflation and the frequency of price changes. Kovanen (2006) and Creamer *et al.* (2012) both use month-to-month aggregate CPI inflation in their research.

However, analysing price setting behaviour and its response to changes in inflation using aggregate prices can be problematic as aggregation does not account for considerable heterogeneity across individual products. Therefore, aggregate inflation measures do not offer a good approximation of the behaviour of underlying prices at the most basic level. Alternatively, product-specific inflation reflects changes in demand or supply conditions in a given market which affect the optimal price (Cecchetti, 1986). It also eliminates possible

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heterogeneity found in the data because it also varies across outlets. This chapter makes use of disaggregated prices that vary across products and across time.

The relationship between the frequency of price changes and inflation can also differ depending on the importance of aggregate and/or idiosyncratic conditions to firms. It is therefore important to distinguish between national and sector-specific inflation to test whether firms consider national or local conditions or both in their price setting decisions.

Most studies that use product and sector specific inflation computed using disaggregated price data find stronger evidence of state-dependent pricing in response to sectoral shocks than to aggregate shocks. Alvarez and Hernando (2004), for example, find a positive relationship between the frequency of price change at firm level and product-specific inflation computed at sector level, for Spanish data. Aucremanne and Dyne (2005) also find a positive relationship using accumulated inflation as a measure at sector level for Belgian data. Lünnemann and Mathä (2005) use accumulated price changes at a more disaggregated 10-digit COICOP level in Luxembourg and also find evidence of state-dependence. Benkouskis *et al.* (2012) used accumulated inflation at the product (6-digit COICOP) and the product group (2-digit COICOP) levels and report that Latvia's firms followed the state-dependent pricing strategy. Different results were reported by Baumgartner *et al.* (2005) in the case of Austria. They find that 1 percent increase in accumulated monthly inflation increased the frequency of price change by 18 percent.

The relationship between inflation and the frequency of price changes can also be different between price increases and price decreases as the frequency of price changes combines both price increases and price decreases. However, few studies analyse this relationship. Dhyne *et al.* (2006), for example, examined the impact of inflation (and other

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factors) on the frequency of price change using European data.[32] They find that retail price inflation was not significantly correlated with the overall frequency of price change, but was correlated with the frequency of price increases and decreases separately. They find that inflation is positively associated with the frequency of price increases and negatively associated with the frequency of price decreases. Other studies that found similar results include Alvarez and Hernando (2004); Veronese *et al.* (2005) and Dhyne *et al.* (2006) for European countries and Klenow and Kryvtsov (2008) for the US. In contrast, Nakamura and Steinsson (2008) find a positive association between the frequency of price increases and inflation, but no significant relationship to the frequency of price decreases using the US data. To our knowledge, only the study by Creamer *et al.* (2012) distinguishes between price increases and price decreases when assessing frequency of price changes in developing countries. They find a positive relationship between CPI inflation and the frequency of price increases but not with price decreases. However, they use aggregate CPI to establish this relationship which is a major drawback in their research.[33]

Overall, the empirical evidence shows that heterogeneity across products and countries necessitate a thorough investigation of the relationship between the frequency of price changes and product-specific inflation. Yet this analysis is very limited for developing countries where inflation is categorised as high and volatile compared to inflation in developed countries.

The main contribution of this chapter is to add to the literature by analysing this relationship, distinguishing between product-specific inflation at local, national and regional levels as the main determinants of the frequency of price changes in Lesotho for firms that

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[32] They regressed the frequency of price change across 50 product categories in 9 countries on the mean and standard deviation of inflation at the product category level and dummy variables for product type (unprocessed and processed food, energy, non-energy industrial goods, and services) and country dummies, among others.
[33] See Creamer et al. (2012, pp. 498)

follow state-dependent pricing. So far, no other study has analysed these dimensions of inflation in a developing country.

3.4 Description of the data

In addition to the Lesotho dataset that was discussed in detail in Chapter 2, we also draw on a price data-set for South Africa. This dataset consists of monthly retail price data for South African products. As is the case with the method of collection for the Lesotho data, Statistics SA (StatsSA) collects the product price data every month from various retail outlets across locations in South Africa. Using the Lesotho and South African data sets, 132 products were mapped and a sample of 192, 705 observations were obtained for the period 2002-2007. Mapping of products between two datasets is advantageous as it includes only prices of nearly homogeneous products sold in stores located in both countries, therefore minimising the bias that can be generated by heterogeneity across products. It involved mapping, for example, the price of 500 ml of cooking oil in both the Lesotho and South African data-sets.

Table 13 presents a description of the summary statistics for the mapped data.

Table 13: Summary statistics by product categories (2002-2007)

PRODUCTCLASS	No. of products	No. of observations	Percent
Food	59	111,758	58.0
non-alcoholic beverages	5	12,104	6.3
alcoholic beverages	4	2,961	1.5
tobacco and narcotics	2	4,553	2.4
clothing and footwear	14	12,147	6.3
Fuel	11	13,933	7.2
household furniture	20	12,910	6.7
household operations	4	8,330	4.3
Health care services	2	1,498	0.8
transport equipment	1	426	0.2
recreation and culture	3	1,821	0.9
personal care	4	7,633	4.0
other goods and services	3	2,631	1.4
Perishable	30	41,520	21.6
non-perishable	38	85,303	44.3
Durable	33	30,413	15.8
non-durable	23	33,582	17.4
Services	6	1,887	1.0
Total	132	192,705	100

The largest proportion of the observations in the sample are food products (58 percent), of which 44 percent are perishable and 22 percent are non-perishable products. Services make up the smallest proportion of the total sample (1 percent). This kind of mapping of products

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between two datasets has the advantage of including only prices of nearly homogeneous products sold in stores located in both countries, therefore minimising the bias that can be generated by substantial heterogeneity across products.

3.5 Empirical analysis

3.5.1 Testing state-dependence: empirical strategy

Based on the theory reviewed in section 3.2, state-dependent pricing models predict that there is a relationship between the frequency of price changes and average retail price inflation, while time-dependent models predict no relationship between the two. A simple test of these two alternative hypotheses is done estimate the following equation:

$$freq_{j,k,t} = \beta_0 + \beta_1 dlp_{j,g,t} + \mu_{j,t} \tag{1}$$

1) $freq_{j,k,t}$ is the average frequency of price change for product k sold across retail outlets across district j at month t . We use the frequency of price change because our analysis is time-based such that we are able to distinguish between the variation in the frequency of price increases and price decreases overtime. The analysis is at the district level based on the assumption that idiosyncratic shocks are common across retailers at the district level.

2) $dlp_{jg,t} = \sum_{i=1}^{I_j} \sum_{i=1}^{k_g} dlp_{ijk,t} = lp_{jg,t} - lp_{jg,t-1}$ is the monthly log of price change estimated at product category g across outlets in district j.[34] In the following sections, this variable is referred to as average retail price inflation. It is product-specific inflation that is computed at the product group level. We use log of price changes at the product group level in order to be able to analyse whether firms' decisions are affected by price changes in a particular market. Product-specific price changes are considered to be a better measure of changes in market

[34]The product categories in this case are as the 16 groups, classified according to the United Nations classification of Individual Consumption According to Purpose (COICOP). See appendix 3B for detailed description of the variables

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conditions as they reflect changes in demand and supply while aggregate price changes ignore the heterogeneity found across products and product groups.

The following hypothesis is tested from equation (1):

$H_0 : \beta_1 > 0 \Rightarrow$ There is evidence of state-dependence pricing

$H_A : \beta_1 = 0 \Rightarrow$ There is evidence of time-dependence pricing

A positive and statistically significant coefficient of average retail price inflation indicates that retailers in Lesotho generally follow state-dependent pricing behaviour, while an insignificant coefficient implies evidence of time-dependent pricing behaviour.

Theories of models of price setting behaviour argue that the frequency of price change can also be influenced by other aspects of retail price inflation. The New Keynesian Phillips Curve (NKPC) approach relates current inflation to expected inflation. However, it has been proved that a pure forward-looking approach fails to generate enough inflation persistence to match the empirical data, (Greenslade and Parker, 2012). Bakhshi, *et al.* (2007) derived a state-dependent Phillips curve that uses a backward looking rule of thumb to set prices from the dynamic stochastic general equilibrium (DSGE) model with state-dependent pricing developed by Dotsey, King and Wolman (1999). Their model assumes that inflation persistence in which current inflation relates to lagged inflation can adequately describe inflation dynamics that are generated in a state-dependent pricing economy.

Following this proposition, inflation persistence is introduced into equation (1), by including the quarterly lagged values of inflation at product group level in the specification below:[35]

$$freq_{j,k,t} = \beta_0 + \beta_1 dlp_{j,g,t} + \beta_1 dlp_{j,g,t-1} + \mu_{j,t} \qquad (2)$$

[35] Lagged inflation also accounts for the potential simultaneity problem arising from the fact that, at this level of disaggregation, inflation as a regressor may be expected to reflect changes in prices occurring at the product group level. More lags are also included in the regression to test if the relationship extent beyond one quarter.

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Product and district dummies are also included to control for unobserved heterogeneity, specific to individual products and districts. Monthly dummies are also included to control for changes in overall inflation and seasonal effects. The specification is as follows:

$$freq_{j,g,t} = \beta_0 + \beta_1 dlp_{j,g,t} + \beta_2 dlp_{j,g,t-1} + \lambda_g + \lambda_j + \lambda_t + \mu_{j,t} \qquad (3)$$

However, the results based on equation (3) may suffer from omitted variable bias as retail price inflation may capture both local and national conditions. The model of sticky prices developed by Mackowiak and Wiederholt (2009a) predict that the frequency of price change can also be affected by either idiosyncratic shocks (conditions that pertain to a particular market) or aggregate shocks (conditions that affect the whole economy). The assumption is that when idiosyncratic conditions are more relevant than aggregate conditions, then firms pay more attention to idiosyncratic conditions and vice versa. Distinguishing between idiosyncratic and aggregate conditions helps to explain the importance of different shocks in firms' price setting decisions.

To account for this theoretical prediction in the empirical analysis, the product group-specific inflation at national level $(dlp\_national)$ is thus included to account for aggregate shocks, such that the product group-specific inflation at district level (*dlp)* accounts for idiosyncratic shock. We include inflation at aggregate level because if it is correlated with the frequency of price change, but we do not account for it in the regression, then the effect of local inflation will be biased upwards since local inflation will be correlated with average retail price inflation at the national level.

One concern with the extended model is the possibility of multi-collinearity between inflation variables. To test for this, several tests are carried out and the results are discussed in the analysis. These include computing correlation coefficients, and the F-test for joint significance and also estimated regressions, including only one measure of inflation.

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The average retail price inflation at national level describes price changes at the national level (national inflation) while the average retail price inflation at district level describes price changes at the local market (local inflation). Equation (3) becomes as follows:

$$freq_{j,g,t} = \beta_0 + \beta_1 dlp_{j,g,t} + \beta_2 dlp_{j,g,t-1} + \beta_3 dlp\_national_{g,t} + \lambda_g + \lambda_j + \lambda_t + \mu_{j,t} \qquad (4)$$

If $dlp\_national > 0$ & $dlp = 0$, then retailers pay more attention to national conditions and not to local conditions;

If $dlp\_national = 0$ & $dlp > 0$, then retailers pay more attention to local conditions and not to national conditions.

The first outcome also suggests that firms cannot make a distinction between local and national conditions because markets are fully integrated. The second outcome also suggests that firms only consider local conditions when markets are not integrated.

If $dlp\_national > 0$ & $dlp > 0$, it means retailers consider both local and national markets and also this outcome might be an indication of markets that are not fully integrated. However, including inflation variables in the same specification (national inflation and inflation at district level) can presents possible collinearity problems. We deal with this as we present the results.

The importance of unexpected inflation in explaining the frequency of price change is stressed in the literature (for example Lach and Tsiddon, 1992; Konieczny and Skrzypacz, 2005). The model of Lucas (1973) suggests that the reason for the differences in the frequency of prices changes across different sectors is the inability of firms to differentiate between aggregate and local shocks due to them having incomplete information about price changes. Firms therefore face a trade-off between paying attention to aggregate conditions and paying attention to idiosyncratic conditions. For example, suppose the nominal price of the good sold at one market is observed only in that market, and the complete history of the

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aggregate price level is observed up to the last period. Then retailers in each market are thus faced with a challenge to figure out how much of the change in their own prices reflects a general price change and how much reflects a change in relative prices. This approach therefore links the frequency of price changes to unexpected inflation.

To control for unexpected inflation in the specification, the Hodrick-Prescott (HP) filter is used to remove the cyclical component (which incorporates any other irregular components) from the trend. The HP filter is considered a standard filter in the business cycle literature because it is able to be applied to non-stationary series.[36] The filter in this case is used to smooth over the sample to decompose overall inflation into the trend component and the cyclical component. The measure of unexpected inflation (un_dlp) is then computed as the ratio of overall unfiltered inflation to the HP-filtered trend term (expected inflation)[37] to and is included in equation (4) to obtain the equation (5):

$$\begin{aligned} freq_{j,g,t} &= \beta_0 + \beta_1 dlp_{j,g,t} + \beta_2 dlp_{j,g,t-1} + \beta_3 dlp\_national_{g,t} \\ &\quad + \beta_4 un\_dlp_{j,g,t} + \lambda_g + \lambda_j + \lambda_t + \mu_{j,t} \end{aligned} \tag{5}$$

If $un\_dlp > 0$, this means that the frequency of price changes in Lesotho is also affected by unexpected conditions, suggesting that firms also take into consideration unexpected shocks in their price setting decision. The coefficient is interpreted as the marginal effect of unanticipated inflation to the frequency of price changes. In this case, $dlp_{j,g,t}$ is unfiltered inflation.

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[36] As suggested in Hodrick and Prescott (1980) for monthly data, we use (µ=14400) as the value of the smoothing parameter. Although the H-P Filter is a commonly used econometric technique, we also use the standard deviation of inflation to further validate our results and find that the results do significantly change. Other alternative methods such as Auto-Regressive Integrated Moving Average (ARIMA) are not appropriate for the inflation data because auto-correlation foes not die exponentially (Gujarati, 1995).

[37] The estimated model then becomes: $freq_{jg,t} = \alpha_0 + \beta_1 \pi + \beta_2 \pi^u + ... + \varepsilon_{j,g}$

3.5.2 The frequency of price change and inflation: empirical results

Figure 10 plots the retail price inflation and the frequency of price change over the sample period March 2002 to December 2009. The diagram shows a co-movement between the frequency of price change and average retail price inflation.

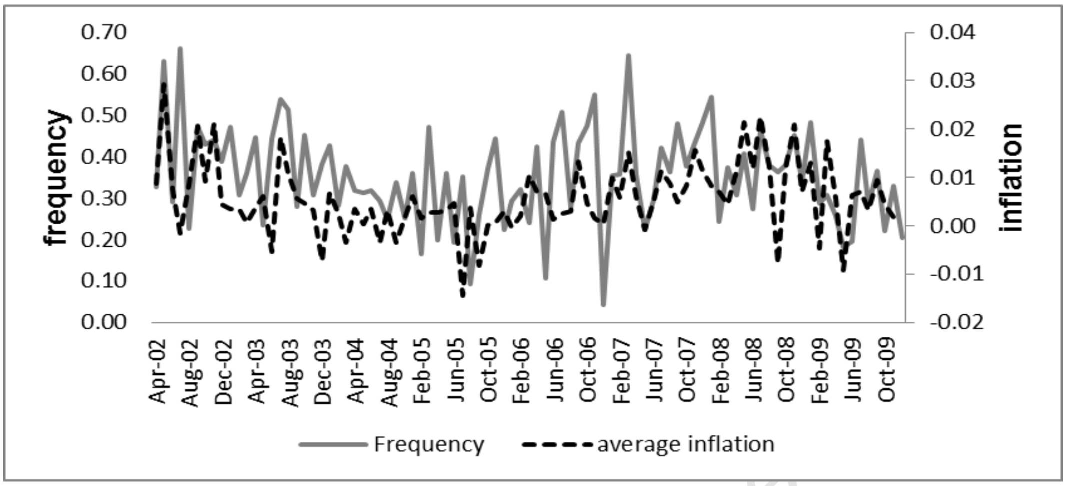

Figure 10: Average monthly frequency of price change and retail price inflation

The average price changes from 2002 gradually decline until mid 2005 and then increases until 2008. This movement follows the trend in the overall inflation rate shown in appendix 2.4. The frequency of price change also declines as inflation falls from 2002-05, but then increases as inflation rises from mid-2005. The diagram therefore provides visual evidence of a positive relationship between average retail price inflation and the frequency of price change in Lesotho. The correlation coefficient between the frequency of price change and retail price inflation is also positive and significant (0.041). To deal with the potential problem of multicollinearity, we use two measures. First, we compute the correlation coefficients between local inflation and national inflation and find that is it 54 percent. [38] This indicates that the two variables are not higly correlated. Second, we compute the joint F-test statistic for equality of coefficients of these two variables based on equation (5). This statistic test the null hypothesis that the two variables are jointly equal to zero. Rejecting the null

[38] See appendix 3.1 (table 3.1.1) for correlation matrix of all the variables used in this section

implies that there is no potential collinearity between the variables. These results show that the two variables are significantly important in the mode and robust to no potential problem of multicollinearity. [39]

Table 14 presents the regression results of the relationship between the frequency of price change and retail price inflation in Lesotho.

Table 14: Estimated regression on the frequency of price change and product inflation

Dependent variable is the average frequency of price change	Coefficient (1)	Coefficient (2)	Coefficient (3)	Coefficient (4)
Inflation Lesotho (dlp)	0.097*** (0.021)	0.112*** (0.019)	0.104*** (0.017)	0.097*** (0.017)
Inflation Lesotho, t-1 (dlp(t-1))		0.106*** (0.019)	0.120*** (0.014)	0.094*** (0.012)
Inflation Lesotho, t-2 (dlp(t-2))		0.063*** (0.011)	0.060*** (0.010)	0.052*** (0.010)
Unexpected inflation (un_dlp)			0.002*** (0.000)	0.002*** (0.000)
National inflation (dlp_national)				0.689*** (0.143)
National inflation, t-1 (dlp_national(t-1))				0.694*** (0.183)
National inflation, t-2 (dlp_national(t-2))				0.581*** (0.126)
National inflation, t-3 (dlp_national(t-3))				0.685** (0.264)
Constant	0.382*** (0.028)	0.368*** (0.018)	0.350*** (0.018)	0.339*** (0.015)
Product group, District and Month dummies	Yes	Yes	Yes	Yes
Observations	358,278	304,870	304,870	304,870
Adj. R-squared	0.18	0.18	0.23	0.23

Notes: The dependant variable is the average frequency of price changes. Column (1) is the basic regression. Column (2) is the basic regression with lagged values of inflation. Column (3) includes unexpected inflation. Column (4) includes national inflation and its lagged values. Robust standard errors in parenthesis below the estimated coefficients are clustered at product group level. *** Significant at 1 percent level ** significant at 5 percent level * significant at 10 percent level.

The first column presents the results of equation (2) where we regress the frequency of price change on average retail price inflation, controlling for unobserved heterogeneity. The results show a significant and positive relationship between the frequency of price change and average retail price inflation. A 1 percentage point increase in average retail price inflation is associated with a 0.10 percentage point increase in the frequency of price change in Lesotho. This result suggests evidence of state-dependent pricing among retailers in Lesotho. Other studies also find a positive relationship between the frequency of price change and retail price inflation both at aggregate and sectoral level. Alvarez and Hernando (2004) find a lower

[39] See appendix 3.1 table 3.1.3 for results on the F-tests on equality of the coefficients

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coefficient of inflation (0.006) for Spanish retailers and similarly Creamer *et al.* (2012) finds a lower coefficient of inflation (0.005) for South Africa while Kovanen (2006) finds a relatively higher finds a greater coefficient (0.77) for Sierra Leone.

Column 2 includes the coefficients of lagged values of inflation which are also positive and significant, suggesting that there is inflation persistence in price setting behaviour. This result reveals that a fraction of retailers in Lesotho are backward-looking in price setting, as predicted by Bakhshi *et al.* (2007). In column 3, we account for unexpected inflation and find that the coefficient is significant and positive. This shows that a 1 percentage point increase in unexpected inflation is associated with a 0.002 percentage point increase in the frequency of price change.[40] This result provides sufficient evidence that retailers in Lesotho also consider unexpected conditions when setting their prices. This result is consistent with the prediction of the incomplete information model of Lucas (1973) that unexpected inflation is positively associated with the frequency of price change. Lach and Tsiddon (1992) also find a stronger positive relationshp (with the coefficient of 0.36) for Israel and Konienczny and Skrzypacz (2005) report a coefficient of 0.10 for the Polish economy.

Column 4 includes national inflation to account for aggregate shocks. First we adress the concern about potential collinerity problem that can arise when we include both local and national inflation in the same regression. The correlation between local inflation and national inflation is high as expected (54.3 percent), suggesting that the two variables are closely related.[41] This shows excluding of one of the variables from the regression might bias the results. However, the F-test of the equality of the coefficients rejects the null hypothesis that

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[40] Similar results are presented in appendix 3.2 where the standard deviation of retail price inflation is used as the alternative measure of unexpected inflation.

[41] See appendix 3.1 (table 3.1.1) for correlation matrix of all the variables used in this section

the two variables are equal, indicating that there should be no concern for multicolinierity. The results are presented in table 3.1.2 of appendix 3.1.

The results from coulumn 4 reveal a positive and significant coefficient, suggesting that the frequency of price changes is also affected by aggregate conditions. A 1 percentage point increase in national inflation is associated with a 0.70 percentage point increase in the frequency of price changes. When national inflation is accounted for, the coefficient of local inflation also falls as expected, given the anticipated bias.

Overall, these results are consistent with the predictions of state-dependent pricing. They reveal the following key features about price setting behaviour in Lesotho First, retailers also consider the history of inflation, suggesting evidence of inflation persistence in price setting behaviour in Lesotho. Second, both local and national inflation are positively correlated with the frequency of price changes. This result provides enough evidence to suggest that markets are not fully integrated in Lesotho as both local and national conditions are correlated with price setting behaviour. In the next section, we test and analyse state-dependent pricing across various sectors.

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The frequency of price change and inflation by product groups

The heterogeneity in the frequency of price changes across and within different products and product groups, is very important in explaining price setting behaviour in Lesotho. However, the result in Table 13 assumes a homogeneous coefficient across sectors, which may not be the same. Yet the relationship between the frequency of price change and retail price inflation can be different within and across product groups due to heterogeneity.

Economic theory predicts that some theoretical models can better explain price setting behaviour in some sectors than in others. For example, in state-dependent pricing models, the presence of variable menu costs across products influences the relationship between the frequency of price changes and retail price inflation differently across different sectors. In the absence of menu costs, firms follow the time-dependent pricing rule. Based on this prediction, it is important to analyse this relationship at the sector level to test which sectors are characterised by state-dependent pricing behaviour and which sectors by time-dependent pricing behaviour. The conclusion from the results will also provide insights into the degree of menu costs across these sectors as predicted by theory. As predicted by menu cost models under state-dependent theory, the higher the menu cost, the stronger the relationship between the frequency of price change and inflation, suggesting that the greater the size of the coefficient of inflation, the higher the costs of changing prices in that sector.

Table 15 presents the results of the estimates for 13 different product categories to analyse the relationship between the frequency of price change and inflation in different sectors.[42] The interesting result is that the relationship between the frequency of price change and inflation differs across product categories, particularly goods and services. This provides sufficient evidence that price setting behaviour differs across different sectors in the case of Lesotho.[43]

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Column 1, for example, shows a positive and significant association between the frequency of price change and inflation in the food sector. A 1 percentage point increase in inflation is associated with a 0.13 percentage point increase in the frequency of price change. The results reveal stronger association between average retail price inflation and the frequency of price change within tobacco and narcotics (0.29), alcoholic beverages (0.25) and fuel (0.20) product groups; and weaker association within non-alcoholic beverages (0.09), clothing and footwear (0.04), household furniture (0.04) and household operations (0.11) sectors. These results show evidence of state-dependent pricing behaviour.

An examination of the services sector shows no association between the frequency of price change and average retail price inflation. In column 13, for example, the coefficient is

[42] In this thesis, product groups/categories are also referred to as sectors. Other sectors were excluded because of insufficient observations.
[43] The month fixed effects are included in this case to also capture national inflation.

statistically insignificant, implying that there is no association between the frequency of price change and average retail price inflation in the education services sector. Similarly, the results in columns 9, 11, and 13 indicate that there is no significant association between the frequency of price change and retail price inflation in the medical care, transport, recreation and culture sectors respectively. These results provide evidence of time-dependent pricing behaviour.

The coefficient on inflation within the transport equipment sector is also not statistically significant, suggesting that retailers in this sector follow time-dependent pricing behaviour. The composition of products in this sector comprises durable goods and therefore prices are not flexible enough to respond to changes in inflation. Similarly, other goods and services reveal evidence of state-dependence which suggest that the composition of products in this sector might be dominated by goods rather than services.

These results also provide insight concerning the presence of menu costs as the main source of state dependence in the relationship between inflation and the frequency of price changes. Dotsey *et al.* (1999) predict that the degree to which the frequency of price change responds to inflation depends on the size of the menu costs. Firms with low menu costs change prices more frequently as inflation increases. This implies that the size of the coefficient of local inflation may be related to the size of menu costs, that is, larger coefficients of inflation suggest lower menu costs. The results depicted in Table 15 suggest that the cost of changing prices for fuel products is lower than the cost of changing prices for food products. This is consistent with the fact that fuel prices are regulated in Lesotho and the costs of changing prices are to a large extent borne by the regulator than the outlets themselves. Similarly for services, the results imply that menu costs are not relevant in terms of the response of the frequency of price changes to inflation since services follow time-dependent pricing.

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Given the foregoing, the results reveal the following key features. Firstly, the relationship between the frequency of price changes and inflation differs for different product groups. Goods are generally characterised by state-dependent pricing and services by time-dependent pricing. Secondly, menu costs are generally lower for luxury goods (alcoholic beverages, tobacco and narcotics) and higher for basic goods (food, clothing and footwear, and household operations). This has important implications for consumer welfare.

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Table 15: Estimated regressions of frequency of price changes and inflation by product categories

Dependent variable is the average frequency of price change	Food (1)	Non-alcoholic beverages (2)	Alcoholic beverages (3)	Tobacco and narcotics (4)	Clothing and footwear (5)	Fuel (6)	h/h furniture and equipment (7)
Inflation Lesotho (dlp)	0.131***	0.086***	0.249***	0.291***	0.044***	0.199***	0.045***
	(0.011)	(0.030)	(0.085)	(0.074)	(0.016)	(0.059)	(0.016)
Inflation Lesotho, t-1 (dlp(t-1))	0.086***	0.137**	-0.190**	0.054	0.030	0.051	0.057**
	(0.019)	(0.053)	(0.086)	(0.100)	(0.029)	(0.070)	(0.026)
Unexpected inflation (un_dlp)	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.458***	0.457***	0.358***	0.648***	0.135***	0.523***	0.548***
	(0.009)	(0.029)	(0.135)	(0.047)	(0.034)	(0.033)	(0.043)
Product, District and Month dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	164,587	19,199	4,392	8,235	30,587	18,386	26,011
Adj. R-squared	0.24	0.29	0.28	0.34	0.18	0.21	0.30

Dependant variable is the average frequency of price change	h/h operations (8)	Medical care services (9)	Transport equipment (10)	Transport services (11)	Recreation and culture (12)	Education (13)	other goods and services (14)
Inflation Lesotho (dlp)	0.113***	0.053	0.256	0.084	0.087	0.028	0.099***
	(0.024)	(0.052)	(0.196)	(0.104)	(0.040)	(0.037)	(0.031)
Inflation Lesotho, t-1 (dlp(t-1))	0.128***	0.026	-0.045	0.001	-0.052	0.016	0.155***
	(0.043)	(0.077)	(0.438)	(0.152)	(0.063)	(0.034)	(0.055)
Unexpected inflation (un_dlp)	0.002***	0.002	0.006	0.003	0.002	0.001	0.002***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.219***	0.063*	-0.111**	0.113	0.025	-0.002	0.391***
	(0.019)	(0.033)	(0.043)	(0.083)	(0.017)	(0.003)	(0.049)
District and Month dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	21,914	3,660	698	574	4,756	1,972	11,374
Adj. R-squared	0.30	0.33	0.31	0.50	0.32	0.69	0.25

Notes: The dependent variable is the average frequency of price change. These specifications include district and month fixed effects. *** Significant at 1 percent level ** Significant at 5 percent level * significant at 10 percent level. Robust standard errors are in parenthesis below the estimated coefficients.

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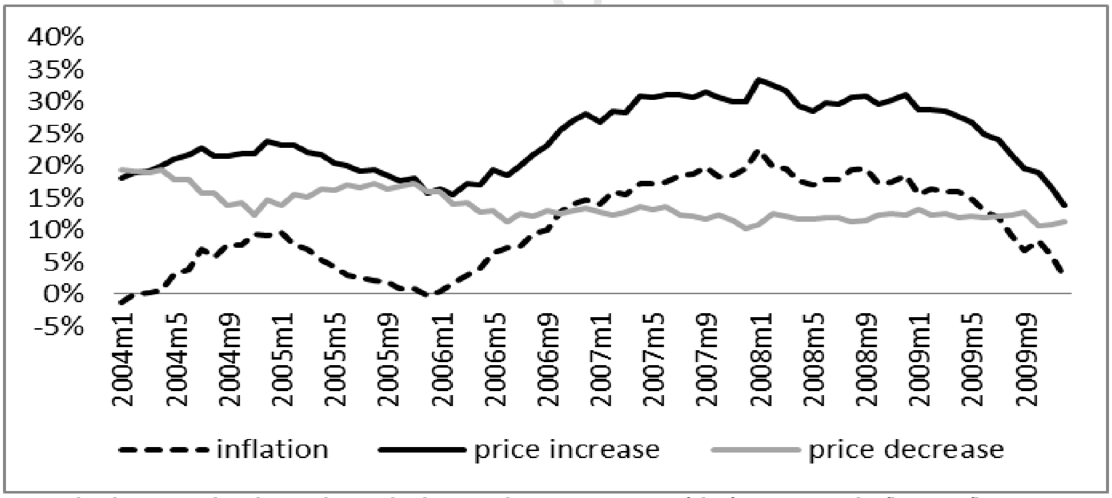
3.5.3 The frequency of price increases and decreases

In the previous sections, we analysed the relationship between inflation and the frequency of price changes. The drawback of using price changes is that it combines both price increases and price decreases, and will hide underlying heterogeneity between price increases and price decreases. Distinguishing between the frequency of price increases and price decreases will eliminate possible bias related to firms that increase prices and those that reduce prices.

Evidence has shown that inflation co-moves with the frequency of price increases and price decreases and not with the size of price increases and price decreases. This result is consistent with the prediction of state-dependent pricing models but not time-dependent pricing models. Klenow and Kryvtsov (2008), Nakamura and Steinsson (2008) and Gagnon (2009) also relate the frequency of price increases and decreases to inflation. They find that inflation correlates most with the frequency of price increases. In this section, we explore this theoretical prediction further to determine whether it holds in the case of Lesotho.



Notes: This diagram is plotted using the weighted 12-month moving averages of the frequencies and inflation. Inflation was computed as the month-to-month average price changes at the sector level.

Figure 11: Inflation and frequency of price increases and price decreases (2004-2009)

Figure 11 plots the evolution of the monthly frequency of price increases and decreases along with the average inflation rate from 2002 to 2009. The frequency of price increases displays a stronger association with average price inflation per sector than the frequency of price decreases. The correlation coefficient with inflation is higher for price increases (0.8 percent) than for price decreases (-0.62 percent). It is therefore expected that the sign of the coefficient of inflation will be positive for the frequency of price increases and negative for the frequency of price decreases.

This relationship is tested through regression analysis using similar explanatory variables to those in equation 4 but with the frequency of price increases and price decreases being the dependent variables as presented below:

$$freq^{+}_{jk,t} \Big/ freq^{-}_{jk,t} = \beta_0 + \beta_1 dlp_{j,g,t} + \beta_2 dlp_{j,g,t-1} + \beta_3 dlp\_national_{g,t} \\ + \beta_4 un\_dlp_{j,g,t} + \lambda_g + \lambda_j + \lambda_t + \mu_{j,t} \tag{6}$$

$freq^{+}_{jk,t}$ *for frequency of price increase*

and

$freq^{-}_{jk,t}$ *for frequency of price decrease*

Table 16 presents the results for both the frequency of price increases and price decreases.

Table 16: Estimated regressions of the frequency of price increase, price decrease and inflation

Dependent variable	Price increase (1)	Price increase (2)	Price decrease (3)	Price decrease (4)
Inflation Lesotho (dlp)	1.304***	1.287***	-1.091***	-1.094***
	(0.172)	(0.171)	(0.128)	(0.131)
Inflation Lesotho, t-1 (dlp(t-1))	0.128***	0.117***	-0.021	-0.011
	(0.031)	(0.027)	(0.034)	(0.035)
Inflation Lesotho, t-2 (dlp(t-2))	0.058***	0.047***	0.004	0.001
	(0.010)	(0.010)	(0.018)	(0.018)
Unexpected inflation (un_dlp)		0.002***		0.002***
		(0.000)		(0.000)
National inflation (dlp_national)		0.999***		-0.406**
		(0.122)		(0.144)
National inflation, t-1 (dlp_national(t-1))		0.529***		0.152**
		(0.151)		(0.064)
National inflation, t-2 (dlp_national(t-2))		0.645***		0.037
		(0.128)		(0.067)
National inflation, t-3 (dlp_national(t-3))		0.524**		0.111
		(0.217)		(0.094)
Constant	0.183***	0.155***	0.195***	0.179***
	(0.017)	(0.012)	(0.009)	(0.009)
Product group, District and Month dummies	Yes	Yes	Yes	Yes
Observations	304,870	304,870	304,870	304,870
Adj. R-squared	0.20	0.23	0.21	0.24

Notes: The dependant variable is the average frequency of price decreases, shown in columns (1) and (2) and as shown in columns (3) and (4) the average frequency of price increases. Clustered and robust standard errors are in parenthesis below the estimated coefficients. *** Significant at 1 percent level ** significant at 5 percent level * significant at 10 percent level

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The results reveal a strong significant relationship between the frequency of price increases and price decreases and average retail price inflation. The regression coefficient of average retail price inflation on the frequency of price increase is positive and statistically significant, while the coefficient on the frequency of price decreases is negative. A 1 percentage point increase in retail price inflation is associated with a 1.3 percentage point increase in the frequency of price increases and a 1.1 percentage point decrease in the frequency of price decreases.

The results also show that the relationship between retail price inflation and frequency of price changes is stronger with price increases than with price decreases, indicating asymmetry in price setting. This suggests that retail price inflation is an important determinant of the frequency of price increases than it is of the frequency of price decreases. These results also provide evidence of state-dependent pricing according to Dotsey *et al.* (1999). An explanation for this result could be that the frequency of price increases covaries more with shocks to the price level than the frequency of price decreases (drawing on Nakamura and Steinsson, 2008).[44]

These results also reveal evidence of heterogeneity across price increases and price decreases in Lesotho as indicated by a much lower (0.097) coefficient of the frequency of price changes (in column 4 of Table 13) than the sum of the coefficients for price increases and price decreases (0.193) in Table 15.[45] Although the standard errors do not indicate that the frequency of price increases is significantly different from the frequency of price decreases, the combination of the two as related in table 13 and in table 15 suggests that the

[44] Nakamura and Steinsson (2008) indicated that greater covariance of the frequency of price increases than the frequency of price decreases is a outcome of the fact that the price level is drifting upward. Positive inflation implies that the distribution of relative prices is asymmetric with many more prices bunched toward the lower sS bound than the upper sS bound.
[45] The frequency of price change only reflects the net relationship between retail price inflation and the frequency of price increases and price decreases.

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measure of the relationship between inflation and the frequency of price increases is greater than the reductions in the frequency of price decreases.

Several other studies also find asymmetry in price setting behaviour. Nakamura and Steinsson (2008), for example, find lower coefficients for the relationship inflation between the frequency of price increases (0.96 and 0.56) than for the relationship between inflation and the frequency of price decreases (-0.22 and -0.36), for the periods 1988-1997 and 1998-2005 respectively, using US data. Carstensen and Schenkelberg (2011) report relatively higher coefficients for Germany (14.92 for the relationship between inflation and the frequency of price increases and -8.07 for the relationship between inflation and the price decreases). Creamer *et al.* (2012) report much lower coefficients for the frequency of price increases (0.005) but do not report results for the relationship between inflation and the frequency of price decreases.

Overall, the results in this section reveal the following key features about price increases and price decreases. Firstly, the relationship between inflation and the frequency of price increases and price decreases shows evidence of state-dependent pricing. Secondly, evidence points to possible asymmetry where the frequency of price increases covaries more with shocks to the price level than the frequency of price decreases. This result provides important insight onto firm price setting behaviour in the presence of increasing inflation. That is, when inflation increases, a significant fraction of firms increase their prices while a smaller fraction reduce prices or keep them unchanged.

The analysis now shifts to an investigation of the role of regional price inflation (South African price inflation) on the price setting behaviour of Lesotho retail firms.

3.6 SA inflation dynamics and the frequency of price changes in Lesotho

The main objective of this section is to analyse the importance of the influence of regional conditions on the frequency of price changes in Lesotho, using price data from South Africa.

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This is because Lesotho, is a small open economy, a member of the monetary and customs union with South Africa, and net importer of South African products, and is thus likely to be affected by external shocks from South Africa.

3.6.1 Background

Changes in economic conditions in South Africa are important in explaining the frequency of price changes in Lesotho. This is firstly because Lesotho is dependent on imports from South Africa (Wang *et al*., 2007). Most Lesotho's imports (around 80 percent) come from South Africa, and these will naturally bring them South Africa's inflation and market price fluctuations.

Secondly, Lesotho's retail sector is strongly dominated by South African companies (banks, restaurants, supermarkets and clothing and footwear stores). This implies South African markets are highly likely to influence price changes in Lesotho's retail markets.

Finally, Lesotho and South Africa are both members of the same customs union (Southern African Customs Union) and monetary union (Common Monetary Area).[46] Under SACU, Lesotho imports its goods from South Africa duty-free, while under the CMA, Lesotho has pegged its domestic currency to South Africa's Currency (Rand). This means that the Rand's fluctuations against major currencies have a direct impact on Lesotho's economy.

Under the CMA therefore, virtually all monetary policy decisions in Lesotho are determined by the South African Reserve Bank (SARB). Lesotho essentially adopts the monetary policy of South Africa. This implies that the Central Bank of Lesotho (CBL) does not have influence over interest rates or exchange rates in Lesotho. Its main objective is to achieve and maintain price stability, but it does not have a domestic inflation target. Lower inflation is therefore maintained through the exchange rate peg with the Rand by constraining the scope for excessive monetary expansion. Domestic interest rates also follow those in

[46] The Common Monetary Area (CMA) began as the Rand Monetary Area (RMA) in 5 December 1974 and was replaced by CMA in April 1986.

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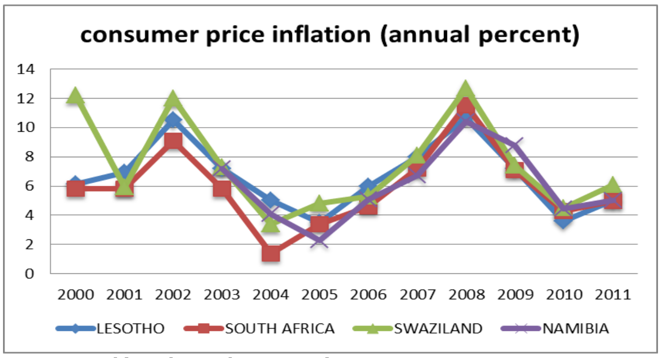
South Africa but the CBL can use Open Market Operations (OMO) to influence overall monetary and credit conditions, but their use is constrained by the need to maintain the peg.

As a result, Lesotho's inflation rate is closely linked to South Africa's inflation rate (and other CMA member countries). Figure 12 plots the annual aggregated inflation rates of the CMA countries for the period 2000 to 2011.



Source: World Bank Development Indicators

Figure 12: Inflation rate for CMA countries

The diagram indicates that price movements within the CMA countries over the past decade have tracked each other closely. The co-movement in inflation rates suggests a high degree of integration between Lesotho and South Africa (and other CMA countries). But aggregate inflation as a macroeconomic variable is an aggregate measure of price changes at a unit level and therefore may disguise different underlying patterns of price changes such as nominal price rigidities, which are important in explaining the relationship between inflation and price setting behaviour at the most basic level.

Thus there is need for a case study using disaggregated product level prices to analyse if markets are integrated between Lesotho and South Africa. The expectation is that if markets are integrated, only regional conditions will be strongly related to the frequency of price change in Lesotho. This is because if markets are fully integrated firms will view Lesotho and South Africa as one market, and will not be able to distinguish between domestic and regional conditions. But if local conditions also determine price setting behaviour in

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Lesotho, this implies that markets are not fully integrated between Lesotho and South Africa. We test this relationship in the following sections.

3.6.2 Descriptive statistics: comparison between Lesotho and South Africa

In this section, the data sets for Lesotho and South Africa are used to obtain a series of nearly homogeneous products. We compare the cross-sectional series on the frequency of price changes across product groups in Lesotho and in South Africa as presented in Table 17.

Table 17: Frequency of price changes: Comparison between Lesotho and South Africa (2002-2007)

	frequency of price change		frequency of price increase		frequency of price decrease	
SUB-CATEGORY	**LESOTHO**	**SOUTH AFRICA**	**LESOTHO**	**SOUTH AFRICA**	**LESOTHO**	**SOUTH AFRICA**
perishable	44.9%	19.5%	27.0%	12.6%	17.0%	6.9%
non-perishable	36.8%	17.8%	22.6%	11.3%	13.5%	6.5%
durable	33.3%	10.9%	19.2%	7.0%	13.4%	3.9%
non-durable	37.3%	14.9%	22.3%	9.8%	14.1%	5.1%
services	34.8%	8.3%	19.3%	8.0%	14.4%	0.3%

The following key features are noted from the table. Firstly, the frequency of price changes, price increases and price increases in Lesotho is almost twice more than that in South Africa. This holds for all the categories except for durables and services which display much lower frequencies. Secondly, the results reveal evidence of substantial heterogeneity in the frequency of price changes between Lesotho and South Africa across product groups. For example, the frequency of price changes for perishable products in Lesotho is 44.9 percent whereas in South Africa it is 19.5 percent.

The frequency of price changes between Lesotho and South Africa also varies over time. Figure 13 displays the trends in the frequency of price changes in Lesotho and South Africa.

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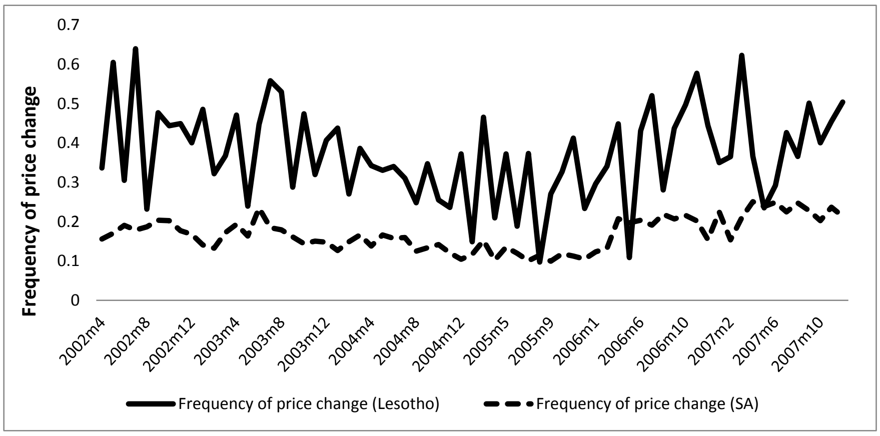

Figure 13: The frequency of price changes (2002-2007)

From the results depicted in Figure 13, we can note the following key features. First, the frequency of price changes in Lesotho is more unstable than in South Africa over the period of analysis. Secondly, it is higher than that of South Africa throughout the period of analysis. These two observations suggest that while inflation at the aggregate level is similar between Lesotho and South Africa, the micro price data show evidence of substantial heterogeneity in the frequency of price changes between the two countries. This diagram may also reflect the fact that markets are not fully integrated between Lesotho and South Africa. Therefore, it is important to explore the relationship using the disaggregated retail level data.

3.6.3 Empirical results

Evidence detailed in this study suggests integrated markets between Lesotho and South Africa at the aggregate level. It is therefore justifiable to assume that price setting behaviour in Lesotho is not only related to inflation in Lesotho, but also to inflation in South Africa at the micro level. However, the micro price data reveals that the frequency of price changes in Lesotho is different from that in South Africa (in Figure 13). Therefore if regional conditions such as inflation and price setting behaviour in South Africa are not controlled for, then the regression in section 3.5 may suffer from omitted variable bias. If the coefficients of national and regional inflation are different, this may be an indication of market integration between

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the two countries. We account for these regional conditions by including product-specific inflation estimated at product group level and the frequency of price change in South Africa. The specification is as follows:

$$\begin{aligned} freqles_{j,k,t} = {} & \beta_0 + \beta_1 dlp\_les_{j,g,t} + \beta_2 dlp\_les_{j,g,t-1} + \beta_3 dlp\_sa_{g,t} \\ & + \beta_4 dlp\_sa_{g,t-1} + \beta_5 freqsa_{g,t} + \beta_6 freqsa_{g,t-1} + \beta_7 un\_dlp_{j,t} \\ & + \beta_8 dlp\_national_{g,t} + \lambda_g + \lambda_j + \lambda_t + \mu_{j,t} \end{aligned} \tag{7}$$

Where:

$freqsa_{g,t} =$ Average frequency of price change in SA in period t

$freqsa_{g,t-1} =$ Average frequency of price change in SA in period t - 1

$dlp\_les_{j,g,t} =$ Retail price inflation in Lesotho in period t

$dlp\_les_{j,g,t-1} =$ Retail price inflation in Lesotho in the period t - 1

$dlp\_sa_{g,t} =$ Retail price inflation t in SA in period t

$dlp\_sa_{g,t-1} =$ Retail price inflation in SA in the period t - 1

$dlp\_sa_{g,t-2} =$ Retail price inflation in SA in the period t - 2

However, the concern again in this case is the potential collinearity problem due to inclusion of local inflation, national inflation and regional inflation. The correlation coefficients between local inflation and regional inflation (3 percent) and between national inflation and regional inflation (8 percent) are very low, indicating that there is not much correlation between the variables. [47] We also use the joint F-test statistics for equality of coefficients, based on equation (7), and the results do not indicate any potential collinearity between the variables.[48]

[47] See appendix 3.1, table 3.1.2 for the correlation coefficients
[48] See appendix 3.1, table 3.1.3 for the correlation coefficients

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Table 18 presents the estimated results of the examination of the relationship between inflation dynamics in Lesotho and South Africa and the frequency of price changes in Lesotho.

Table 18: Frequency of price change and inflation in Lesotho and SA

dependent variable is the frequency of price change in Lesotho	Coefficient (1)	Coefficient (2)	Coefficient (3)	Coefficient (4)
Inflation Lesotho (dlp_les)	0.164***	0.168***	0.176***	0.159***
	(0.046)	(0.039)	(0.036)	(0.035)
Inflation South Africa (dlp_sa)	0.251	0.263	0.120	0.107
	(0.128)	(0.131)	(0.080)	(0.078)
Inflation Lesotho, t-1 (dlp_les(t-1))		0.083**	0.091**	0.086**
		(0.031)	(0.036)	(0.035)
Inflation South Africa, t-1 (dlp_sa(t-1))		0.349***	0.250**	0.243**
		(0.111)	(0.109)	(0.109)
Unexpected inflation (un_dlp)			0.003***	0.003***
			(0.000)	(0.000)
Frequency South Africa (freqsa)			0.132***	0.130***
			(0.028)	(0.028)
Frequency South Africa, t-1 (freqsa(t-1))			0.084***	0.085***
			(0.017)	(0.017)
Frequency South Africa, t-2 (freqsa(t-2))			0.037*	0.037*
			(0.018)	(0.018)
National inflation (dlp_national)				0.156***
				(0.027)
Constant	0.360***	0.125***	0.486***	0.485***
	(0.032)	(0.010)	(0.019)	(0.019)
Product group, district and month fixed effects	Yes	Yes	Yes	Yes
Observations	148,807	134,112	131,663	131,663
Adj. R-squared	0.11	0.11	0.20	0.20

Notes: The dependent variable is the average frequency of price change. *dlp_les* represents local inflation in Lesotho; *dlp_sa* represents regional inflation while *dlp_national* represents national inflation in Lesotho. *** Significant at 1 percent level ** Significant at 5 percent level * significant at 10 percent level. Robust standard errors in parenthesis below the estimated coefficients are clustered at product group level.

In column 1, the frequency of price change is regressed on retail price inflation in Lesotho and in South Africa at the product group level, controlling for the product group, month and district fixed effects. The coefficient of inflation in Lesotho is positive and highly significant. A 1 percentage point increase in inflation at product level is associated with a 0.16 percentage point increase in the frequency of price change. This confirms a positive relationship between the frequency of price change and inflation in Lesotho, providing evidence of state dependent pricing. The coefficient of retail price inflation in South Africa is, however, not statistically significant, suggesting that when we consider all product groups in the sample, price setting behaviour in Lesotho is not associated with external conditions from South Africa.

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In column 2, the lagged values of inflation in Lesotho and in South Africa are included to account for inflation persistence in price setting. The coefficient of lagged inflation in Lesotho is positive and highly significant, suggesting backward looking behaviour in price setting as retailers do not only consider current inflation, but also the history of inflation when setting prices. Column 2 also includes the lagged value of inflation in South Africa. Contrary to the effect of current average retail price inflation in South Africa, the coefficient of the lagged value of inflation in South Africa is highly significant and positive. This suggests a delayed adjustment of price setting behaviour in Lesotho to price changes in South Africa. The transmission of South African price shocks to Lesotho price setting behaviour is not immediate. This delayed pass-through is common for many developing countries (Flamini, 2004).

In column 3, the results are estimated, including the frequency of price change in South Africa. The coefficient is positive and highly significant, showing that a 1 percentage point increase in the frequency of price changes in South Africa is associated with a 0.13 percentage point increase in the frequency of price changes in Lesotho. Column 3 also includes the lagged value of the frequency of price change in South Africa, and similarly, the coefficient is positive and highly significant. This result shows that there is a strong correlation between Lesotho and South African product markets, suggesting integrated markets between the two economies. This result points to a close linkage between Lesotho and South African product markets due to dominance of South African chain stores in Lesotho retail industry.

Column 4 includes the coefficient of national inflation to account for Lesotho's domestic aggregate shocks. The coefficient is significant and positive: A 1 percentage point increase in national inflation is associated with a 0.156 percentage point increase in the

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frequency of price change in Lesotho. This result suggests that price setting behaviour in Lesotho is influenced by local conditions, but also by national and regional conditions.

Given the foregoing, the results reveal the following key features: Firstly, regional conditions drive price setting behaviour in Lesotho, but with delayed pass-through effects. Secondly, South African retail markets also drive price setting behaviour in Lesotho. Finally, markets are not perfectly integrated between Lesotho and South Africa as the effect of local markets on price setting behaviour is also strong.

However, because of the heterogeneity across sectors that was highlighted in Table 14, these results could imply that transmission mechanism could be different in specific sectors. We analyse this relationship for different product groups. If the results are different in different sectors, this would imply that the outcomes depicted in Table 17 could be largely influenced by the fact that the degree of integration differs according to the tradability of products.

Table 19 presents the results of the regressions of inflation and the frequency of price change by product groups. The product groups comprise: Food products which are categorised into perishables and non-perishables, non-food products which are categorised into durables and non-durables, and services. Splitting the analysis by product group provides important insight into the response of the frequency of price change to shocks and how this differs between tradables or non-tradables.

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Table 19: Estimated frequency of price changes and inflation between Lesotho and SA product categories

dependent variable is the frequency of price change in Lesotho	Perishables (1)	Non-perishables (2)	Durables (3)	Non-durables (4)	Services (5)
Inflation Lesotho (dlp_les)	0.125***	0.265***	0.068**	0.133***	0.105
	(0.044)	(0.049)	(0.027)	(0.043)	(0.077)
Inflation South Africa (dlp_sa)	0.102	0.268**	0.003	0.270**	0.419
	(0.082)	(0.108)	(0.086)	(0.135)	(11.927)
Inflation Lesotho, t-1 (dlp_les(t-1))	0.072	0.074	0.004	0.127**	0.121
	(0.055)	(0.053)	(0.047)	(0.063)	(0.180)
Inflation South Africa, t-1 (dlp_sa(t-1))	0.060	0.423***	0.170*	0.719***	8.944
	(0.080)	(0.113)	(0.099)	(0.136)	(12.762)
Unexpected inflation (un_dlp)	0.003***	0.005***	0.002***	0.003***	0.002*
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Frequency South Africa (freqsa)	0.215***	0.125***	0.041**	0.058***	0.351***
	(0.022)	(0.016)	(0.032)	(0.022)	(0.597)
Frequency South Africa, t-1 (freqsa(t-1))	0.047**	0.079***	0.071**	0.067***	2.490
	(0.024)	(0.017)	(0.031)	(0.022)	(1.776)
Frequency South Africa, t-2 (freqsa(t-2))	0.013	0.039**	0.035	0.070***	0.802***
	(0.022)	(0.016)	(0.030)	(0.021)	(0.352)
National inflation (dlp_national)	0.163**	0.083	0.051	0.301***	0.374
	(0.067)	(0.077)	(0.068)	(0.083)	(0.474)
Constant	0.490***	0.399***	0.411***	0.281***	-0.484
	(0.037)	(0.017)	(0.039)	(0.031)	(0.321)
Product, district and month fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	26,300	64,267	15,922	23,624	1,550
R-squared	0.23	0.22	0.26	0.20	0.35
Adj. R-squared	0.23	0.22	0.26	0.20	0.32

Notes: In column 1, the dependent variable is the average frequency of price change for perishable products, in column 2 for non-perishable products; column 3 is durable products; column 4 is non-durable products and; column 5 is for services. *dlp_les* represents local inflation in Lesotho; *dlp_sa* represents regional inflation. *** Significant at 1 percent level ** Significant at 5 percent level * significant at 10 percent level. Robust and clustered standard errors are in parenthesis below the estimated coefficients.

Column 1 presents the results for the frequency of price changes for perishable products. The results show a positive significant relationship between the frequency of price changes and inflation for the perishable products sector. A 1 percentage point increase in local inflation is associated with a 0.12 percentage point increase in the frequency of price change for perishable products.

The coefficient of retail price inflation in South Africa is insignificant, suggesting that retailers that sell perishable products do not consider external shocks from South Africa when setting their prices. However, in South African markets, the frequency of price changes for perishable products is positive and significant. This suggests that prices for perishable products are not affected by inflationary shocks from South Africa but are largely influenced by the price setting decisions of retailers in South Africa. The similar frequency between the two countries could possibly also reflect seasonality.

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This result also provides insight into terms of tradability of perishables products, which is a function of trade costs and barriers. The more tradable the product is, the more we would anticipate price setting behaviour in Lesotho to be correlated with market conditions in South Africa and also nationally. This suggests that local supply and demand conditions are important for perishables in Lesotho. This result provides evidence that perishable products may be tradable across districts but not between Lesotho and South Africa. Transport costs are likely to be the main barrier for integration of markets for perishables, because these are more difficult to store and transport than non-perishable products.

Column 2 presents the results for the frequency of price changes and retail price inflation for non-perishable products. In this case, the coefficients for retail price inflation in both Lesotho and South Africa. Their lagged values are positive and significant. This indicates that for non-perishable products, price setting behaviour in Lesotho is highly associated with inflationary shocks and price setting behaviour in South African markets for non-perishable products. It is also apparent that shocks from South Africa filter through immediately to Lesotho price setting behaviour for non-perishable products, which is an indication of strong market integration between these sectors in the two countries. This result suggests that non-perishables are more tradable between Lesotho and South Africa because they are not susceptible to spoilage. This conclusion is consistent with the fact that local supply is not sufficient to meet demand in Lesotho. Hence we would anticipate a closer relationship with South African inflation than with local inflation for non-perishables.

Column 3 depicts the frequency of price changes in Lesotho for durable products. This is not correlated with inflation or price setting behaviour in South Africa and also aggregate conditions in Lesotho. This suggests that durable products may not be tradable across districts and regions.

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Column 4 presents the results for the frequency of price changes and retail price inflation for non-durable products. In this case, all the coefficients are significant, showing that in the non-durable sector in Lesotho, local, national, and regional conditions drive price setting decisions.[49] This result confirms that for non-durables, price setting behaviour is influenced by local, aggregate and regional shocks, indicating that non-durable products are also highly tradable between Lesotho and South Africa. Similarly in this case, shocks from South Africa filter through immediately into Lesotho price setting behaviour for non-durable products, which is an indication of strong market integration between the two countries in these sectors.

Column 5 presents the regression results for services and the coefficients of local inflation and regional inflation are insignificant. Interestingly, for services, the frequency of price change in South Africa is strongly correlated (0.35) with price setting behaviour in Lesotho. This probably reflects the tendency among retailers to change prices annually in both countries, during the same month.

Overall, these results add up to the following key conclusions about the relationship between price setting behaviour in Lesotho and average retail price inflation across product groups. Firstly, response to regional shocks differs according to the tradability of the sector. More tradable sectors (non-perishable and non-durable products) respond to both regional inflation and price setting in South Africa, while less tradable products (durable and perishable products) respond to price setting behaviour in South Africa and not to inflation. Price setting behaviour in the services sector does not respond to shocks. This suggests that for non-tradable products, pricing decisions in South Africa drive price setting behaviour in Lesotho, not inflationary shocks. This relationship could be reflected through similar pricing strategies, distribution networks between Lesotho subsidiaries and their South African

[49] See table 3.3 in appendix 3 for the results of 16 disaggregated product groups

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counterparts. Secondly, the tradability of products has implications for the degree of market integration between Lesotho and South Africa. The results suggest that market are more integrated for non-perishable and non-durable products than for durable and perishable products, while markets are not integrated in the services sector. Finally, the results also reveal that after accounting for regional conditions, the sector is characterised by state-dependence while the services is characterised by time dependence.

In the following section, we distinguish between the frequency of price increases and price decreases, controlling for regional conditions. Table 20 presents the results.

Table 20: Inflation, frequency of price increases and price decreases between Lesotho and SA

dependent variable is the frequency of price change in Lesotho	Price increase (1)	Price increase (2)	Price decrease (3)	Price decrease (4)
Inflation Lesotho (dlp_les)	1.320***	1.302***	-1.156***	-1.142***
	(0.216)	(0.197)	(0.172)	(0.163)
Inflation South Africa (dlp_sa)	0.335**	0.127	-0.083	-0.020
	(0.137)	(0.124)	(0.055)	(0.072)
Inflation Lesotho, t-1 (dlp_les(t-1))		0.093***		-0.006
		(0.021)		(0.023)
Inflation South Africa, t-1 (dlp_sa(t-1))		0.288***		-0.045
		(0.086)		(0.075)
Unexpected inflation (un_dlp)		0.002***		0.002**
		(0.000)		(0.000)
Frequency South Africa (freqsa)		0.112***		0.018
		(0.024)		(0.011)
Frequency South Africa, t-1 (freqsa(t-1))		0.031**		0.053*
		(0.018)		(0.009)
National inflation (dlp_national)		0.754***		-0.598***
		(0.055)		(0.038)
Constant	0.271***	0.367***	0.089***	0.118***
	(0.025)	(0.021)	(0.012)	(0.018)
Product group, district and month dummies	Yes	Yes	Yes	Yes
Observations	148,807	131,663	148,807	131,663
Adj. R-squared	0.21	0.25	0.23	0.27

Notes: *dlp_les* represents local inflation in Lesotho; *dlp_sa* represents regional inflation while *dlp_national* represents national inflation in Lesotho. *** Significant at 1 percent level ** Significant at 5 percent level * significant at 10 percent level. Robust standard errors in parenthesis below the estimated coefficients are clustered at product group level.

Columns 1 and 2 present the results of an analysis of the frequency of price increases while columns 3 and 4 present the results of the examination of the frequency of price decreases. The results point to the following key features. Firstly, the coefficient of local inflation is significant and positive, as shown in columns 3 and 4, suggesting a positive association between local inflation and the frequency of price increases. Similarly, the coefficient of local inflation is negative (detailed in columns 1 and 2), showing a negative association between local retail price inflation and the frequency of price decreases. Secondly, the coefficient of

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the lagged values of local inflation and inflation in South Africa are positive and significant for the frequency of price increase but insignificant for the frequency of price decreases.[50] This implies that the frequency of price increase is also associated with past values of inflation. Thirdly, national inflation is significantly associated with the frequency of price increases and decreases. Finally, the coefficient of the frequency of price change in South Africa and its lagged value is positive and significant for price increases while it is insignificant for the price decreases. Overall, the frequency of price increases is significantly associated with South African price dynamics while the frequency of price decreases is not.

3.7 Conclusion and policy implications

This chapter investigated the extent to which the price setting behaviour of individual retail outlets in Lesotho is influenced by local, national and regional inflation dynamics.

First, we tested state-dependence in price setting by regressing the frequency of price change on retail price inflation, which is estimated as price changes at the product group level. The results reveal that in the services sector price setting is unrelated to inflation (recreation, education, medical care) but this is positive and significantly related in most goods sectors (food, fuel, clothing and footwear). This indicates that goods sectors are generally characterized by state-dependent pricing behaviour, whereas services are generally characterized by time dependent pricing behaviour. Evidence of state-dependence is found to be stronger in basic goods (food and clothing) than in luxury goods (alcoholic beverages and tobacco).

This result also explains the relative importance of menu costs in driving price setting behaviour across firms in Lesotho. It suggests that menu costs are higher for basic goods than for luxury goods and not relevant for services.

[50] The results do not change even when we regress on the frequency of price increases and price decreases for SA.

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The results also provide insight into the extent to which local markets are integrated into national markets. We estimate this relationship including national inflation in the basic estimation to distinguish between local and national inflation. We find that the frequency of price change is positive and significantly related to both local and national inflation. This result suggests that both idiosyncratic and aggregate shocks strongly drive price setting behaviour in Lesotho. Thus markets may not be fully integrated within Lesotho as retailers are able to distinguish between local and national markets. If markets were fully integrated, retailers would view the entire economy as a single market and not be able to distinguish between local and national shocks.

In this chapter, we also investigated the extent to which the price setting behaviour of retail outlets in Lesotho is linked to local, national and regional (South African) shocks. The results provide important insight into the relative importance of regional conditions and price setting behaviour in South Africa. They reveal a positive relationship between the frequency of price changes in Lesotho and South Africa's inflation and price setting, but not for all products. The frequency of price changes in South Africa, particularly in the food and fuel sectors, is strongly correlated with price setting behaviour in the Lesotho. This is suggestive of a relatively high degree of product market integration in the region for these products. Further, the close association is indicative of the dominance of South African chains in Lesotho retail industry, particularly for food products, and common global shocks with particular regulated price setting for fuel products.

The results also reveal a positive relationship between inflation in South Africa and price setting in Lesotho, but not for all product groups. External shocks from South Africa strongly drive price setting in the more tradable sectors (non-durable and non-perishable) and are not as important in the less tradable sectors (durable and perishable) and are not related to price setting in the non-tradable sectors (services). High storage and transport costs prevent

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integration of markets for perishables, as they are difficult to store and transport. Markets for non-perishables are more integrated as they are not subject to decay.

This result gives information on the degree of product market integration across different sectors between Lesotho and South Africa. The differential impact of local, national and regional inflation on price setting behaviour suggests that product markets are not fully integrated across all markets as it would be expected for countries that are members of the same customs union (SACU) and monetary union (CMA). This implies that inflation targeting monetary policy, adopted from South Africa, affects price setting behaviour in Lesotho differently as it does not affect all markets equally.

In the next chapter, the role of the Southern African Customs Union (SACU) and the Common Monetary Area (CMA) in driving these relationships will be further interrogated using cross country retail price data.

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4 Border effects, monetary agreements and product market integration

4.1 Introduction

In a well-functioning market, a high degree of regional integration should lead to price level convergence for similar products across member countries. This relationship is described by the Law of One Price (LOP). This states that in a properly integrated market, price differences should be arbitraged away through intra-regional trade.[51] This implies that any deviations from LOP can be linked to the degree of economic integration and any initiative towards further market integration, such as monetary unions, is expected to enhance convergence toward LOP (Martin and Mejean, 2013).

However, it has become increasingly evident that product markets are far from being perfectly integrated across countries. Product market segmentation continues to exist and political barriers continue to shape the pattern of trade within and between countries. This is despite the observed general reduction in explicit barriers to international trade in recent years, particularly quantifiable ones such as tariffs, quotas, transaction costs, national borders and other physical impediments to travel (Horvath et. al., 2008). These concerns are arguably of particular relevance for Africa where many countries are landlocked and internal transport costs can be extra-ordinarily high (Limão and Venables, 2001). High transaction costs and infrastructure barriers within Africa are impediments to intra- and extra-regional trade flows in the region. Therefore, despite integration efforts across countries (technological progress in transport and communications and negotiated reductions in tariff barriers), product market segmentation continues to exist and political barriers continue to shape pattern of trade, even within highly integrated regions in Africa.

[51] Prices of identical tradable goods in the same currency should, under competitive conditions, be equal across all locations, national and international.

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The empirical literature has confirmed that national borders substantially segment markets. Many studies have found substantial border effects. For example, Engel and Rogers (1996) find that even after accounting for transport costs, prices of similar products in retail outlets located on either side of the national border display large unexplained variations.[52] The border effect remains a dilemma and has been cited as one of the 'great puzzles' in international economics (Obstfeld and Rogoff, 2000).

Governments have pursued various policy options to enhance integration. These include the establishment of customs unions where members impose a common external tariff and allow free flow of goods between member states. They also include monetary unions where countries adopt a single currency and a common monetary policy. The achievement of exchange rate and price stability through monetary union usually promotes allocative efficiency which is conducive to the overall economic performance of the regional economy.

Monetary unions are viewed as a way to reflect a single market between member countries and are thus a symbol of hope to provide support for economic and political integration within Africa (Jefferis, 2007; Kenen and Meade, 2008). To support this view, empirical findings (Tsangarides *et al.*, 2006) indicate that monetary union benefits are not region-specific and African countries stand to benefit as much from monetary union membership as countries in the rest of the world.

Despite the importance of monetary unions in explaining product market integration between countries, very little has been done to assess this relationship using the price measurement of product market integration in developing countries. The exceptions are studies by Parsley and Wei (2003) and Rose and Engel (2002). Rogoff (1996) argues that international product markets, although becoming more integrated over time, remain segmented, with large trading frictions across a large range of products. However, the

[52] Other studies include Parsley and Wei (2001) and Crucini *et al.* (2005)

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ultimate cause of lack of market integration between countries is yet to be completely understood and explained in the literature (Engel and Rogers, 2001).

It has not been possible to fully interrogate the impact of the various economic agreements (customs unions, monetary unions) on product price integration in Africa. This is firstly because of the lack of product price data over time which has been a major constraint in developing an understanding of price transmission mechanism from border to consumer and how policy changes and trade-related impediments affect integration of markets across borders. The transmission mechanisms are also important to understand how barriers affect poverty through production and consumption channels. Little is also known about within and between country price dispersion, which may be particularly interesting in Africa where markets are proven to be segmented (World Bank report, 2012; and Edwards and Rankin, 2012).

This chapter investigates the extent of product market integration and sources of market segmentation between Botswana, Lesotho and South Africa.

It contributes towards the literature in the following ways. First, the chapter measures market integration across borders using a unique panel of highly disaggregated retail price data. The numbers vary across narrowly defined observed products (for example, a loaf of white bread, and 340 ml of Coca Cola) and different regions in the three countries (Botswana, Lesotho and South Africa) over a period examined (in this case 40 months). The unit record nature of this data and its time coverage allows for an in-depth study of the extent of product market integration at the most disaggregated level. The results obtained provide evidence on the degree of market integration within and between the countries and how observed integration has changed over time.

Secondly, the data that is used in this chapter provides us with the opportunity to identify the microeconomic impact of monetary unions on product market integration. Most

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existing studies that analyse the impact of monetary union use trade flows as a measure of market integration (for example Rose, 2000; Rose and van Wincoop, 2001; Glick, 2001; Frankel and Rose, 2000; Glick and Rose, 2002; and Nitsch, 2002). But price data provides complementary insight that is better able to identify the extent of integration.

In this chapter, we consider a case study of two policy reforms in Botswana that were introduced in May 2005 and January 2008 as a strategy to harmonise the country's domestic monetary and exchange rate policies with those of its major trading partners (including South Africa) to enhance cross border market integration. We analyse the deviations from LOP before and after the introduction of these policy reforms to establish if the observed convergence in macro variables (exchange rates, inflation rates and interest rates) have also resulted in convergence in retail prices for Botswana and other two CMA countries. The convergence in retail prices between Botswana and the CMA countries implies further integration among the three countries.

To control for other factors that might otherwise affect convergence in retail price among these countries, we use Difference-in-Difference estimation strategy in which we isolate the impact of policy change. In this way, any changes in the size of deviations from LOP at the product level will be attributable to product-specific determinants that are not related to monetary integration. Any other changes in LOP deviations will then be attributable to policy change in Botswana.

The remainder of this chapter is divided into the following sections. Section 4.2 discusses theoretical insights on how national borders affect product market integration and then discusses the relationship between monetary union and product market integration and the theoretical channels through which monetary union can enhance product market integration. Section 4.3 presents a review of the relevant empirical literature on studies that analyse sources of product market segmentation, in particular, distance and border effect and

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studies that analyse the impact of monetary unions of product market integration. Section 4.4 describes the data and its sources while Section 4.5 outlines the detailed conceptual framework on product market integration and sources of market segmentation and presents the relevant results. Section 4.6 first outlines the background on regional integration within the Southern African region, in relation to recent policy changes in Botswana. This investigation is similar to monetary union analyses on the impact of monetary union on product market integration. In this section, we also outline the empirical strategy of analysing the impact of monetary union and discuss the analysis and related results. Section 4.7 tests the robustness of the results and the chapter is then concluded in Section 4.8.

4.2 Theoretical insights

In this section, the relevant theoretical foundations are discussed; in particular, the measurements of product market integration, sources of market segmentation and the theoretical link between monetary unions and product market integration. From these insights, the hypotheses of this chapter are drawn.

4.2.1 Measurement of product market integration

There are two broad measures of product market integration. One measure uses the volume of trade between national markets and is referred to as the quantity measure of product market integration. This measure is based on the degree to which countries trade with each other, conditional on several factors that are controlled within the standard trade models such as gravity models (Edwards and Rankin, 2012). The link between market integration and the volume of trade is argued to be rather problematic as changes in trade volumes can arise from factors that are not related to transaction costs, such as government expenditure patterns (Edwards and Rankin, 2012; Parsley and Wei, 2003).

Using trade flows, in well-integrated markets, once transaction costs and other relevant factors are accounted for, price differences should be arbitraged away through intra-

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regional trade (Edwards and Rankin, 2012). But even though we may see no trade, prices could be very similar since trade only occurs if the price gap is greater or equal to transaction costs. Therefore trade volume is not necessarily a good indicator of market integration.

Given these limitations, an alternative and more direct approach is to measure product market integration through prices. Prices carry the important signals that are associated with increased market integration, which may lead to firms and consumers making new allocation decisions. The price metric is motivated by an insight from Heckscher (1916), who argued that the existence of positive arbitrage costs implies an equality constraint between prices in two locations. This argument was formalised recently by Obstfeld and Taylor (1997), Taylor (1999), O'Connell and Wei (2002) who looked at non-linear deviations from the LOP. Consequently, in this chapter, we consider retail product prices as an indicator of product market integration.

The arbitrage condition is defined as:

$$\left|P_{i,k} - P_{j,k}\right| \leq t_{ij,k}$$

where $t_{ij,k}$ is transaction costs between locations *i* and *j* for product *k*.[53] The standard explanation of this condition is that as soon as price gap exceeds transaction costs, then trade occurs to ensure that the condition equalises again. But once it has equalised, volume of trade is consistent with a constant price gap. However, the inequality condition also suggests that price differences do not necessarily reflect the size of transaction costs. This has a number of implications for the role of transaction costs on price differences across regions and outlets, as is discussed by Borazz *et al.* (2012) and Anderson *et al.* (2010). These concerns are discussed and dealt with in the empirical part of the chapter.

Prices exclusive of transaction costs, such as taking out transaction costs, will not necessarily be equal. At some transaction costs, markets will be fully segmented and the price

[53] Arbitrage is the practice of taking advantage of a price difference between two or more markets. It has an advantage of causing product prices in different markets to converge.

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gap will fall within the inequality constraint, hence including the sample of irrelevant price pairs. At an alternative transaction costs, markets will be fully integrated but the price gap will fall outside the inequality constraint, thus excluding a sample relevant price pairs. This implies that the sample of price differences will contain a number of observations where the equality constraint is not binding and excluding a number of observations where the equality constrain is binding. This results in an equivalent effect as sample selection bias. This bias also has implications on the estimation, but will be dealt with in the analysis section.

4.2.2 Sources of market segmentation

Although the Law of One Price (LOP) is a theoretical benchmark, in practice product prices are influenced by various factors that could impede complete arbitrage of prices across locations in different countries. The violation of the LOP between countries has been noted as one of the most long-term concerns in the international pricing literature. Trade costs are the main source of deviations from LOP between markets in different countries.[54]

Krugman (1979) and Helpman (1981) explain observable trade costs in terms of border related and non-border related costs. Non-border related costs are generally transaction costs which include distance and geographical irregularities. Transaction costs determine the level of trade between two locations and also limit the ability of economic agents to arbitrage away any price differences between the locations. The 'new' theory considers these costs implicit, under the form of the iceberg costs as suggested by Samuelson (1954). According to Samuelson, transaction costs should depend on the distance between locations, so that the variation in relative prices also increases with distance.[55]

Border-related costs include costs that are incurred at the border between two countries. Traded goods can be subject to costs (explicit and implicit) of crossing the border

[54] Generally defined, trade costs include all costs that are incurred in transporting the good from the origin to its final destination.
[55] This way of modelling transport costs is very useful since it implies that price differences between two locations cannot be higher than the cost of trading. In addition, it has integrated perfectly within the models of monopolistic competition.

(Engel and Rogers, 1996). If the effects of these costs are high, then trade between the two countries may be impeded, also hindering arbitrage activities. The resulting effect will then be price disparities between the countries.

Transaction costs are assumed to increase with distance between locations by some component and the costs associated with crossing a border (Hummels 2001):

$$t_{ij} = dist_{ij}^{\alpha_1} \exp\left(\alpha_2 border_{ij}\right)$$

Where $border_{ij}$ is defined as: $\begin{Bmatrix} 1 & \text{if city i and city j are separated by a national border} \\ 0 & \text{otherwise} \end{Bmatrix}$

The border dummy variable measures the aggregate effect of official trade restrictions and the delays and burdens of doing business in another country and under another legal system, all of which can be expected to disrupt the ability of the retailer to arbitrage away price differences between locations. It is expected that the presence of a national border between two locations will increase differences in prices of similar products sold in retail stores that are located on the opposite side of the border.

The distance variable is such that $1 + dist_{ij,k,t}$ units of product k must be transported to country A for 1 unit to arrive. The implication is that for every unit transported, consumers receive and pay for only a fraction of that unit while the remaining portion is lost to transaction costs, that is, 'melts in transit'. These are referred to as the "iceberg form of transaction costs". Even in the presence of transaction costs, firms continue to export to other countries. However, in the presence of large transaction costs, trade between countries may be eliminated in terms of tradable goods. It is therefore expected that the greater the distance

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between locations, the higher the transaction costs, and the more different prices will be between those locations.[56]

4.2.3 Customs union, monetary union and product market integration

In this section, we discuss the link between customs unions and monetary unions and their influence on product market integration.

A customs union is a form of regional integration that involves the elimination of tariffs and import quotas among members but maintains a common external tariff against non-members. It eliminates the costs that are related to border procedures between member countries. For example, rules of origin are no longer necessary because member countries face the same tariff and this effectively creates "destination-neutrality" for imports into the customs union. The combination of zero tariffs and reduced border controls substantially reduces border related costs and enhances integration in product markets between member countries. Thus product markets are expected to be more integrated between members of a customs union than between non-members.

Monetary unions are an additional policy to enhance integration. Academic interest in monetary integration has existed ever since the renowned study of Mundell (1961) pointed to a serious omission in existing exchange rate theory which was the basis of Friedman's (1953) influential "Case for Flexible Exchange Rates". A monetary union involves two or more countries adopting a common currency (either a new currency or a single currency usually of a dominant member country that circulates as the principal medium of exchange)[57] or different currencies that are permanently fixed to each other even though they may vary with non-union currencies. The exchange rate union may be monitored and controlled by one central bank or several central banks with closely coordinated monetary policies. Monetary

[56] Also see Anderson and van Wincoop (2003)
[57] Usually a small and/or poor country unilaterally adopts the money of a larger, richer "anchor" country.

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unions also involve harmonised monetary and exchange rate policies with a view towards achieving common macroeconomic objectives.

This form of integration can therefore be seen as a variety of arrangements ranging from an optimum currency area (OCA) to a full-blown monetary union.[58] Monetary unions also involve the removal of exchange controls on current or capital transactions between member countries.

Monetary unions are advocated for their perceived benefits which are fully compatible with Mundell’s renowned 'Trinity' theory which states that a country would prefer its monetary regime to deliver three desirable goals that turn out to be mutually exclusive. The first derives from the standard functions of money as a medium of exchange and a store of value. In a monetary union, a common currency as a medium of exchange can eliminate the transaction costs of converting money and forward cover required under a flexible exchange rate system for intra-regional trade and investment. The second derives from the ability of monetary unions to enhance free capital mobility between member countries. Under a monetary union arrangement, speculative capital flows would be eliminated, and long-term interest rates would decline and be less volatile. In fact, the viability and growth of some domestic capital markets would be somewhat limited if they did not open their doors to the regional possibilities. The third derives from the ability of the fixed exchange rate system to stabilise the exchange rate within the union. The existence of inconvertible sub-regional currencies and widely fluctuating exchange rates hinder competitive regional production potentials between countries.

New topics of inquiry seek to investigate the micro-economic impact of monetary unions through price comparison. Mundell (1961) argues that free circulation of goods and

[58] OCA is a geographical area in which a single currency circulates as the principal medium of exchange (Mason and Taylor, 1993). A full-blown monetary union is the advanced stage than of OCA where in addition to a common currency; member countries also have common monetary and fiscal policies, a common pool of foreign exchange reserves, a harmonised credit policy and a common monetary authority or central bank.

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services, as a result of regional integration, and use of the same currency, as a result of monetary union, should reduce price differences between member states. Consequently, monetary union eliminates the border as a line demarcating currency usage between countries, thereby reducing the forces that give rise to 'border effects'.

The preferable way to look at the effect of monetary union on product market integration is to base the investigation on price comparisons, which is motivated by the theory of arbitrage in the presence of transaction costs. Monetary union can further enhance integration between member countries through three channels. The diagram below explains the transmission channels of monetary union in relation to domestic product market prices.

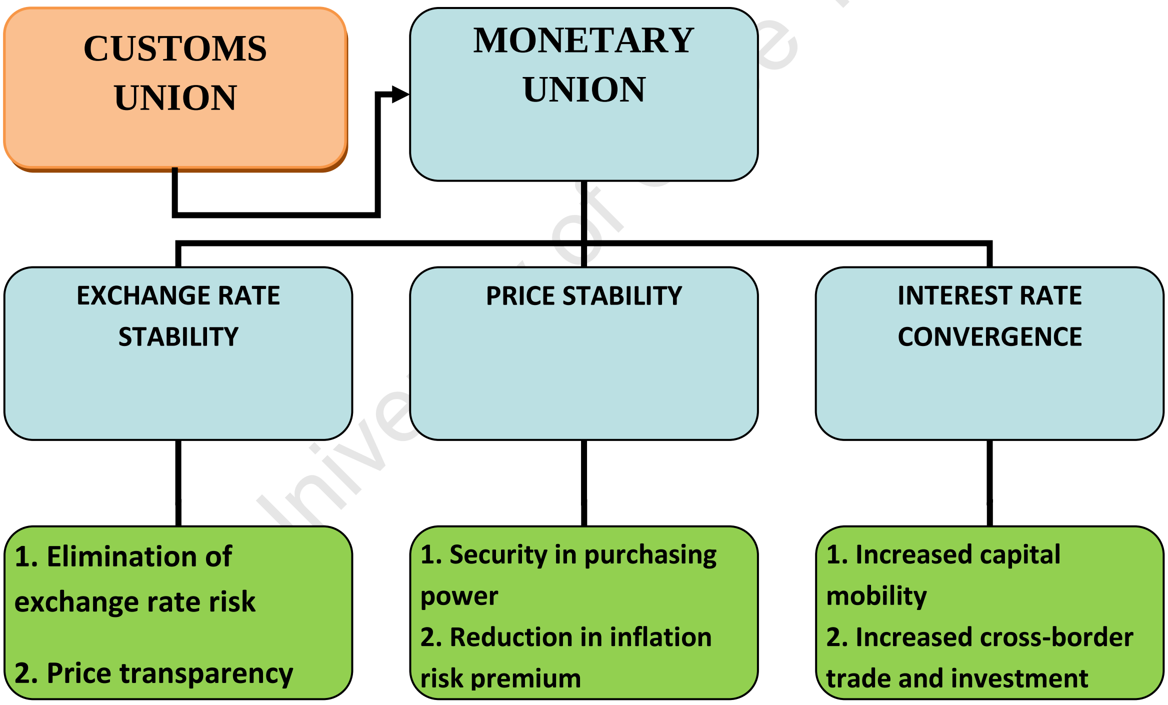

Figure 14: Transmission channels of monetary union to market integration

Monetary union can directly reduce LOP deviations through a fixed nominal exchange rate system. A fixed exchange rate system eliminates fluctuations in the exchange rate, thus lowering uncertainty and deepening integration among member countries. In the short-run, nominal prices are sticky in consumer's currencies. But when exchange rates are flexible, real price misalignments can occur. If each country's nominal goods prices are set in the local currency, as the nominal exchange rate fluctuates and goods prices adjust slowly, deviations of prices arise (expressed in a common currency) across borders.

For example, if P represents the price of a product in Lesotho and P^* the price of the product in Botswana, and P and P^* adjust sluggishly, then their relative price P/EP^* will fluctuate as the nominal exchange rate (for example, Loti per Pula) E fluctuates. If nominal exchange rate movements are large, there can be currency misalignments in which price levels in one country differ from price levels in another country when expressed in a common currency. This suggests that fluctuations in the nominal exchange rate may lead to greater price heterogeneity across countries and therefore a greater dispersion in prices between these countries. Even if markets are otherwise well integrated, exchange rate misalignment can obstruct market efficiency. Fixed exchange rates thus reduce the exchange rate risk associated with trade and investment between countries, making it more attractive for firms to increase their intra-country trade.

The use of a common currency within a monetary union creates price transparency because it allows for payments to be made with the same currency between member states. The use of the same currency among a group of countries also reduces the costs and complexity of converting currencies in calculating prices, thereby insuring profitable cross-border trading between member countries, enhancing arbitrage opportunities and narrowing price dispersion between these countries.[59] It reduces transaction costs and increases the predictability of relative prices for firms doing business across countries.

A monetary union also induces interest rate convergence among member countries. Harmonised interest rates increase capital mobility between member countries. As countries

[59] Arbitrage involves market forces that take advantage of failures of LOP by buying products where they are cheap and possibly selling them where they are expensive.

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become more integrated, firms view these countries as a single market creating incentive for them to re-locate or restructure their production scale, increasing pressure on price-cost margins and price convergence. Free movement of capital allows investment to take place anywhere within the integrated region, where firms can utilise the best combination of production factors. Optimal allocation of production factors reduce production and distribution costs and therefore lower the prices that are paid by consumers between locations.

Finally, monetary unions increase price stability among member states. Price stability involves harmonisation of inflation rates among member states. Harmonised inflation rates also enhance interest rate convergence among the member counties. Price stability keeps inflation under control and increases competition thus reducing arbitrage opportunities between product markets. If prices are relatively stable, member countries are able to recognise changes in relative prices and therefore avoid inflation risk premium.

Overall, the theoretical foundations provide evidence on the nature of the relationship between customs and monetary unions and product market integration across member states. Customs unions form a foundation for monetary unions. Monetary unions further enhance market integration between member countries through various channels.

In this chapter, we test the impact of monetary union (CMA) through the following hypotheses. The first hypothesis is that monetary union enhances product market integration between member countries through exchange rate stability. The second hypothesis is that monetary union increases product market integration between members of monetary unions through interest rate convergence.

4.3 Findings in the empirical literature

For several decades, researchers in international macroeconomics have investigated the related phenomena of the LOP (Rogoff, 1996; Goldberg and Knetter, 1997). The major

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conclusion drawn from this literature is that there are frictions that provide significant barriers to the integration of product markets across nations. The literature cites several factors that provide significant barriers to the integration of product markets across nations. These include transaction costs, information barriers, implicit or explicit trade barriers and currency fluctuations (Engle and Rogers, 2004).

4.3.1 Border effects and market segmentation

The empirical literature documents surprisingly large deviations from LOP across countries, 'the border effect'.[60] The classical reference of this literature is a paper by Engel and Rogers (1996) who examine the nature of deviations from PPP using consumer price indices for the US and Canada. They use price data from 23 US cities for 14 disaggregated consumer price indexes, for the period 1978-1994. Their results reveal that crossing the US-Canada border was equivalent to shipping a good for 75,000 miles. This finding shows that the LOP fails both within and between countries, but more strongly so in the latter aspect because of the presence of a national border. What is particularly striking in the results of this study, reiterated by subsequent work by Parsley and Wei (2001) and Beck and Weber (2001), is the magnitude of the influence of the 'border effect' on relative prices within a highly integrated market (USA and Canada). A strong theoretical assumption is that, all things being equal, lower trade costs from integration between cities or regions on either side of an international border should be associated with increased price integration in product markets. Several other similar studies test this hypothesis. Rodrik (2000) provides a comprehensive analysis of why national borders have significantly depressed the effects of economic integration. He argues that "*National borders demarcate political and legal jurisdictions. Such demarcations serve to segment markets in much the same way that transport costs or border taxes do. Exchanges*

[60] The border effect is the additional unexplained variation in prices between cities in different countries beyond that which can be explained by physical distance.

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that cross national jurisdictions are subject to a wide array of transaction costs introduced by discontinuities in political and legal systems". This clearly advocates that the presence of national borders is a significant barrier to integration between markets across countries.

Estimates of the size of the border effect however are sensitive to the empirical method used. Gorodnichenko and Tesar (2009) re-examine the identification strategy employed by Engel and Rogers (1996) and other related studies in estimating the border effect. They argue that the border effect identified by Engel and Rogers (1996) was mostly driven by differences in the distribution of prices within the US and Canada and therefore reflected the combination of border effects and country heterogeneity effects on trade prices.[61] Borraz *et al.* (2012) extend the argument presented by Gorodnichenko and Tesar (2009) and complement the work of Gopinath *et al.* (2011) in developing a framework to separate the volatility and persistence of nominal exchange rate and cross-country heterogeneity from the true border effect. They use the alternative method of Quantile regression analysis to estimate the border effect between cities in Uruguay. Their results show that after controlling for these confounding factors, the border effect between these countries was negligible.

Very few studies look at national borders as sources of LOP deviation in an African context. Versailles (2012) studied border effects using price data for four of the five Eastern African Community (EAC) member states, for 24 products for the period 2004 to 2008. The results show a much lower border effect compared to studies that use the Engel and Rogers regression specifications. They also find that the border effect from cities within countries that do not share a national border is higher than that of cities in adjacent countries. They also examine the effect of customs union on prices in Kenya and Uganda between 2004 and 2008

[61] Country heterogeneity is explained as a case where the border effect measured by a regression that compares the within-country and between-country price dispersion is confounded by divergent internal price distribution between two countries, particularly if the relative price variability across locations within the same country differs systematically country by country.

and find that a customs union significantly reduce the border effect between the two countries.[62]

Aker *et al.* (2010) offer a different explanation for the border effect, specific to the African context. Their study adds the additional dimension of ethnic borders as one of the causes of price differences in product markets between countries. They find evidence of a border effect for selected agricultural products (grains and cash crops) between Niger and Nigeria, but even larger effects for the border separating two regions (Hausa and Zarma) within Niger. A recent study by Edwards and Rankin (2012) of 12 African countries find evidence of increased product market integration in Africa. The instability of bilateral real exchange rates between African economies seems to have declined from the early 1990s. At the product level, they find convergence in retail prices for similar products. However, lack of appropriate price data for African economies constrains an analysis of the broader trends in price integration within the African region.

In summary, the empirical literature consistently reveals the presence of border effects. However, evidence concerning the precise magnitude of border effects is mixed. Analyses of product market integration using price-based measures are also more regularly applied to developed countries due to lack of appropriate price level data available for developing countries, particularly in Africa. This chapter adds to this literature by investigating factors that explain deviations in the LOP in an African context using disaggregated price level data.

4.3.2 The impact of monetary union on product market integration

Over the past decade, a rapidly expanding number of studies have investigated the impact of monetary integration (currency union and other exchange rate arrangements) on product market integration. However, the majority of the existing studies that analyse the impact of

[62] There were no customs union effects found with Rwanda and Burundi as they only joined the EAC in 2007.

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monetary unions on LOP deviations use data for developed countries, particularly those of the European Union (EU). The main conclusion from these studies is that the formation of a monetary union substantially reduces price dispersion among member countries.

Martin and Mejean (2013), for example, analyse the impact of the Euro on French exporters' pricing strategies in relation to members of the Euro zone. They use the difference–in-difference strategy to estimate the impact of the European monetary union. The results showed that a single currency reduced relative price dispersion of export prices in the Euro zone by 4 percentage points compared to the rest of the European Union.

Other studies use data from the European car market and find evidence of price convergence after the introduction of the Euro (Goldberg and Verboven, 2005; Gil-Pareja and Sosvilla-Rivero, 2008). Allington *et al.*, (2005) also find significant reduction in price dispersion across the Euro Area (for EA members) compared to non-EA countries. In contrast to the findings of these studies, Engel and Rogers (2004) consider detailed consumer price data set for European cities from 1990 to 2003 to analyse the impact of the introduction of the Euro on consumer price integration. They find that the introduction of the Euro under the European Monetary Union (EMU) did not have much impact on price convergence.

Most of these studies provide evidence that the European monetary union has resulted in increased market integration between member countries, yet markets are still not fully integrated. The exception in the literature is Cavallo, Neiman and Rigobon (2012), who find that LOP holds perfectly within prices of products sold between members of the EMU while prices of similar products exhibit large deviations from LOP for non-EMU countries even when nominal exchange rates are pegged. Their conclusion is that a common currency rather than lack of nominal volatility is the main source of integration of prices in product markets among these countries.

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A number of studies have also analysed the impact of monetary unions on product market integration in Africa. However, these studies have predominantly used quantity-based measures of product market integration. For example, Tsangarides *et al.* (2006) analyses the effect of currency unions on trade between African countries and the rest of the world. They find that the effect of currency unions doubles trade and increase price co-movements among member countries. Their results also show that the duration of a monetary arrangement also contributes to this result. Carrere (2004) focuses on Sub-Saharan African countries and find a currency union has a positive effect on intra-regional trade.

The literature that analyses the micro-impact of monetary unions using price-based measures in the African context is sparse. Rose and Engle (2002), for example, focus on the two monetary unions of the West African Economic and Monetary Union (WAEMU) and Central African Economic and Monetary Community (CAEMC). They use price indices to test the impact of a currency union on product market integration in the CFA zone and find that members of currency unions tend to experience less volatile exchange rates than countries with their own currencies.

Parsley and Wei (2003) study the impact of a common currency on price dispersion among groups of countries, including members of the CFA Franc Zone. Using a cross-country data set on the prices of 95 disaggregated products among 83 cities in the world from 1990 to 2000, they find that the use of a common currency reduce a range of deviations from the LOP. The stronger effect was generated by a more institutionalised arrangement such as a currency union or a currency board as opposed to instrumental arrangement such as dollarization. The drawback of this study is that they use dummy variables to estimate the effects of monetary union. The limitations of using dummy variables is that they create the problem of omitted variable bias that stems from omitted variables that are correlated with

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the monetary union dummy and product market integration variable. This is described as the 'gold medal mistake' in Baldwin's (2005) critique.

Nonetheless, the empirical results from these two studies strongly support the proposition that the use of the same currency reduces the economic significance of national borders and therefore the deviations in retail prices between member countries.

Given the foregoing, it is apparent that findings on the impact of monetary union on product market integration is the result of robust empirical research, both in developed (EU and US) and developing regions. The overall conclusion is that monetary unions increase price integration in product markets among member countries. However, very few studies have been conducted using price data for developing countries (Parsley and Wei, 2003; Rose and Engel, 2002), to our knowledge, no study has analysed the micro impact of CMA on product market integration. Studies that use data from African countries do not use price data to measure product market integration (for example, Tsangarides *et al.*, 2006) while others use a dummy variable to identify the impact of monetary union (Parsley and Wei, 2003). The results stemming from these analyses are however not able to quantify the impact of shocks for comparison with other studies.

Another limitation is that other studies analyse the evolution of product market integration within the monetary union to infer its likely impact (for example Gil-Pareja and Sosvilla-Rivero, 2008; Goldberg and Verboven, 2005). This method does not consider price integration before and after the introduction of policy shocks and therefore does not account for differences in trends that could also affect price dispersion before and after a shock.

This chapter makes an important methodological contribution in identifying the effect of monetary unions on product market integration. In particular, it analyses how changes in exchange rate and interest rate policy in Botswana (not a member of the CMA) affects integration with South Africa, while controlling for changes in integration between South

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Africa and Lesotho (both members of CMA). Further details are provided but the chapter essentially applies a difference-in-difference method to identify the impact of monetary unions on price integration.

The advantage of this method is that it enables one to account for factors that are not related to the policy shock but can also affect price integration among the three countries through the use of information on the control group. This method is also useful when trying to measure the quantitative impact of a policy shock on a specific group as it considers information before and after the shock (Martin and Mejean, 2012).

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4.4 Background and data

The case study countries for the analysis in this paper are Botswana, Lesotho and South Africa. These countries make an interesting case study for this analysis because, firstly, they have all been members of a customs union (Southern African Customs Union, SACU) since 1910. The SACU structure is such that all tariff barriers have been eliminated between member countries while common external tariff against non-members have been maintained against non-members. This was to enhance cross-border trade and investment between member states and promote integration of member states into the global economy. Secondly, South Africa and Lesotho are both members of the monetary union (Common Monetary Area, CMA), fostering further integration between the member countries. CMA members adopt South African monetary policy and have pegged their currencies to the Rand. Therefore membership of CMA also eliminates the biases that could be caused by exchange rate volatility and, interest rate differences.[63] Thirdly, the three countries are closely related through colonial history, and this eliminates the bias that could be caused by differences in language and culture and religion among others. Finally, their geographical location is such that Lesotho shares a border with South Africa but not with Botswana, while Botswana shares the border with South Africa but not with Lesotho.[64]

These features provide evidence that there is a close relationship that enhances integration among these countries. These features are also very useful in accounting for different estimation issues such as omitted variable bias. In addition, to estimate the impact of a monetary union, we need information on the treated group and the control group. The choice of case study countries is very important in order to have an appropriately defined

[63] The CMA is made up of the four countries; Lesotho, Namibia, Swaziland (LNS countries) and South Africa.
[64] Lesotho shares a border with South Africa but not with Botswana while Botswana share the border with South Africa but not with Lesotho (see appendix 4.5 for detailed geographical locations of these countries)

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control group. A control group needs to have similar characteristics to the treated group such that it captures any changes in price dispersion that are not related to monetary integration.

Data description and sources

This chapter utilises two types of dataset: the price database and a distance database. The price database consist of micro-level product prices underlying consumer price index (CPI) in Botswana, Lesotho and South Africa, collected by the Botswana Central Statistics Office (BCSO), the Bureau of Statistics Lesotho (BOS) and Statistics South Africa (StatsSA) respectively. The data is at the product level and varies across cities and across time and therefore accounts for heterogeneity across products and geography. Each product has several price records and has information on the date (month and year), city, product and unit codes and the price of that product. Nearly homogeneous products were mapped according to common identifier from the three countries.

The period for the data is 60 months (January 2004 to December 2008) which is divided into two periods according to the structure of our analysis. For the first period (January 2004 to August 2006), 125 matching products were identified across 61 cities (10 Districts of Lesotho, 40 cities of SA and 11 cities of Botswana). For the second period (September 2006 to December 2008), 183 products were mapped across 99 cities (10 Districts of Lesotho, 40 cities of South Africa and 49 cities of Botswana). The advantage of this data is that it is comparable across the three countries in terms of classification, allowing a longer length for individual price series.

Table 21 presents summary statistics of the absolute value of the log of price differences (see equation 2), which is the dependent variable in the subsequent regression analysis, across country-pairs, 12 various disaggregated product groupings and time.

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Table 21: Summary statistics for price dispersion by product categories (2004-2008)

(2004-2006)						
product classification	**no. of products**	**Percent**	**mean**	**p50**	**Sd. Deviation**	**no. of observations**
alcoholic beverages	8	6.4	0.337	0.194	0.355	112,284
clothing and footwear	14	11.2	0.499	0.372	0.429	89,857
education and stationary	2	1.6	0.632	0.519	0.518	20,866
food	43	34.4	0.278	0.179	0.296	633,754
fuel	5	4.0	0.204	0.130	0.227	76,175
household furniture and equipment	16	12.8	0.484	0.340	0.441	121,661
household operations	7	5.6	0.236	0.157	0.244	70,336
non-alcoholic beverages	6	4.8	0.187	0.094	0.250	60,506
other goods and services	1	0.8	0.608	0.516	0.450	12,295
personal care	14	11.2	0.431	0.226	0.492	91,704
recreation and entertainment	5	4.0	0.270	0.051	0.373	23,099
tobacco and narcotics	2	1.6	0.264	0.101	0.343	23,074
transport equipment	2	1.6	0.233	0.203	0.176	7,969
Total	**125**	**100**	**0.324**	**0.192**	**0.358**	**1,343,580**
(2006-2008)						
product classification	**no. of products**	**Percent**	**mean**	**p50**	**Sd. Deviation**	**no. of observations**
alcoholic beverages	10	5.46	0.314	0.189	0.331	500,009
clothing and footwear	24	13.11	0.495	0.373	0.454	1,050,070
food	67	36.61	0.283	0.168	0.331	2,703,748
fuel	7	3.83	0.147	0.089	0.183	299,623
household furniture and equipment	22	12.02	0.376	0.238	0.436	961,333
household operations	17	9.29	0.320	0.190	0.375	690,690
non-alcoholic beverages	11	6.01	0.199	0.139	0.216	457,407
other goods and services	2	1.09	0.500	0.290	0.572	98,147
personal care	12	6.56	0.338	0.177	0.443	595,533
recreation and entertainment	5	2.73	0.197	0.004	0.338	141,395
tobacco and narcotics	4	2.19	0.137	0.100	0.169	192,241
transport equipment	2	1.09	0.269	0.183	0.281	58,862
Total	**183**	**100**	**0.320**	**0.185**	**0.380**	**7,749,058**

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The table reveals the following key features about price dispersion across different product groups. First, there is evidence of substantial heterogeneity in product market integration across different product groups and across time. The mean of price differences, across two different time periods, is higher for clothing and footwear (0.499 and 0.495 respectively than for fuel (0.204 and 0.147 respectively) and non-alcoholic beverages (0.187 and 0.199 respectively). Secondly, the standard deviation of price differences differs across the product groups. For example, price dispersion is greater for personal care products (0.492 and 0.443 respectively) than for fuel products (0.227 and 0.183 respectively).

The second data set comprise the geographical distances of city-pairs within and between the three countries that are used as a proxy for transaction costs. The distance data was collected from geographical websites such as Google maps and travel math. This data enables us to calculate the distance between city pairs (in terms of the shortest distance by road) within and between countries. For example, the shortest distance by road between

Gaborone and Johannesburg is 374 km, between Maseru and Johannesburg is 409 km and between Gaborone and Maseru is 649 km.[65]

4.5 Product market integration between and within countries

In this section, we outline the empirical analysis for establishing the degree of product market integration within and between countries, using retail product prices. We also establish the appropriate mechanism by which border effects influence product market integration between countries.

4.5.1 Conceptual framework

The basic framework for the analysis of product market integration in this chapter is based on the LOP which states that for any product *k*:

$$P_{i,k,t} = E_{j,k,t} P_{j,k,t} \qquad (a)$$

Where $P_{i,k,t}$ is the price of product *k* in city *i* at time *t* and $P_{j,k,t}$ is the price of the same product in city *j*. $E_{j,k,t}$ is the nominal exchange rate and is equal to one if both cities are in the same country or both countries use the common currency. Equation (a) explains the concept of absolute *LOP* which states that the prices of similar products, when expressed in the same currency should be sold for the same price in different countries. LOP is a theoretical benchmark as product prices are influenced by a number of factors. Some of the factors include transport costs, trade barriers, market power and services costs (Rogoff, 1996).

To illustrate this framework, this chapter draws on the approach by Crucini *et al.* (2005). The main argument here is that products in different locations vary because of the tradability of the inputs required to produce them. A retailer in a particular location combines a non-traded input (for example labour) and a traded input to produce a retail product. LOP deviations for a retail product are therefore a simple reflection of input-price LOP deviations.

[65] See appendix 4.3 for detailed table of bilateral distance between city-pairs within and between Lesotho, South Africa and Botswana.

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The relative price of non-traded good is assumed to reflect productivity differences in the manner of Balassa (1964) and Samuelson (1964). Under the assumption of perfect competition, the unit cost is also the retail price which is a function of both traded (*T*) and non-traded (*NT*) inputs:

$$P_{i,t} = \left(P_i^N\right)^{\alpha_k}\left(P_i^T\right)^{(1-\alpha_k)} \tag{1}$$

Where *P* is the retail price of product *k*, expressed in South African Rands (ZAR), in city *i*. LOP deviations of a retail product are therefore a simple reflection of LOP deviations of an input price.[66] Product specificity takes the form of different input shares between traded and non-traded goods. Location specificity takes the form of different transport costs.

Comparing this product *k* in city *i* with an identical product k sold in another city (*city j*), then the two products will differ in terms of traded inputs.[67] The log difference in prices of product *k* between cities *i* and *j* in time *t* can be expressed as:

$$\ln\left(P_{ik,t} / P_{jk,t}\right) = \alpha_k \ln\left(P_{ik,t}^N / P_{jk,t}^N\right) + \left(1-\alpha_k\right)\ln\left(P_{ik,t}^T / P_{ik,t}^T\right)$$
$$\ln\left(P_{ik,t} / P_{jk,t}\right) = \alpha_k P_{ijk,t}^N + \left(1-\alpha_k\right)P_{ijk,t}^T$$

This can also be expressed as:

$$Q_{ijk,t} = \left(P_{ik,t} / P_{jk,t}\right) = \left(\ln P_{ik,t} - \ln P_{jk,t}\right) = \alpha_k P_{ijk,t}^N + \left(1-\alpha_k\right)P_{ijk,t}^T$$
$$OR$$
$$\left|Q_{ijk,t}\right| = \left|\left(P_{ik,t} / P_{jk,t}\right)\right| = \left|\left(\ln P_{ik,t} - \ln P_{jk,t}\right)\right| = \left|\alpha_k P_{ijk,t}^N + \left(1-\alpha_k\right)P_{ijk,t}^T\right| \tag{2}$$

Where $P_{i,k,t}$ is the price of product *k* city *i* and; $P_{j,k,t}$ for city *j* at month *t*. $\left|Q_{ijk,t}\right|$ is the absolute value of the log price difference of product *k*, measured in common currency (ZAR)[68], for a given city pair (*i* and *j*). Positive and negative values of log price differences tend to cancel out in summation such that the mean deviation is always zero. Therefore, the

[66] In this case a region is a geographical area within a country, for example, a city, a district, or a province. This depends on how the statistical office of a particular country has divided its areas of price data collection.
[67] Retailers therefore purchase traded products and add value through the service quality.
[68] We express all prices in terms of South African Rands so that we can be able to compare prices across all cities.

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advantage of using the absolute value is that it represents the typical deviation without regarding the sign of the difference.

Equation (2) implies that price deviation is a linear combination of the differences in the non-traded and traded input prices as well as deviations in production. Differences in trade costs can also influence the relative price of traded inputs such that $P^{T}_{ij,k,t}$ is assumed to be negative if region *i* imports product *k* from region *j* and positive if trade flows the other way. On the other hand, markets for non-traded products may be highly integrated at national level such that $P^{N}_{ij,k,t}$ is more similar between two regions within a country than between two regions that are separated by a national border. The weights (α) in the linear combination are the shares of non-traded and traded inputs in production. Equation (2) therefore provides the basis for the successive analysis of price integration.

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4.5.2 Mean deviations from LOP

Table 22 presents the descriptive statistics where absolute mean deviations from LOP in each city-pair are compared between and within countries.[69]

Table 22: Descriptive statistics for price dispersion between and within countries (Jan2004-Dec2008)

MEAN ABSOLUTE VALUE		
COUNTRY-PAIR	**Jan2004-Aug2006**	**Sept2006-Dec2008**
between countries	***0.430***	***0.428***
SA-LESOTHO	0.390	0.337
BOTSWANA-LESOTHO	0.531	0.512
SA-BOTSWANA	0.431	0.445
within countries	***0.225***	***0.222***
intra-SA	0.238	0.231
intra-BOTSWANA	0.163	0.217
intra-LESOTHO	0.229	0.221

The table illustrates that price differences between countries are greater than price differences within countries. In the two periods, the mean of the absolute price difference of city-pairs within one country is significantly lower compared to city-pairs in different countries. For the first period (2004-2006), the average mean for city-pairs in between countries is 0.430, which

[69] We consider that the introduction of the exchange rate policy shock which was in May 2005 and the change in monetary policy which was implemented in January 2008.

is twice the mean (0.225) for city-pairs within the same country. This implies that the average absolute deviations from LOP is 25.2 percent ($e^{0.225}$-1) for city-pairs within a country and 53.7 percent ($e^{0.430}$-1) for city-pairs between countries. Slightly lower values are reported for the second period (2006-2008); the average absolute deviations from LOP is 24.9 percent for city-pairs within a country while it is 53.4 percent for city-pairs between countries.

This evidence is comparable with other studies. Versailles (2012), for example, finds slightly higher deviation from LOP (average mean for within country country-pairs of 0.243 and for between country country-pairs of 0.443) for the East African Community.

Another important feature to note is that the mean deviation from LOP is larger between Botswana and Lesotho city-pairs (70.1 percent in 2004-2006 and 66.9 percent in 2006-2008) relative to city-pairs between Lesotho and South Africa (48.9 percent in 2004-2006 and 40.1 percent in 2006-2008). This suggests that price disparities are larger between countries that do not share the same border than between countries that share a national border and are both members of the same monetary union.

It is also important to note that the mean deviation from LOP is lower between Lesotho-South Africa city-pairs (49.9 percent in 2004-2006 and 40.1 percent in 2006-2008) than between Botswana-South Africa city-pairs (55.7 percent in 2004-2006 and 56 percent in 2006-2008). On the face of it, this result provides evidence about the effectiveness of the monetary union in reducing price deviations between member countries.

Overall, the results reveal evidence of increased integration in product markets over the period of analysis. However, we cannot make substantial conclusions based on these results due to the fact that because other observed and unobserved factors are not accounted for. Figure 15 presents a more comprehensive analysis of the distribution of price dispersion through the estimated kernel densities of mean absolute log price difference within and between Botswana, Lesotho and South Africa.

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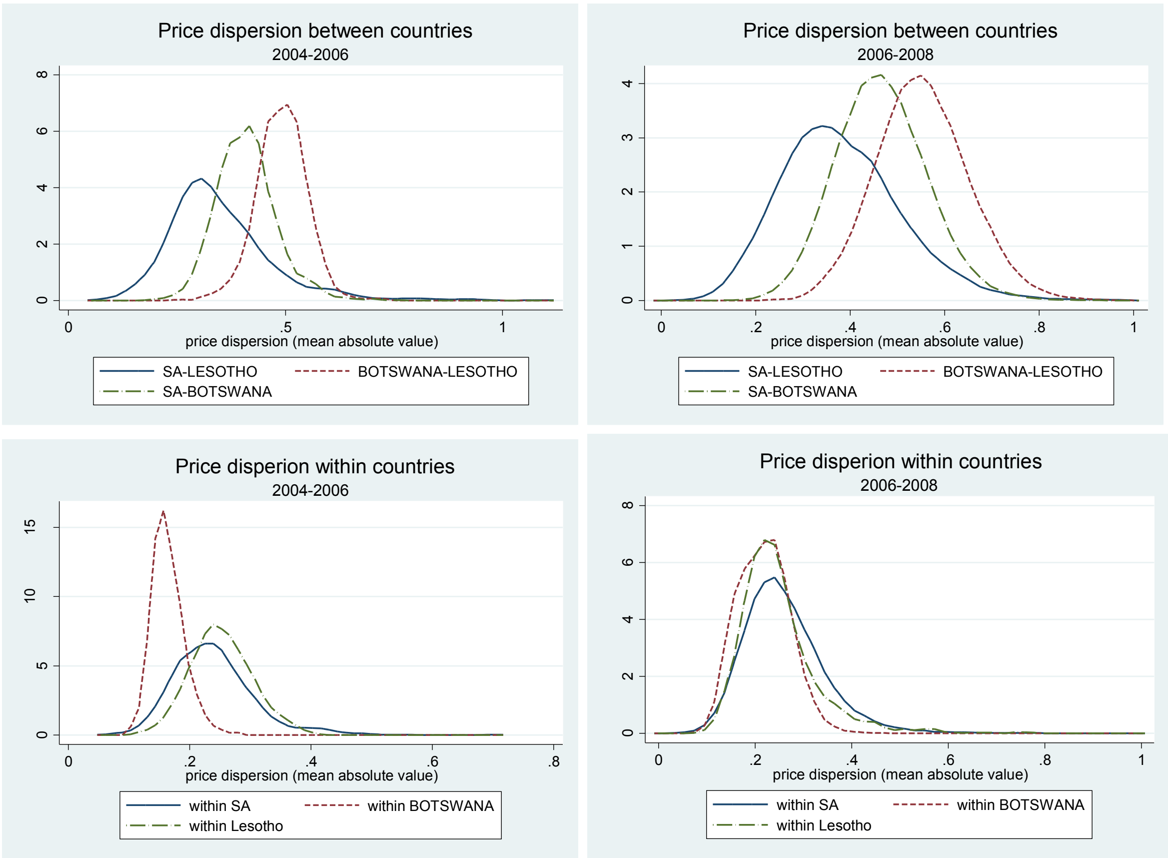

Figure 15: Kernel densities for price dispersion between and within countries (2004-2008)

From the diagram, we can note three important results. First, mean deviations from LOP are large; the between-country densities are in the order of ± 80 percent while the mean deviations within countries are in the order of ± 40 percent. Second, deviations between city-pairs within countries are smaller than deviations between city-pairs across countries in both periods. In particular, smaller within-country mean deviations are reported in the second period (2006-2008). Third, evidence confirms the results found earlier that greater price integration is observed between Lesotho-South Africa city-pairs (the CMA member countries) relative to city-pairs between Botswana and CMA countries.

Overall, there is evidence of increased product market integration between the CMA member countries than between Botswana and the CMA countries. This evidence confirms the earlier observation of the likely impact of monetary union on price integration within the region. However, the descriptive statistics can only give a picture of trends in LOP deviations but cannot explain sources of these trends. In the subsequent section, we unbundle some of the factors that contribute to price disparities between countries.

4.5.3 Estimating the border effect

In their seminal paper, Engel and Rogers (1996) argue that the major explanation for larger unexplained disparities in product prices between cities across countries is the border effect. If the effects of these costs are high, then trade between the two countries may be impeded; hindering arbitrage activities and resulting in large price disparities between these countries.

Assuming that price differences equal to transaction costs, we control for transaction costs using distance between cities, using the variant of the specification by Engel and Rogers (1996) as specified in equation (3):

$$\left|Q_{ijk,t}\right| = \alpha_1 ldist_{ij} + \alpha_2 border_{ij} + \varepsilon_{ij,t} \tag{3}$$

Where $border_{ij}$ is defined as: $\begin{Bmatrix} 1 & \text{if city i and city j are separated by a national border} \\ 0 & \text{otherwise} \end{Bmatrix}$

The coefficient of the border dummy variable (α_2) explains the border effect and therefore its sign should be positive.

$ldist_{ij}$ is log of the shortest distance between the two cities (*i* and *j*) and its coefficient (α_1) should also be positive.[70] We assume that transaction costs are of the "iceberg" formulation as popularised by Samuelson (1954). Instead of modelling transport cost, Samuelson assumed that "*as a fraction of ice exported reaches its destination"*, only a fraction of exported goods reach their destination. Equation (5) therefore shows that price differences between two locations can be affected by observable transaction costs such as the presence of a national border and the distance between the two countries.

[70] Economic theory states that relative prices are an increasing function of transport costs.

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To control for other observed and unobserved characteristics, we include city-pair, month and product fixed effects in equation (4) to give the log-linear specification that captures the long-run deviations from the LOP:

$$\left|Q_{ij,k,t}\right| = \alpha_1 border_{ij} + \alpha_2 ldist_{ij} + \alpha_3 ldist2 + \sum_k \gamma_k D_k + \sum_{ij} \delta_{ij} D_{ij} + \lambda_t + \varepsilon_{ij,t} \qquad (4)$$

Where: D_{ij} is a vector of dummy variables for city-pairs to control for non-traded effects specific to city-pairs while D_k for product k to control for unobserved heterogeneity across products; λ_t is a vector of monthly dummies to capture time fixed effects; and γ_k *and* δ_{ij} are product and city-pair fixed effects respectively. We also test for the non-linearity of distance by including the square of log distance in the specification. Since the three countries are all members of the customs union (SACU), price differences due to tariffs and trade restrictions are automatically eliminated.

Table 23: Price dispersion and the border effect

Dependent variable is mean absolute price difference	2004-2006 (1)	(2)	(3)	2006-2008 (1)	(2)	(3)
border	0.208***	0.206***	0.204***	0.241***	0.249***	0.246***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
log of distance	0.024***	0.028***	-0.088***	0.007***	0.011***	-0.031***
	(0.000)	(0.001)	(0.006)	(0.000)	(0.000)	(0.002)
square of distance			0.010***			0.004***
			(0.001)			(0.000)
Constant	0.056***	0.027***	0.360***	0.173***	0.149***	0.261***
	(0.003)	(0.004)	(0.017)	(0.001)	(0.001)	(0.004)
Fixed effects	no	yes	yes	no	yes	yes
Observations	992,961	992,961	992,961	6,913,727	6,913,727	6,913,727
Adj. R-squared	0.10	0.49	0.49	0.11	0.51	0.51

Robust and clustered standard errors in parentheses[71] Column 1 is the basic specification of border effect and Column 2 controls for non-linearity of distance. Results in column 2 and 3 include city, product and month dummies. *** p<0.01, ** p<0.05, * p<0.1

Table 23 presents the results of the basic regression for the effect of national borders on product market price integration between Botswana, Lesotho and South Africa. In general, the border coefficient is positive and significant in all the regressions. However, when we control for non-linearity of distance, the results show some irregularity in the distance

[71] standard errors are clustered in the city by month level

variable. This irregularity could be the result of selection bias that was raised in Borazz et al. (2012).

Controlling for cross-country heterogeneity

In their study, Gorodnichenko and Tesar (2009) argue that in many empirically relevant cases, the standard measure of border effect is biased because of factors that are not related to border issues. If the within-country price dispersion is systematically different from that between countries, then the border effect will suffer from country heterogeneity effect because it will be measured by comparing within-country and cross-country price dispersion that is confounded by the divergence between two countries' internal price distributions. If there is any cross-country heterogeneity in the distribution of within-country price differentials there will be no clear benchmark from which to measure the border effect because the between and within country price dispersion will be estimated simultaneously without distinguishing between the border frictions and the effect of trade between countries with different price distributions (Gorodnichenko and Tesar, 2009).

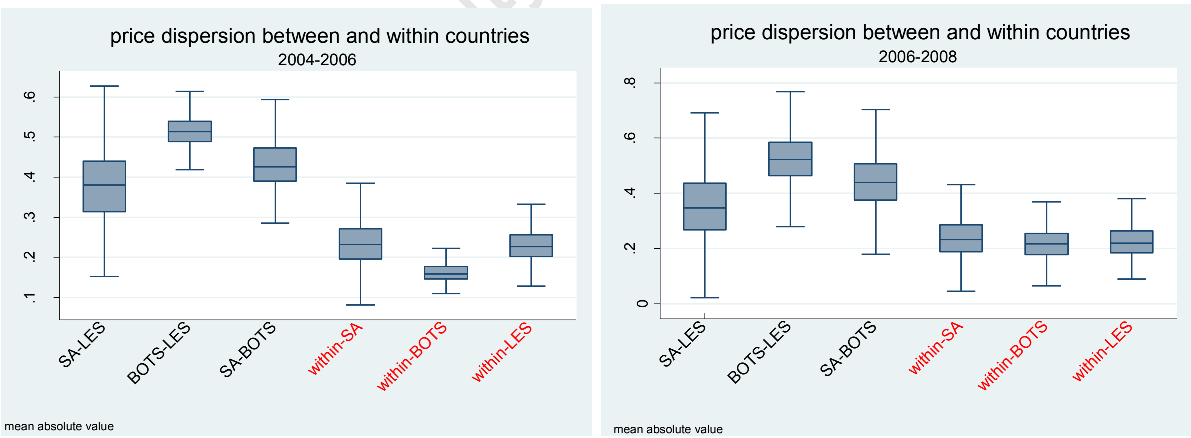

Figure 16: Box plots for price dispersion between and within countries

Figure 16 presents box plots for the dependent variable (mean absolute log price difference) within and between the three countries. Both diagrams indicate evidence of substantial heterogeneity in price distribution of city-pairs within and between countries, particularly in the first period. The within-country distribution of price dispersion is systematically different between the three countries in both periods. This evidence is sufficient for us to suspect possible cross country heterogeneity effect.

To control for country heterogeneity that could bias the results, we draw from the procedure proposed by Gorodnichenko and Tesar (2009) by including three dummy variables that capture country-specific effects in relative price variability. The specification is as follows:

$$\begin{aligned}\left|Q_{ij,k,t}\right| &= \alpha_1 border_{ij} + \alpha_2 ldist_{ij} + \alpha_3 ldist2 + \alpha_4 LS_{ij} + \alpha_5 LB_{ij} + \alpha_6 LL \\ &+ \alpha_7 SS + \alpha_8 Z + \sum\nolimits_k \gamma_k D_k + \sum\nolimits_{ij} \delta_{ij} D_{ij} + \lambda_t + \varepsilon_{ij,t}\end{aligned} \quad (5)$$

Where $border_{ij}$ is the BOTSWANA-SA dummy variable, which is our reference variable. LL_{ij} and SS_{ij} are country dummies that estimate the price difference within Lesotho and South Africa respectively.[72] α_6 and α_7 reflect the institutional and structural features of the data, specific to city-pairs within Lesotho and within South Africa respectively. LS_{ij} and LB_{ij} reflect the variation in prices that is specific to crossing a national border (between-country variation) between Lesotho and South Africa and Lesotho and Botswana respectively. α_4 measures the increase in the relative price difference of a city pair between Lesotho and South Africa in relation to a Botswana-South Africa city pair (the baseline variable). α_5 measures the increase in relative price variation of a city-pair between Lesotho and Botswana compared to a Botswana-South Africa city pair. α_1 measures the increase in relative price variation of city-pairs between Botswana and South Africa. Therefore, by including these dummies, we separate country heterogeneity from the true effect of national borders between the three countries. We cannot include both the border dummy variable and

[72] Gorodnichenko and Tesar (2009) propose a conventional approach to reduce the border effect as much as possible. They suggest choosing the country which has the lowest price difference between within-country and between-country city-pairs. In our case this is Botswana (as observed in figure 5), thus all regressions are estimated without a 'Botswana - Botswana' dummy variable.

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dummy variables for all three countries as this would create the problem of perfect collinearity. We drop the within-Botswana city-pair dummy variable as they have the minimum price dispersion in both periods, according to figure 16. Table 24 presents the results of the analysis of border effects when we control for cross-country heterogeneity.

Table 24: Border effect and product market integration with cross country heterogeneity (2004-2008)

Dependent variable is mean absolute price difference	2004-2006 (1)	(2)	(3)	(4)	2006-2008 (1)	(2)	(3)	(4)
Log of distance	0.001***	0.019***	0.033***	0.030***	0.003***	0.015***	0.024***	0.026***
	(0.000)	(0.004)	(0.004)	(0.008)	(0.000)	(0.002)	(0.002)	(0.002)
Square of distance		-0.001***	-0.003***	-0.002**		-0.001***	-0.000***	-0.002***
		(0.000)	(0.000)	(0.001)		(0.000)	(0.000)	(0.000)
Botswana-SA	**0.313*** **	**0.313*** **	**0.292*** **	**0.269*** **	**0.228*** **	**0.230*** **	**0.230*** **	**0.234*** **
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.000)	(0.000)	(0.001)
Lesotho-SA	-0.024***	-0.024***	-0.033***	-0.035***	-0.085***	-0.086***	-0.084***	-0.041***
	(0.001)	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)	(0.001)	(0.003)
Lesotho-Botswana	0.040***	0.040***			0.076***	0.076***		
	(0.001)	(0.001)			(0.001)	(0.001)		
Within SA	0.178***	0.179***	0.157***	0.150***	0.023***	0.024***	0.024***	0.029***
	(0.001)	(0.001)	(0.001)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Within Lesotho	0.082***	0.083***	0.098***	0.080***	0.005***	0.005***	0.008***	0.010***
	(0.002)	(0.002)	(0.001)	(0.004)	(0.001)	(0.001)	(0.002)	(0.004)
Constant	0.088***	0.032**	0.005	0.058***	0.198***	0.153***	0.155***	0.115***
	(0.003)	(0.013)	(0.012)	(0.021)	(0.001)	(0.004)	(0.004)	(0.006)
City & month dummies	yes	yes	yes	yes	yes	yes	yes	yes
Observations	992,961	992,961	832,092	384,579	7,191,256	7,191,256	6,437,939	2,904,756
Adj. R-squared	0.40	0.40	0.38	0.47	0.51	0.51	0.50	0.20

Robust and clustered standard errors are in parentheses. Column 1 is basic specification while column 2 controls for non-linearity of distance. Column 3 and 4 excludes the Lesotho-Botswana city-pairs. Column 4 is also a restricted model with border city-pairs that are <= 500km apart. Note: restricting the border city-pairs to 250km apart does not change the results. All regressions include city and month dummies. *** p<0.01, ** p<0.05, * p<0.1 We estimate the size of the distance-equivalent border effect using $B = \exp\left(\alpha_1/\alpha_{2+}\alpha_3\right)$ which was also used by Engel and Rogers (1996) and also Gorodnichenko and Tesar (2009) and use the alternative

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Column 1 and 2 are regression results for the full sample and the following features are evident. Firstly, the effect of distance is highly significant and positive but small in magnitude. Controlling for non-linearity of distance in column 2 does not change the significance and magnitude of coefficients. The distance effect is concave as the log of distance is positive and significant and the squared distance is significant and negative. Secondly, the within-country border effect is less than the between-country border effect across the two time periods. Thirdly, the Lesotho- South Africa border effect is lower than the Botswana- South Africa border effect in both periods. In the first period, the Lesotho- South Africa border effect was 2.4 percentage points lower than the Botswana- South Africa border effect, while in the second period it was 5.9 percentage points lower. Overall, these results show evidence of increased price integration in product markets between Lesotho and South Africa and between Botswana and South Africa over the two periods.

The results also reveal that a larger border effect between Lesotho and Botswana than between to the Botswana- South Africa. The border effect between Lesotho and Botswana was 4 percentage points higher than the SA-Botswana border effect during the first period and 9.3 percentage points higher in the second period. These results suggest reduced product market integration between Botswana and Lesotho.

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Controlling for non-binding price pairs

One concern with these estimates is that the sample may include product pairs where price differences are less than the transaction costs between the regions. As Borazz *et al.* (2012) show, the inclusion of these pairs leads to biased estimates of the distance and border effects. Anderson et al. (2010) also argued that when price dispersion measure includes all possible bilateral comparisons, spatially relevant source-to-destination location pairs are mixed with irrelevant location pairs.

In this chapter, we deal with these concerns by conducting several tests for robustness of the estimates. We first exclude the irrelevant city-pairs which are considered to be Lesotho-Botswana city-pairs because the two countries are very distant from each other; the shortest bilateral distance is 557 km (between Hlotse and Lobatse). Therefore it would not be realistic to assume that prices in Lesotho could be directly affected by prices in Botswana except through South Africa. Column 3 presents the results of equation 5 re-estimated without these city-pairs.

The results show that the effect of distance is highly significant and concave as predicted by the gravity model. The results indicate that, for example, a distance of 100 km between two cities results in a 15.2 percent deviation from LOP.[73]

The Botswana-South Africa border effect is positive and significant in both periods. This implies that the relative price differences between South Africa and Botswana due to the presence of a border between the two is 29.2 percent in the first period and 23 percent in the second period. The border effect between Lesotho and South Africa is lower than the Botswana- South Africa border effect. The relative price differences between South Africa and Lesotho due to the presence of a border between the two is 25.9 percent in the first period and 14.6 percent in the second period. We can explain the results in terms of how much the presence of a border adds to the distance between two countries. The presence of the border between Botswana and South Africa increase distance by 15, 783 km in the first period and 14, 520 km in the second period while the border between Lesotho and South Africa increases the distance by 2554 km in the first period and 438 km in the second period.[74]

The second robustness check involves restricting the sample to city-pairs that are less than 500 km apart. The results presented in column 4 do not change significantly. Thus

[73] This is estimated as $\left(\alpha_2 = 0.033\right) * \ln\left(100\right)$, as in Versailles (2012)

[74] These were estimated using $B = \exp\left(\alpha_1 / \alpha_{2+} \alpha_3\right)$

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Column 3 represents our benchmark empirical specification for the analysis of border effect, as they exclude irrelevant city-pairs between Lesotho and Botswana.

Overall, the results show evidence of increased price integration within and between Botswana, Lesotho and South Africa, yet border effects are also significant between these countries. This result is comparable to the results found in similar research on other African countries (for example, Versailles, 2012; Arker *et al.*, 2010). As expected, product markets are more integrated between Lesotho and South Africa than between Botswana and South Africa in both periods. This suggests that even though the three countries are members of the customs union, monetary union has a more significant impact on product market integration between member countries than the customs union. In the next section, we test the robustness of these results.

4.5.4 Additional robustness checks

In this section, we investigate the robustness of the results in Table 25. First, equation (5) is re-estimated using the standard deviation of log price difference as the alternative measure of the dependent variable. Secondly, we re-estimate equation (5) by restricting the sample to homogeneous individual products. Finally, we re-estimate the border effect using the quantile regression to control for possible outliers in the data which could bias the results.

Using the standard deviation of log price difference

To check the sensitivity of the results obtained in Table 25, we use the alternative measure of price integration which is referred to as relative price integration. Unlike the previous measure of product market integration which looked at a city-pair's absolute price differences, this approach measures the city-pair's relative price differences across products. The dependent variable of equation (5) is then defined by the standard deviation of log price difference; $sdq_{ij,t} = sd_k\left(Q_{ij,k,t}\right)$ across products *k*. It measures the extent to which the price of

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good k in city i relative to good k in city j differs in country i from country j. This approach is consistent with standard economic models where allocation of resources is determined by internal relative prices. It also has the advantage of identifying evidence of integration that is not revealed by changes in the mean deviation from LOP (Edwards and Rankin, 2012).This is because there may be observed price convergence between city-pairs even if the deviation from the mean is increasing. Equation (5) then becomes as follows:[75]

$$
\begin{aligned}
sdq_{ij,t} &= \alpha_1 boder_{ij} + \alpha_2 ldist_{ij} + \alpha_3 ldist2 + \alpha_4 LS_{ij} + \alpha_5 LB_{ij} + \alpha_6 LL \\
&\quad + \alpha_7 SS + \alpha_8 Z + \sum_{ij} \delta_{ij} D_{ij} + \lambda_t + \varepsilon_{ij,t} \qquad (6)
\end{aligned}
$$

Table 25 presents the estimated results for the two data sets. The first sample yields 53, 555 observations while the second sample yields 203, 919 observations. The first and second columns present the coefficients for the full sample while the third columns exclude the Botswana-Lesotho city pairs.

Table 25: Regression results on relative price dispersion (2004-2008)

The dependent variable is the standard deviation of the log price difference	2004-2006 (1)	(2)	(3)	2006-2008 (1)	(2)	(3)
Log of distance	0.006***	0.072***	0.090***	0.006***	0.030***	0.008**
	(0.001)	(0.011)	(0.011)	(0.001)	(0.003)	(0.003)
Square of distance		-0.007***	-0.008***		-0.003***	-0.003***
		(0.001)	(0.001)		(0.000)	(0.000)
Botswana-SA	0.310***	0.312***	0.312***	0.256***	0.258***	0.258***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Lesotho-SA	-0.014***	-0.017***	-0.020***	-0.052***	-0.054***	-0.052***
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
Lesotho-Botswana	0.162***	0.163***		0.135***	0.136***	
	(0.002)	(0.002)		(0.001)	(0.001)	
Within SA	0.085***	0.086***	0.085***	0.025***	0.026***	0.027***
	(0.003)	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)
Within Lesotho	0.088***	0.092***	0.088***	0.029***	0.030***	0.032***
	(0.004)	(0.004)	(0.006)	(0.003)	(0.003)	(0.005)
Constant	0.285***	0.055*	0.010	0.378***	0.275***	0.282***
	(0.008)	(0.032)	(0.034)	(0.003)	(0.012)	(0.012)
City and Month dummies	yes	yes	yes	yes	yes	yes
Observations	53,555	53,555	47,307	203,919	203,919	179,279
Adj. R-squared	0.43	0.43	0.35	0.54	0.54	0.47

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The results show that there is increased relative price convergence between countries over the two periods. The relative price convergence between Botswana- South Africa cities is greater

[75] This measure of price dispersion is also used by Parsley and Wei (2003), Edwards and Rankin (2012)

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than between Lesotho-South Africa cities. However, there is no evidence of relative price convergence between Lesotho-Botswana cities. These results are consistent with the results in terms of the absolute price dispersion, suggesting that there is evidence of increased price integration between Botswana- South Africa and Lesotho-South Africa cities over the sampled period in terms of absolute and relative terms. Distance effect is concave but greater in the first period than in the second period.

Using the sample of homogeneous products

Another source of bias in the estimation of price differences is inclusion of differentiated product combinations. We test the robustness of our results by using a sub-sample of 13 homogeneous products such as 410 g of canned beans in tomato sauce and 750 ml of sunflower cooking oil.[76] Table 26 presents the results.

Table 26: Regression results on price dispersion using identical products (2006-2008)

Dependent variable is the mean of absolute log price difference	**(2004-2006)** general	general	cities border <500km	**(2006-2008)** general	general	cities border <500km
Log of distance	0.009***	0.066***	0.056***	0.010***	0.021***	0.014***
	(0.001)	(0.010)	(0.020)	(0.000)	(0.004)	(0.005)
Square of distance		-0.006***	-0.006***		-0.003***	-0.002*
		(0.001)	(0.002)		(0.000)	(0.000)
Botswana-SA	0.171***	0.174***	0.191***	0.175***	0.172***	0.147***
	(0.003)	(0.003)	(0.004)	(0.002)	(0.002)	(0.002)
Lesotho-SA	-0.036***	-0.039***	-0.057***	-0.099***	-0.097***	-0.067***
	(0.005)	(0.005)	(0.007)	(0.003)	(0.003)	(0.005)
Within-SA	0.045***	0.047***	0.045***	0.011***	0.010***	0.013***
	(0.004)	(0.004)	(0.006)	(0.003)	(0.003)	(0.003)
Within-Lesotho	0.093***	0.097***	0.073***	0.055***	0.055***	0.060***
	(0.007)	(0.007)	(0.010)	(0.006)	(0.006)	(0.008)
Constant	0.137***	0.150***	0.191***	0.1016***	0.200***	0.115***
	(0.007)	(0.027)	(0.048)	(0.003)	(0.009)	(0.011)
City dummies	Yes	Yes	Yes	Yes	Yes	Yes
Month dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	167,290	167,290	72,652	775,174	775,174	326,195
Adj. R-squared	0.09	0.09	0.10	0.14	0.14	0.07

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

The results show that even after we control for product heterogeneity, the results still hold, except that in this case the magnitude of the border dummy coefficient is lower while the distance effect has increased. This suggests that controlling for product quality reduces the

[76] See appendix 4.2 for the detailed list of these products.

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magnitude of the border effect. This result is consistent with the fact that the more similar the products, the more important distance is in determining relative prices. And the more similar the products the lower the border effect as the coefficient no longer captures variations in quality.

Estimation using Quantile regression

The standard method of estimating transaction costs relates transaction costs to distance according to the assumption of 'iceberg' transport costs generated by Samuelson (1954). However, this method has been criticised as not being able to fully explain the relationship between costs and distance. We also use the alternative method of Quantile regression analysis to test the robustness of the results. This method has considerable appeal for several reasons. For example, the median regression (least absolute-deviations regression) is argued to be more robust to outliers than the mean regression which is a common feature for price data (Cameron and Trivedi, 2009). It is also suitable for heteroskedastic data as it uses the semi-parametric approach.

$$\left|Q_{ij,k,t}\right| = \alpha_1 border_{ij} + \alpha_2 ldist_{ij} + \alpha_2 ldist2 + \alpha_4 Z + \varepsilon_{ij,t} \tag{7}$$

Q estimates 50^{th} quintile of the absolute price differences for all the city-pairs *i* and *j*. The results are presented in table 27.

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Table 27: Border effect and product market integration using Quantile regression

The dependent variable is the median absolute price difference	(1)	(2)	City-pairs <=500km	(1)	(2)	City-pairs <=500km
		2004-2006			**2006-2008**	
Botswana-SA	0.194***	0.196***	0.199***	0.173***	0.173***	0.167***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Log of distance	0.004***	0.020**	0.052***	0.006***	0.005**	0.037***
	(0.001)	(0.010)	(0.017)	(0.000)	(0.002)	(0.004)
Square of distance		-0.001*	-0.005***		-0.001*	-0.003***
		(0.001)	(0.002)		(0.000)	(0.000)
Lesotho-SA	-0.063***	-0.064***	-0.062***	-0.106***	-0.106***	-0.080***
	(0.002)	(0.002)	(0.003)	(0.001)	(0.001)	(0.002)
Within SA	0.054***	0.054***	0.057***	0.012***	0.012***	0.015***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
Within Lesotho	0.039***	0.039***	0.039***	-0.003	-0.003	-0.003*
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
Constant	0.079***	0.034	-0.050	0.111***	0.113***	0.039***
	(0.006)	(0.029)	(0.043)	(0.002)	(0.006)	(0.009)
Observations	125,905	125,905	55,879	1,080,110	1,080,110	454,463

Bootstrapped standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The results are consistent with the previous results except that the Botswana-South Africa border effect declined by half. This could be because the median estimates are robust to outlying city-pairs which are unrelated.

Overall, the results presented in this section are consistent and robust to several sensitivity tests. The results suggest evidence of increased price integration in product markets, more between Lesotho and South Africa than between Botswana and South Africa. The magnitude of increased integration is more pronounced between the CMA countries relative to Botswana and South Africa.

In this section we analyse the extent of product market integration between city-pairs in Botswana, Lesotho and South Africa. The results reveal the following key features. First, at the product level, price variation between countries is greater than price variation within countries. Secondly, there is evidence of the presence of the border effect between countries but this declines over the period of analysis. When we control for cross-country heterogeneity, product markets are more integrated between city-pairs in Lesotho and South Africa than between city-pairs in Botswana and South Africa.

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These results are consistent with increased product market integration associated with the monetary union (CMA) between Lesotho and South Africa. However, given the estimation procedure used in this section, it is not possible to isolate the true quantitative impact of the monetary union that could influence the observed integration in product markets. In the next section, we explicitly discuss this method and estimate the impact of monetary union on product market integration among the three countries.

4.6 The impact of monetary union on product market integration

In this section, we analyse the impact of monetary union on product market integration between Botswana, Lesotho and South Africa. We first discuss the methodological issues that are related to estimating the impact of monetary union. We outline the empirical estimation strategy that is used to analyse the impact of a policy shock and also present the results.

4.6.1 Background information: monetary integration within Southern Africa

In a simple case, estimating the impact of monetary union on product market integration would involve analysing how prices could respond between countries in a monetary union and those not in a monetary union. However, this method has not been successful in isolating the true effect of a policy change in our case. The main challenge lies with interpretation of the coefficient of the border effect as an indicator of the effect of monetary union. The basic problem is that some country-specific omitted variable may account for differences in the level of product market integration. If this is correlated with monetary union, then this will lead to biased results or inappropriate inferences regarding the effect of monetary union on product market integration.

The common idea of trying to mimic a randomised experiment involves finding equivalents of the “treatment” and the “control” groups in which everything (apart from the variable of interest) is assumed to be the same. However, it is difficult to make this

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assumption because most frequently the observed differences between treatment and control group maybe the result of some other omitted factors. For example, it may be difficult to know the degree of price integration had a specific country not joined the monetary union. This implies that the lower-South Africa border effect compared to the Botswana-South Africa border effect may reflect country-specific effects and not the impact of the CMA on price integration between Lesotho and South Africa

In order to estimate the treatment effect, we also need sufficient information before and after the policy shock on the treatment and the control group. In our case, this would mean obtaining appropriate information (for example price data, exchange rate data among others) before and after the formation of a monetary union (CMA).

However, it is not possible to obtain information before the formation of CMA given the price data available for this study. An alternative approach is therefore followed. To analyse the treatment effect of a monetary union, we select the case study of Botswana policy shocks that have similar characteristics to those of a monetary union. We consider two policy shocks in Botswana (which is not a member of the CMA) that makes it possible to analyse the impact of policy shocks through channels similar to those of a monetary union (the exchange rate and interest rate channels). The remainder of this subsection presents and overview of this policy shocks and illustrates how they are linked to product market integration within the region.

Botswana's withdrawal from the CMA in 1975 enabled the country to retain its ability to formulate and implement its own monetary policy and to adjust the exchange rate, if necessary, in response to shocks affecting its economy (Wang *et. al.*, 2007). However, in recent years, Botswana revised its monetary policy and exchange rate framework to become more closely aligned with those of the CMA.

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Exchange rate

Although Botswana is not a CMA member, to a substantial degree, the Pula tracks the Rand. In 30 May 2005, Botswana introduced the crawling peg exchange rate policy regime.[77] Under the Crawling peg exchange rate regime, the Pula is pegged to a basket of currencies consisting of the Rand and the Special Drawing Rights (SDR), where the Rand weighs around 60 to 70 percent (Wang *et. al.*, 2007).[78] As a result of this policy change, the Pula approximates the Rand.

Figure 17 displays the bilateral exchange rate between the South African Rand and the Botswana Pula over the past three decades. There are two important observations to note from this diagram. Firstly, there has been a strong convergence of the Pula towards the Rand from 2005. The data shows that after 2005, the exchange rate between Botswana and South Africa moved towards parity, such that in 2011, it was 1.05. Secondly, there has been stability in the exchange rate since 2005. The exchange rate was 1.36 in 2000 and increased to 1.66 in 2002 but declined to 1.37 in 2004. But after the introduction of the crawling peg regime, the exchange rate declined to 1.25 at the end of 2005 and further to 1.15 in 2006. These observations suggests the approximation of a fixed exchange rate as a result of the change in the exchange rate framework in Botswana.

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[77] The crawling peg exchange rate system is where in a fixed exchange rate system the par value of a currency is adjusted continuously within a certain range of values. The adjustments are carried out continuously rather than by sudden currency devaluations (Salvatore, 2004).

[78] The crawling peg exchange rate regime was implemented through continuous adjustment of the trade-weighted Nominal Effective Exchange Rate (NEER) of the Pula at a rate of crawl based on the differential between the Bank's inflation objective and the forecast inflation of trading partner countries.

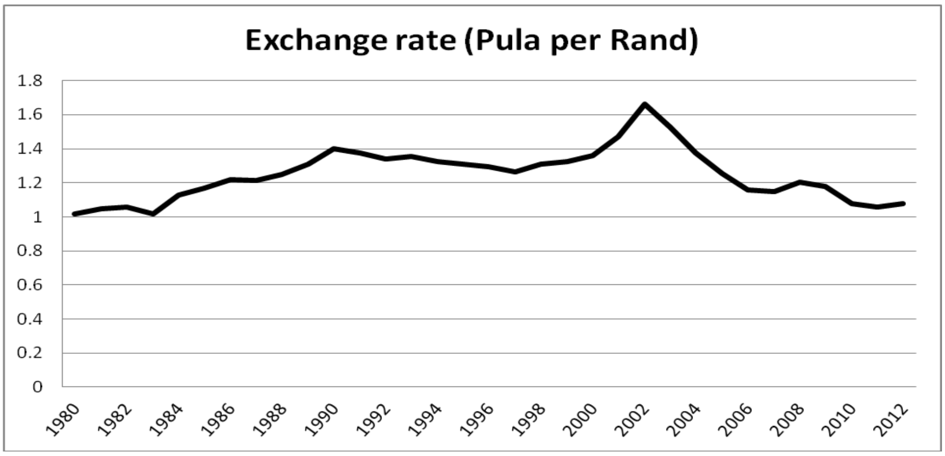

Figure 17: Botswana Pula per South African Rand (1980-2012)

Given the above, we would expect lower cross-border transaction costs, increased cross-border trade and investment and; also higher price integration between Botswana and South Africa. However, we cannot undertake a simple comparison of price integration as this could be biased by unobserved characteristics specific to South Africa and Botswana.

Monetary policy

The monetary policy position of Botswana was initially signalled through the Central Bank rate which is used as the key policy instrument to signal the direction and the magnitude by which the Bank wants market interest rates (deposit and lending rates) to change. In January 2008, the Bank of Botswana revised its price stability objective downward to an inflation range of 3-6 percent as a medium term objective over three years, similar to that of SA.[79] As a result, the inflation rate in Botswana converged to the inflation rates of the CMA countries as indicated in Figure 19. Figure 18 shows a strong co-movement in central bank policy rates and treasury bill rates, even though there are no formal arrangements for common interest rates between Botswana and the CMA countries.

[79] Central banks that use inflation targeting emphasise transparency and communication, particularly with respect to the policy framework, objectives and economic forecasts and, by so doing, they influence price and wage-setting behaviour of economic agents to be in line with the price stability objective.

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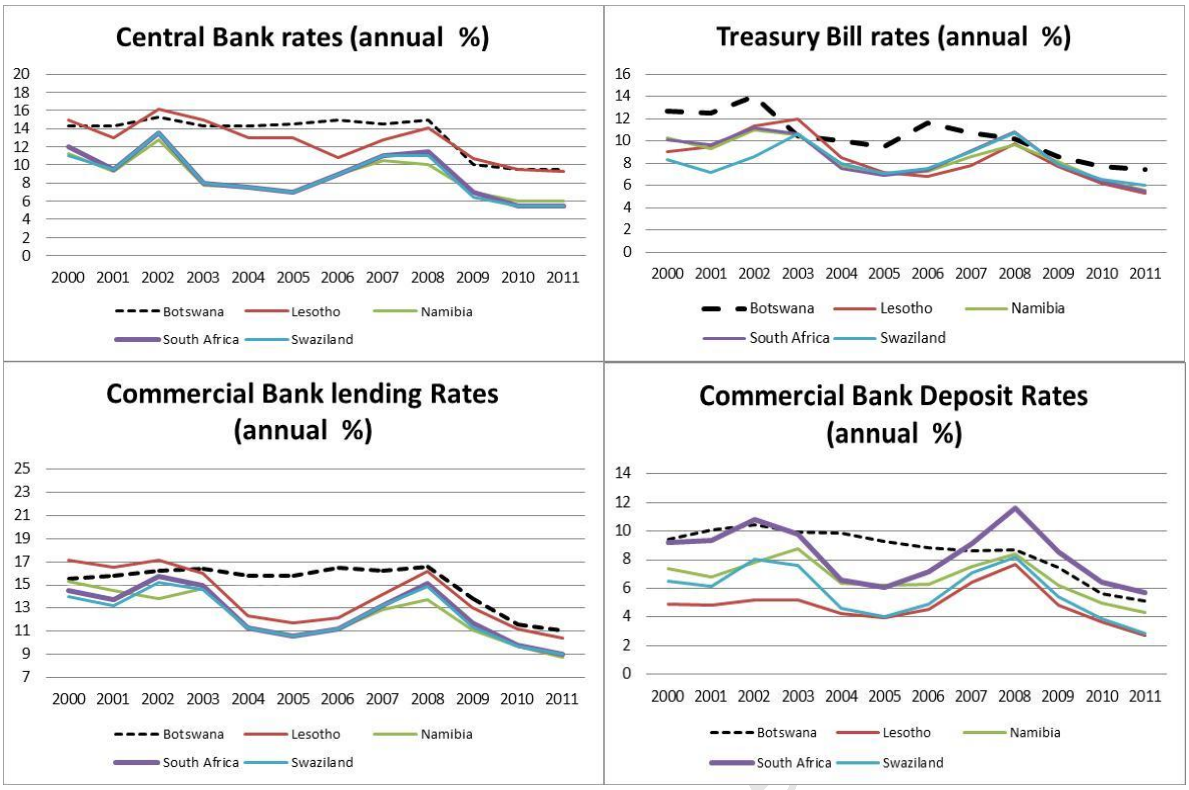

Figure 18: Interest rates for CMA countries (1990-2011)

Interestingly, this strong correlation between interest rates in Botswana and CMA countries is observed from 2008 when the bank rates started converging as a result of the adjustment of policy to stabilise inflation. For example, before 2008, the central bank rate was flat and higher (14 percent) than those of the CMA countries (8-11 percent). But after 2008, we observe a strong co-movement, where it declined to 10 percent, similar to that of Lesotho. Strong co-movement is also observed in treasury bills- and commercial bank rates, -from 2008. Thus, the synchronised movements of central bank rates between Botswana and the CMA countries suggest that from 2008, Botswana monetary policy became an approximation of a de facto single monetary policy operative throughout the CMA. [80]

[80] SA has had a successful adoption of an inflation targeting framework since 2001.

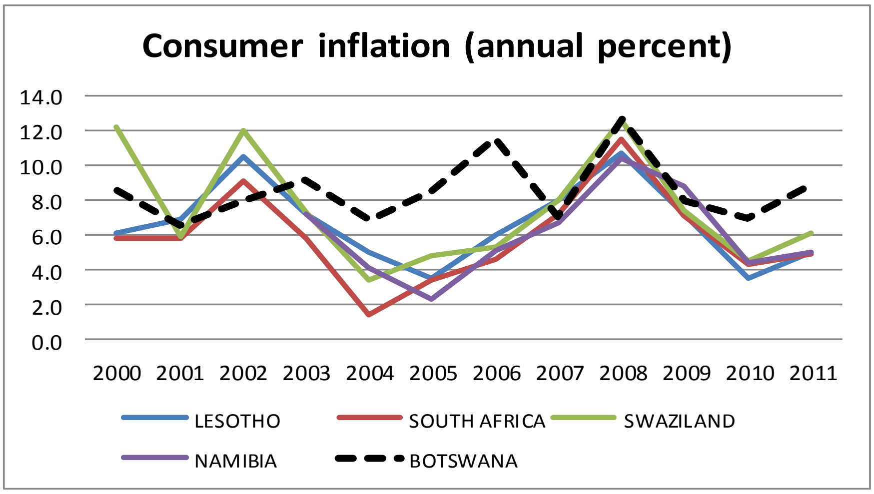

Figure 19: Consumer price inflation for SACU countries (2000-2011)

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Consequently, inflation rate of Botswana converged to those of the CMA countries (around 2007-2009) as depicted in Figure 19. The convergence of the Botswana inflation rate to those of CMA countries suggests evidence of monetary policy transmission to aggregate inflation in Botswana. However, this transmission is mainly determined by the responses of the underlying components such as relative price effects at the disaggregated level. Thus the source of the underlying co-movement in inflation rates is unclear; hence the need to investigate using disaggregated product level price data.

Given the foregoing, it is expected that the introduction of policy reforms in Botswana will increase price integration in product markets between Botswana and the CMA countries. In the next section, we outline the empirical methodology that is used to isolate the true impact of policy shocks in Botswana on product market integration in the region.

4.6.2 Empirical strategy

Estimating the impact of a monetary union involves identifying the treatment effect. However, identifying the treatment effect of a policy requires spelling out a counterfactual which will tell us the price difference between the two countries had there not been a policy. But such a counterfactual is essentially unobservable and therefore requires strong identifying assumptions (for example, it requires that the control and treatment groups be exactly the same). Consequently, the observed coefficients on policy variables may provide biased estimators of the effect of policy.

To estimate the treatment effect of a policy, one can use the Difference-in-Difference (DD) estimation technique. DD estimation is a useful tool in measuring the quantitative impact of a policy treatment on a specific group. It assumes that the change in controls is a good estimate of counterfactuals (what would have happened to a treated group if there was no policy treatment). The validity of the DD estimator is based on the assumption that the underlying 'trends' in the outcome variable are the same for both the treatment and control group. This assumption is never testable and with only two observations, it is hard to demonstrate as plausible. But, with more than two observations, such as in our case, we can get some idea of its plausibility. The standard DD model is given as follows:

$$Y_{it} = \beta_0 + \beta_1 \left(treat_{it} \right) + \beta_2 \left(post_{it} \right) + \beta_3 \left(treat_{it} \right) \times \left(post_{it} \right) + \varepsilon_{it} \qquad (8)$$

Where Y_{it} is the dependent variable; β_0 is the effect on Y_{it} for the treatment group in the pre-treatment period (before the policy shock); $treat_{it}$ is the dummy variable which is =1 if individual is in the treatment group and is equal to 0 if the individual is in the control group; β_1 is therefore the effect on Y_{it} for the treated group. $post_{it}$ is the dummy variable which is =1 for the post-treatment period and is = 0 if in the pre-treatment period; β_2 is therefore the effect on Y_{it} after the treatment. The interaction term $\left(treat_{it} \times post_{it} \right)$ takes the value of 1 if the individual is in the treatment group in the post-treatment period. Therefore, β_3 is the DD estimate; the effect of the treatment on Y_{it} in the post-treatment period. Extensions of equation (8) include fixed effects and other controls that may affect the dependent variable (Y_{it}).

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The empirical framework used in this chapter draws largely from a study by Martin and Mejean (2012) who estimated the impact of the introduction of the Euro on relative dispersion of export prices in the Euro-zone. It involves comparing the magnitude of the gap between retail prices at the product level between CMA countries and Botswana (non-CMA country) before and after the policy change in Botswana. The CMA countries (South Africa and Lesotho city-pairs) are used as the control group to capture any changes in price differences that are not related to changes in Botswana policies. In DD estimation, the control group has to be as similar as possible to the treatment group and in our case, the similarity lies in the fact that all are members of the customs union (SACU).[81] City-pairs between Lesotho and South Africa therefore serve as the appropriate control group because they have introduced similar economic policies to Botswana and these policies are aimed at increasing market integration within the SACU.

In estimation, the average price difference is computed for each CMA city-pair (Lesotho-South Africa) and city-pairs with a non-CMA country (Botswana-Lesotho and Botswana-South Africa) for the period before the policy change (January 2004 to May 2005 for exchange rate policy change and September 2006 to January 2008 for monetary policy change) and the period after the introduction of policy change (June 2005-August 2006 for exchange rate policy reform and February 2008 to December 2009 for monetary policy reform).

The method of estimation is divided into two components. First, the effect of the exchange rate policy shock on price integration is estimated based on the assumption that the policy change in Botswana represents a reduction in exchange rate volatility. Therefore product market integration is affected by this policy shock through the exchange rate channel. Secondly, the effect of this monetary policy shock on price integration is estimated based on

[81] Grandes (2003) finds significant co-movement in real exchange rates which indicates the existence of common trends between Botswana and the CMA countries.

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the presumption that the policy change in Botswana represents price stability due to convergence in interest rates. Therefore product market integration is affected through the interest rate channel. Based on these two estimation frameworks, the hypothesis is that the more harmonised monetary and exchange rate policy frameworks are between Botswana and South Africa, the more integrated their product markets will be. Given this information, we are then able to estimate the treatment effect of two policy shocks for two different periods (2005 and 2008) through the following specification:

$$
\begin{aligned}
\left|Q_{ij,k,t}\right| = {} & \beta_1 border_{ij} + \beta_2 Dnon-cma + \beta_3 border * Dnon-cma + \beta_4 Dpost-shock \\
& + \beta_5 Dnon-cma * Dpost-shock + \beta_6 border_{ij} * Dpost-shock \\
& + \beta_7 border_{ij} * Dnon-cma * Dpost-shock
\end{aligned} \tag{9}
$$

To obtain the DD estimator, additional two dummy variables are generated: $Dnon-cma$ *and* $Dpost-shock$. $Dnon-cma$ is the dummy variable for the treatment group (Botswana) which takes the value of 1 if the city-pairs are Botswana-Lesotho and Botswana-South Africa and zero otherwise. $Dpost-shock$ is the dummy variable which takes the value of 1 if period is post-May 2005 (for the change in exchange rate policy) or post-January 2008 (for change in the monetary policy) and zero otherwise. This variable measures changes over time that affect the border effect among the CMA countries found in the previous section. $\beta_1 > 1$ is the border effect before the introduction of a policy; $\beta_2 > 0$ is the border effect with city pairs with Botswana before the introduction of policy relative to the border effect of CMA countries before the policy change (level effect of the policy change in Botswana); β_3 is the border effect for city pairs with Botswana before the policy change; β_4 is the border effect for city pairs with Botswana after the policy change relative to the border effect with city pairs Botswana before the policy change; $\beta_5 < 0$ is the level effect of the policy change

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in Botswana after the policy shock; β_6 is the Lesotho-South Africa border effect after the policy change; $\beta_7 < 0$ is the coefficient of interest, which is a DD estimate. It measures the specific impact of the policy change on the border effect between Botswana and South Africa.[82] We can manually compute the DD estimate with the following table:

	Post-shock	Pre-shock	**Difference**
Treatment	$\beta_1 + \beta_2 + \beta_3 + \beta_4 + \beta_5 + \beta_6 + \beta_7$	$\beta_1 + \beta_2 + \beta_3$	$\beta_4 + \beta_5 + \beta_6 + \beta_7$
Control	$\beta_1 + \beta_4 + \beta_5 + \beta_6$	β_1	$\beta_4 + \beta_5 + \beta_6$
Difference	$\beta_2 + \beta_3 + \beta_7$	$\beta_2 + \beta_3$	β_7

Equation (9) allows for the analysis of the treatment effect of the monetary union between Botswana and the CMA countries. The dependent variable is computed at the product, month and city level. Product and city fixed effects are included to control for possible heterogeneity in city and product-specific characteristics respectively, that can influence the border effect. Distance variables are also included. The estimated equation then becomes:

$$\begin{aligned} \left|Q_{ij,k,t}\right| = {} & \beta_1 border_{ij} + \beta_2 Dnon-cma + \beta_3 border * Dnon-cma + \beta_4 Dpost-shock \\ & + \beta_5 Dnon-cma * Dpost-shock + \beta_6 border_{ij} * Dpost-shock \\ & + \beta_7 border_{ij} * Dnon-cma * Dpost-shock + \beta_8 ldist + \beta_9 dist2 + \beta_{10} LS \\ & \beta_{11} LB + \beta_{12} SS + \beta_{13} LL + \sum_{ij} \delta_{ij} D_{ij} + \sum_{k} \gamma_k D_k + \lambda_t + \varepsilon_{ij} \end{aligned} \tag{10}$$

Equation (10) is the benchmark equation for estimating the treatment effect of monetary union on price integration. If the anticipation of policy effects is assumed away, the following result holds:

$\delta_{ij} = 0,\ \beta_7 = 0 \rightarrow$ Policy shock has no effect

[82] The policy change can either be the introduction of a crawling peg in 2005 or the introduction of inflation targeting policy in 2008. The border effect between Botswana and Lesotho is excluded because we have restricted it to zero in the benchmark specification

$\delta_{ij} = 0,\ \beta_7 \neq 0 \rightarrow$ Policy shock has full effect

Equation (8) is estimated using 'within-product' fixed effects, absorbing the interaction of city by month dummies, assuming that: (i) there are common characteristics across city-pairs; (ii) the policy variable is strictly exogenous since policy assignment does not change in reaction to past outcomes on the dependant variable, and the errors are roughly uncorrelated. The cluster-robust variance estimators at city by month level are also used. The great appeal of this type of estimation is its simplicity as well as its potential to overcome many of the endogeneity problems that typically arise when making comparisons between heterogeneous entities.

4.6.3 Empirical estimation and results

The main focus of this chapter is to analyse the impact of policy change in Botswana on retail product prices between Botswana and the CMA countries. Table 28 presents the descriptive statistics for absolute price dispersion before and after the policy change for the periods (2004-2006) and (2006-2008).[83]

Table 28: Price dispersion for pre and post shock periods

MEAN ABSOLUTE VALUE				
COUNTRY-PAIR	**pre-shock2006**	**post-shock2006**	**pre-shock2008**	**post-shock2008**
BETWEEN COUNTRY	**0.433**	**0.428**	**0.459**	**0.44**
SA-LESOTHO	0.388	0.391	0.348	0.383
BOTSWANA-LESOTHO	0.514	0.512	0.518	0.538
SA-BOTSWANA	0.439	0.424	0.437	0.452
WITHINCOUNTRY	**0.225**	**0.224**	**0.228**	**0.227**
intra-SA	0.240	0.235	0.249	0.239
intra-BOTSWANA	0.159	0.168	0.215	0.221
intra-LESOTHO	0.221	0.237	0.218	0.252

There are two main conclusions that can be drawn from the data. First, there is evidence of increased integration in retail product prices for city-pairs within countries relative to product prices for city-pairs between countries, before and after the policy change, in both periods. Price deviations for city-pairs between countries are on average 2 times price deviations for city-pairs within the countries. Second, retail product prices differ substantially across city

[83] In table 29, lower values implies there are smaller deviations from LOP and higher values imply larger deviations from LOP

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pairs and between periods. It is difficult to make conclusions about the source of this variation as it may be reflecting a number of product-specific and city-specific factors. Figure 20 plots kernel densities of mean absolute price dispersion before and after the policy change.

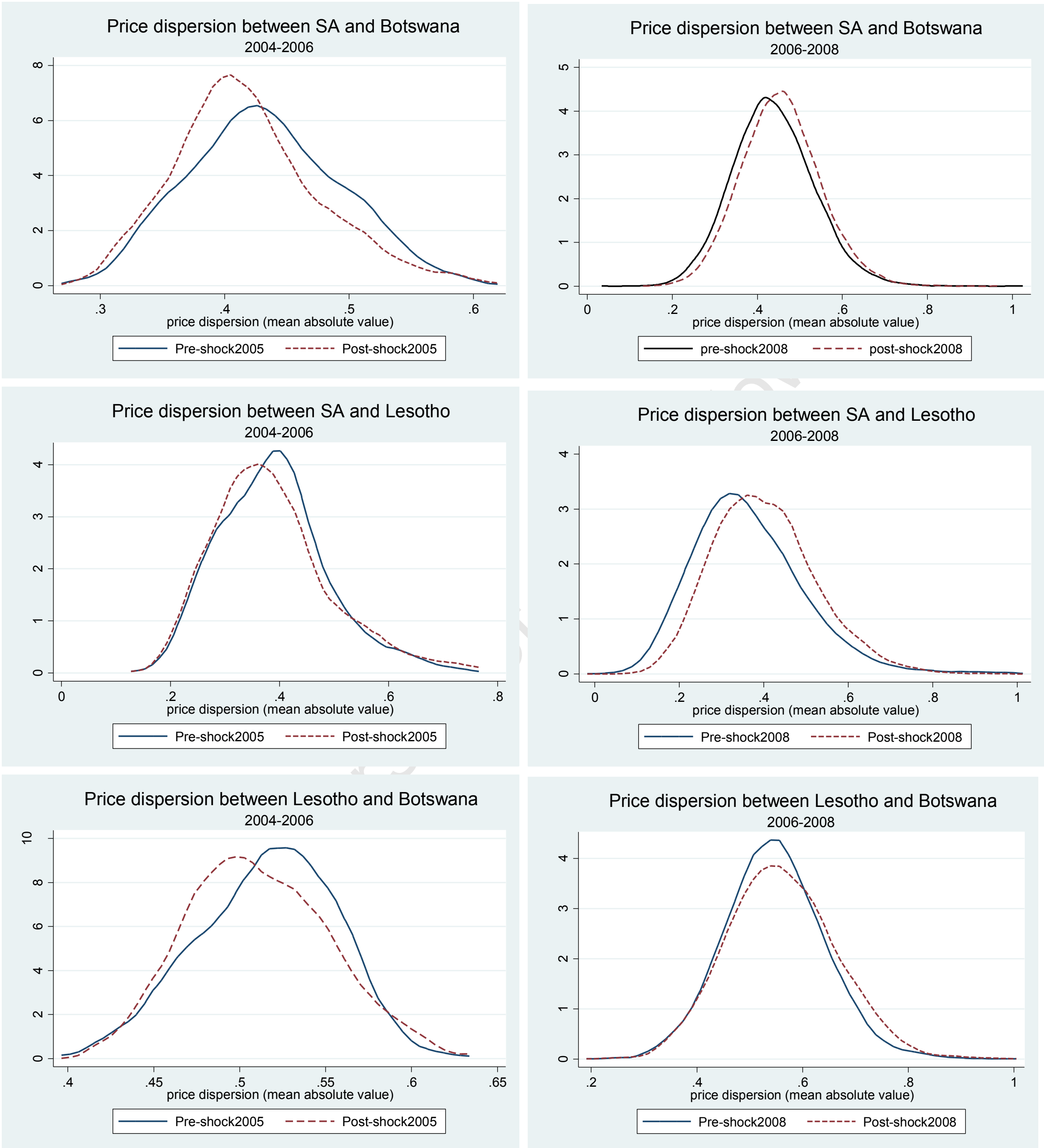

Figure 20: Kernel densities for price dispersion for pre and post shock periods

Figure 20 does not show significant price convergence between countries as a result of a price change, although in the first period (2004-2006) there is a marginal decline in price dispersion between countries, particularly between countries that share a national border

(Botswana and South Africa and Lesotho and South Africa). Yet this pattern could be the result of differences due to trade costs or other factors which we control for in the next section. Therefore, it is difficult to make sound conclusion based on these results. It could be that the observed results are mainly driven by factors that affect retail prices but are not related to the policy change in Botswana. This requires an estimation of product market integration across time (before and after the shock), controlling for observable and non-observable characteristics that can bias the results. In the next section, we employ the appropriate estimation to isolate the true effect the policy.

Difference-in-Difference estimation

The descriptive analysis above presents an initial representation of the trends in price differences before and after policy change but does not isolate the treatment effect of policy change on product price integration. Table 29 presents the results of the DD estimation for the two policy reforms.

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Table 29: Difference-in-difference regression results on price dispersion (2004-2008)

	2004-2006			2006-2008		
Dependent variable is the mean absolute log price difference	(1)	(2)	City-pairs <=500km	(1)	(2)	City-pairs <=500km
Log of distance	0.002***	0.038***	0.037**	0.003***	0.038***	0.036***
	(0.001)	(0.005)	(0.009)	(0.000)	(0.001)	(0.002)
Square of distance		-0.004***	-0.002**		-0.001***	-0.003***
		(0.000)	(0.001)		(0.000)	(0.000)
Botswana-SA border effect (border)	0.270***	0.282***	0.288***	0.255***	0.256***	0.250***
	(0.005)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
South Africa-Lesotho border (Les-SA)	-0.108***	-0.113***	-0.118***	-0.111***	-0.112***	-0.083***
	(0.004)	(0.004)	(0.004)	(0.002)	(0.002)	(0.003)
Within South Africa effect (within SA)	0.038***	0.055***	0.061***	0.020***	0.021***	0.020***
	(0.008)	(0.008)	(0.004)	(0.002)	(0.002)	(0.003)
Within Botswana effect (Dnon-cma)	-0.058***	-0.060***	-0.084***	-0.058***	-0.058***	-0.048***
	(0.006)	(0.006)	(0.004)	(0.002)	(0.002)	(0.004)
Dpost-shock	0.002**	0.002**	0.007***	0.002***	0.002***	0.001*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
*Botswana effect, post-shock (Dnon-cma*Dpost-shock)*	0.008**	0.008***	0.003*	0.011***	0.011***	0.008***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
*South Africa-Lesotho border, post-shock (border*Dpost-shock)*	-0.005**	-0.004**	-0.004*	0.041***	0.041***	0.046***
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)
Botswana border effect, post-shock (DD)	**-0.021*** **	**-0.021*** **	**-0.020*** **	**-0.038*** **	**-0.038*** **	**-0.039*** **
	(0.003)	(0.003)	(0.004)	(0.002)	(0.002)	(0.003)
Constant	0.165***	0.037***	0.092***	0.217***	0.178***	0.106***
	(0.005)	(0.014)	(0.022)	(0.002)	(0.004)	(0.006)
Product and city dummies	yes	yes	yes	yes	yes	yes
Observations	832,092	832,092	384,579	6,437,939	6,437,939	2,904,756
Adj. R-squared	0.36	0.36	0.33	0.29	0.29	0.25

Robust standard errors in parentheses. All the specifications exclude Botswana-Lesotho city-pair dummies. *** p<0.01, ** p<0.05, * p<0.1

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Column 1 reports the results of the baseline regression while columns 2 and 3 restrict the estimation to the assumption that the cross-border price variations sum to zero. Column 3 includes only cross-border city-pairs that are less than 500 km apart. Some key conclusions can be drawn from the results in table 28.

Firstly, the distance effect is stronger when we control for the impact of monetary union. In both periods, around 4 percent of price differences are attributable to distance. The distance effect is also concave as suggested in theory. Secondly, the results reveal increased price integration between Botswana and South Africa after the introduction of policy shocks, in both periods. The border effect between Botswana and South Africa lessens after the introduction of a policy shock. In the first period, the border effect between Botswana and South Africa declines from 28 percent before the policy shock to 26 percent after the policy shock. The DD estimate is 0.020, suggesting that the introduction of the exchange rate policy shock resulted in a 2 percentage point decline in price differences between Botswana and South Africa. In the second period, the border effect between Botswana and South Africa declines from 25 percent before the policy shock to 21 percent after the policy shock. The estimated DD coefficient is 0.038, suggesting that the introduction of the monetary policy shock resulted in a 3.8 percentage point decline in price differences between Botswana and South Africa.

This finding provides insight onto the role of exchange rate policy and monetary policy in product market integration between Botswana and South Africa. The monetary policy channel has a stronger effect on product market integration than the exchange rate channel. This finding also reveals that monetary unions increase integration of product markets between members.

Thirdly, the results also reveal increased price integration between Lesotho and South Africa over the same period. The border effect between Lesotho and South Africa is lower

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than the border effect between Botswana and South Africa. In the first period, the border effect between Lesotho and South Africa is lower than that between Botswana and South Africa by 11 percent before the policy shock and by 0.4 percent after the policy shock. This suggests that even after the policy introduction in Botswana, Lesotho-South Africa markets were more integrated than Botswana-South Africa product markets.

However, in the second period, the border effect between Botswana and South Africa declines more than the border effect between Lesotho and South Africa after the introduction of a policy shock. The border effect between Lesotho and South Africa is higher than that between Botswana and South Africa by 4 percent. This result confirms the earlier conclusion that monetary policy channels have a stronger effect on price differences between Botswana and South Africa than the exchange rate policy channel.

Finally, the results reveal evidence of increasing product market integration between Botswana and South Africa and between Lesotho and South Africa across the time periods. The border effect between Botswana-South Africa declined from 28 percent in the first period to 25 percent in the second period, while the Lesotho-South Africa border effect declined from 17 percent in the first period to 14 percent in the second period. This result shows that product markets are more integrated between Lesotho and South Africa than between Botswana and South Africa. However, there is a significant increase in product market integration between Botswana and South Africa in the period 2006-2008.[84]

Overall, important policy implications can be drawn from the results. Transport and border-related costs are major barriers to integration in product markets within the SACU, but recent efforts to strengthen and harmonise monetary policies have increased product market integration between these countries. Perhaps, further harmonisation of macroeconomic policies could further enhance integration between these countries. Product markets are not

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[84] These results are robust to alternative measures of the dependent variable such as relative price differences (see table 4.1 in appendix 4.1).

integrated within countries. Strong domestic policies that will ensure further integration between markets within countries are suggested. A declining border effect between these countries provides evidence that the exchange rate and interest rate policies are effective in influencing product market integration between the these countries.

However, these results do not provide sufficient support to conclude that the DD estimate is not biased. This is because excluding other factors that also affect the trends in product market integration between the treatment and the control groups may bias the DD estimate. We therefore test the robustness of these results in the next section.

4.6.4 Sensitivity analysis of DD estimate

In this section, we explore the robustness of the results found in Table 27 by first considering a period of no policy change as a “pseudo” treatment. The pseudo treatment is the 'fake' policy shock that is imposed on the data to check if the true estimate is biased or not. In a normal scenario, the 'pseudo' treatment analysis would entail selecting a fake period of policy shock (either a few periods before or after the true policy shock period) and estimating the impact of monetary union as in table 27. If the coefficient is statistically insignificant, then this would imply that the true DD estimate is robust and valid to be used as a measure of impact of policy change.

However, in this case, it is not possible to find a ‘pseudo’ DD estimate that will not be statistically significant due to the observed increased product market integration overtime. This is because, although the macro variables depicted increase in market integration between Botswana and South Africa, it is not evident that this effect is connected to the introduction of the policy reform. It might be that price integration was increasing anyway and was not influenced by the policy reform. If this is the case, then the effect may be driven by factors other than the policies in question.

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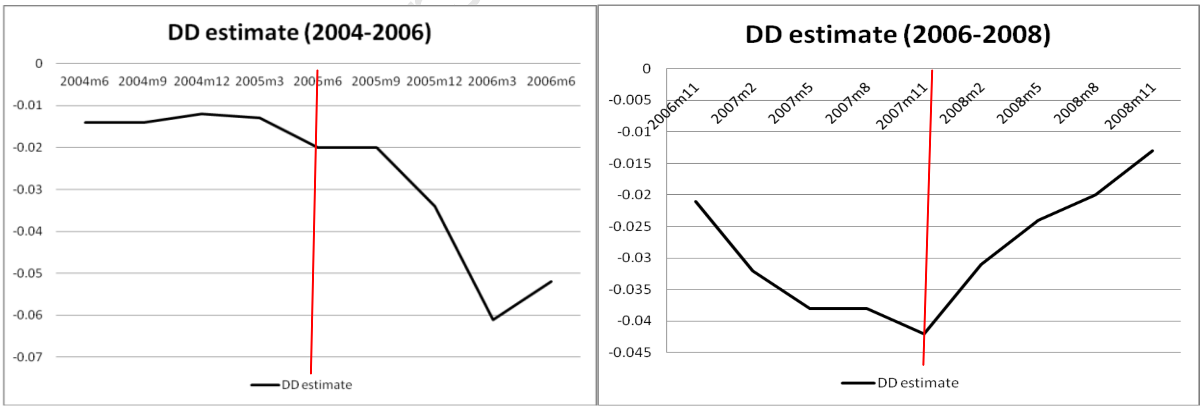
We divide the data into several 'false' pre-and post-policy shock periods selected at four-month intervals to enable us to estimate several 'false' DD estimates. We then plot the coefficients including the true DD coefficient. The expectation is that when we plot the 'false' coefficients with the true DD coefficient, the diagram will show a sharp decline in the observation of true DD estimates (or at least few periods after), reflecting the effect of the policy shock even if price differences were declining throughout the entire period of analysis.

Figure 21(a) plots the DD estimate in the first period (2004-2006). From this diagram, we see a drop in the DD estimate soon after the policy shock and a bigger drop 6-8 month later. This result suggests that there is an impact just after the policy change (June 2005), but the major impact occurs 6 to 8 months later. This result is consistent with the exchange rate pass-through literature, which shows that the exchange rate pass through to domestic prices in Sub-Saharan countries is partial and incomplete.[85]

Figure 21(b) plots the DD estimate in the second period (2006-2008). The diagram shows the immediate impact of policy change, as indicated by a large drop in the first quarter of 2008, confirming the results found in Table 28.



(a) (b)

Figure 21: Line plots for the coefficient of the DD estimates

[85] On average, a 10 percent depreciation of the local currency brings about a 4 percent increase in domestic prices, of which half occurs within the first quarter after the shock and the full impact taking place in the following four quarters (Razafimahefa, 2012).

The sensitivity tests therefore reveal that the impact of the exchange rate policy shock has a less pronounced and delayed effect on retail prices, while the impact of the monetary policy shock on domestic retail prices is more pronounced and immediate (see appendix 4.2 for a different values of "pseudo" DD estimates).

The second sensitivity test is based on Bertrand *et al.* (2004), who argued that collapsing the time series information into a pre- and post-change explicitly corrects for possible serial correlation. If the results are driven by serial correlation, then the coefficient of the DD estimate would be biased as it would be picking up other effects and not the effects of the polices in question.

We collapse the data by pre- and post-treatment periods, and ignore the time series information, to check whether our results are not driven by serial correlation which may have biased the DD estimates. Table 30 presents the results which show that the DD estimates remain negative and significant.

Table 30: Difference-in-difference regression results on price dispersion (2004 and 2008)

Dependent variable is the absolute log price difference	(1) general	(2) general	(1) general	(2) general
Log of distance	0.001*	0.057***	0.003***	0.016***
	(0.001)	(0.012)	(0.000)	(0.003)
Square of distance		-0.005***		-0.001***
		(0.001)		(0.000)
Botswana-SA border effect (border)	0.304***	0.305***	0.263***	0.264***
	(0.003)	(0.003)	(0.001)	(0.001)
South Africa-Lesotho border (Les-SA)	-0.071***	-0.071***	-0.108***	-0.109***
	(0.006)	(0.006)	(0.004)	(0.005)
Within South Africa effect (within SA)	0.062***	0.061***	0.009**	0.009**
	(0.004)	(0.004)	(0.005)	(0.006)
Within Botswana effect (Dnon-cma)	-0.106***	-0.109***	-0.077***	-0.077***
	(0.007)	(0.004)	(0.005)	(0.005)
Dpost-shock	-0.007***	-0.007***	-0.002*	-0.002*
	(0.003)	(0.003)	(0.002)	(0.002)
*Botswana effect, post-shock (Dnon-cma*Dpost-shock)*	0.016***	0.016***	0.010***	0.010***
	(0.003)	(0.003)	(0.002)	(0.002)
*South Africa-Lesotho border, post-shock (border*Dpost-shock)*	0.013**	0.013**	0.032***	0.032***
	(0.005)	(0.005)	(0.004)	(0.004)
Botswana border effect, post-shock (DD)	**-0.028*** **	**-0.028*** **	**-0.032*** **	**-0.032*** **
	(0.007)	(0.007)	(0.005)	(0.006)
Constant	0.218***	0.201*	0.245***	0.211***
	(0.011)	(0.036)	(0.009)	(0.012)
Product and city dummies	yes	yes	yes	yes
Observations	125,210	125,210	1,043,783	1,043,783
Adj. R-squared	0.40	0.40	0.36	0.36

Robust standard errors in parentheses. All the specifications include product and city dummies and exclude Botswana-Lesotho city-pair dummies. The data used in this case are collapsed by pre and post periods. *** p<0.01, ** p<0.05, * p<0.1

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Overall, the results indicate that the DD estimates found in table 28 are robust to serial correlation tests. The DD estimation shows that the introduction of policy reforms in Botswana has led to a decline in price differences between Botswana and South Africa. However, the magnitude of the decline is not substantial enough to eliminate any arbitrage opportunities that create deviations from LOP in the two countries.

4.7 Conclusion

This chapter provides evidence to explain of the effect of national borders and monetary unions on product market price integration between Botswana, Lesotho and South Africa. We establish the extent of product market price integration using data for these countries, evaluating and comparing different methods for estimating the role of borders and transaction costs in defining price differences. We then evaluate how monetary unions alter border effects between these countries by analysing the micro impact of monetary union on product market integration. We draw the following conclusions based on the results.

First, the results reveal that product markets are not fully integrated even within countries. Deviations from the LOP are large between cities within countries, more so within Lesotho than within South Africa and Botswana. The within- country densities are of order of the +/- 40. Evidence points to transport costs as a major source of international market segmentation. The effect of distance is highly significant and concave as predicted by the gravity model. The results indicate that, for example, a distance of 100 km between two cities results in a 15.2 percent deviation from LOP.[86]

The results also reveal that regional product markets remain segmented between these countries, despite geographical proximity and membership of the same customs union and monetary union in the case of South Africa and Lesotho. This shows that the relative price

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[86] This is estimated as $(\alpha_2 = 0.033) * \ln(100)$, as in Versailles (2012)

differences between South Africa and Botswana due to the presence of the border is 29.2 percent for the period 2004-2006, larger than between South Africa and Lesotho (25.9 percent). Similarly for the period 2006-2008, price differences between Lesotho and South Africa are also smaller (14.6 percent) than they are between Botswana and South Africa (23 percent). In terms of the economic impact of borders, this result suggests that the additional distance due to the presence of the border (the width of the border) between South Africa and Lesotho is 2554 km for the period 2004-2006 and 438 km for 2006- 2008 while between Botswana and South Africa it is 15, 783 km for the period 2004-2006 and14, 520 km for the period 2006-2008, after controlling for distance and other factors.

To estimate the quantitative impact of monetary unions on product market integration, the chapter uses a differences-in-differences estimation approach to establish how changes in exchange rate and monetary policies in Botswana impact the border effect, while using the extent of price integration between South Africa and Lesotho as a control. The results reveal that closer alignment of exchanges rates and interest rates are effective in increasing the integration of product markets in Botswana and South Africa. The estimates of the DD effect suggest that the exchange rate policy change resulted in a 2 percent decline in the border effect between Botswana and South Africa while the monetary policy change resulted in a 3.8 percent decline in the border effect between these countries. Therefore, monetary unions are appropriate policies to enhance further integration in product markets within the region.

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5 General conclusion and policy implications

5.1 Summary of findings

This thesis extends the empirical literature on price setting behaviour and product market integration in developing countries, using a data-set of monthly product prices at the retail outlet level and regional level for Botswana, Lesotho and South Africa over the period 2002 to 2009. The thesis comprises three main chapters.

The first chapter analyses the main stylised facts that characterise the price setting behaviour of retail outlets in Lesotho. Different measures are used to integrate the theoretical foundations of price setting behaviour with empirical findings. These include the frequency, size and probability of price changes, price increases and price decreases. The results reveal a number of stylised features of price setting behaviour in Lesotho.

There is substantial heterogeneity in the frequency of price changes across retailers and across products in Lesotho. Retailers on average change prices every 2.7 months, but there is a wide variation in the frequency across products. For example, the average duration across products ranges from 3.1 months for goods to 6.3 months for services.

Price changes are more frequent in Lesotho (36 percent) than in South Africa (22 percent) and the developed countries such as the Euro area (15.7 percent), but are less frequent than in other developing countries such as Sierra Leone (51 percent). This result is consistent with the fact that the frequency of price changes is higher in developing countries than in developed countries.

The frequency of price increases drives overall changes in prices in the economy, revealing evidence of downward price rigidity. On average, the frequency of price increases is 22 percent and of price decreases is 13.5 percent. But there is also a wide variation in price increases and price decreases across products. For example, the average frequency of price increase ranges from 27.2 percent for perishable products to 17 percent for services. In

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contrast, the average frequency of price decreases ranges from 15.1 percent for clothing and footwear to 3.9 percent for education services.

Price changes are large in absolute terms. The average size of price changes is 10.6 percent in absolute terms and 18. 8 percent of price changes are more than 5 percent in absolute terms. Large absolute price changes indicate that aggregate shocks are important for price setting in Lesotho.

Overall, the results reveal substantial heterogeneity in the magnitude of price changes across products and outlets in Lesotho. The distribution of price changes for Lesotho is characterised by a distribution of common small price changes, but large on average. Around 54 percent of price changes are less than 5 percent in absolute terms. The combination of large and small price changes suggest that idiosyncratic shocks are important in price setting in Lesotho.

The results also show that there is substantial heterogeneity in the probability of price change. Aggregate hazard function for goods are downward sloping while the hazard function for services declines initially but becomes flat after 12 months. At the disaggregate level, there is wide variation across products. Hazard functions are upward sloping for goods and generally flat for services.

The size of price changes increases with duration in the case of Lesotho. Price changes range from 3 percent at one month duration to 9.5 percent at 18 months duration, suggesting that as shocks accumulate, the price spell becomes longer between price changes.

Another important insight from the results is that the importance of the frequency and the size of price changes on inflation depend on the level of the aggregate inflation rate. For example, when inflation rate is high (greater than 8 percent) the frequency of price change drive most of the variation in inflation but when inflation is low, the size of price change

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dominates in the variation of inflation. However, the frequency of price increases and price decreases strongly drive the variation in inflation irrespective of the level of inflation.

This chapter also compares the empirical features found in the data to time-dependent and state-dependent theories of price setting behaviour, and examines their consistency in explaining the empirical characteristics found in the data.

In general, evidence on price setting behaviour in Lesotho reveals that none of the time-dependent or state-dependent theories of price setting behaviour are entirely consistent with the empirical features found in the data. State-dependent theories better explain price setting behaviour in goods sectors while time-dependent theories better explain price setting behaviour in services sectors. A combination of large price changes and many small price changes is consistent with state-dependent theory which is found in most developing countries, including South Africa. Golosov and Lucas (2007) use this explanation as a motivation for their state-dependent pricing model with idiosyncratic shocks. Increasing size in age is consistent with time-dependent pricing, indicating that shocks accumulate as more time elapses since the last price change. The strong correlation between the frequency of price increases and price decreases is consistent with state-dependent pricing.

These results provide sufficient evidence that different theories explain different characteristics found in the data and hence it may be difficult to find one theory than can explain price setting behaviour economy wide.

The second chapter investigates the extent to which the price setting behaviour of individual retail outlets in Lesotho is related to local, national and regional inflation dynamics. We analyse the relationship between the frequency of price changes and retail price inflation, controlling for local inflation, national inflation and regional shocks (the frequency of price change and inflation) from South Africa, distinguishing across different product categories. This is achieved in various ways.

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First, we test state-dependence in price setting by regressing the frequency of price changes on retail price inflation, which is estimated as price change at the product group level. Price setting is found to be unrelated to inflation in services sectors but positive and significantly related to most goods sectors. This indicates that goods sectors are generally characterized by state-dependent pricing behaviour, whereas services are generally characterized by time dependent pricing behaviour. Evidence of state-dependence is found to be stronger with basic goods than with luxury goods.

These results also provide insight into the relative importance of menu costs in driving price setting behaviour across firms in Lesotho. The result reveals that menu costs are higher for basic goods than for luxury goods and not relevant for services, suggesting that as inflation increases the benefit of changing prices becomes greater for retailers that sell luxury goods than for those that sell basic foods while not relevant for services providers as their pricing decisions are not dependent on changes in economic conditions.

Secondly, we examine the extent to which price setting behaviour is determined by local and/or national shocks. The results also provide insight into the extent to which local markets are integrated into national markets. We estimate this relationship including national inflation in the basic estimation to distinguish between local and national inflation. We find that the frequency of price changes is positive and significantly related to both local and national inflation. This result indicates that both idiosyncratic and aggregate shocks strongly drive price setting behaviour in Lesotho. Thus markets may not be fully integrated within Lesotho as retailers are able to distinguish between local and national markets. This is because if markets were fully integrated, retailers would view the entire economy as a single market and not be able to distinguish between local and national shocks.

Thirdly, we establish the extent to which regional price dynamics influence price setting behaviour in Lesotho, using data on price setting behaviour and inflation in South

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Africa. This is because we would anticipate that price setting behaviour in Lesotho would be influenced by regional inflation and price setting behaviour in South Africa, given its membership of the SACU and CMA, and the dominance of South African retail chains in Lesotho.

The results reveal a positive relationship between the frequency of price changes in Lesotho and South Africa's inflation and price setting, but not for all products. The frequency of price changes in South Africa, particularly in the food and fuel sectors, is strongly correlated with price setting behaviour in Lesotho. This is suggestive of a relatively high degree of product market integration in the region for these products. Further, the close association is indicative of the dominance of South African chains in Lesotho's retail industry, particularly for food products, and common global shocks with particular regulated price setting for fuel products.

The results also reveal a positive relationship between inflation in South Africa and price setting in Lesotho, but not for all product groups. External shocks from South Africa strongly drive price setting in the more tradable sectors (non-durable and non-perishable) than the less tradable sectors (durable and perishable) and are not related to price setting in the non-tradable sectors (services).

This result aids an understanding of the degree of product market integration across different sectors between Lesotho and South Africa. Product markets are not fully integrated, despite Lesotho's membership of the Southern African Customs Union and the Common Monetary Area. This is supported by differences in the extent of integration across sectors. Evidence from the results indicate that markets for more tradable products are more integrated than market for less tradable products and not integrated for services sectors.

High transaction and storage costs are major barriers to integration in these markets. Perishable products are subject to spoilage and therefore require extra care in distribution and

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storage. Durable products require larger and more complex modes of transportation and storage while non-durables are usually portable and easier to transport and store.

Given this conclusion, it is apparent that, inflation targeting monetary policy, adopted by South Africa, affects price setting behaviour in Lesotho differently as it does not affect all outlets equally.

The third chapter establishes the degree of product market integration between members of the SACU (Botswana, Lesotho and SA) and estimates the effect that monetary union has on product market integration among these countries.

First we estimate the border effect, which is the unexplained price difference across borders, conditional on distance. The results reveal that product markets are not fully integrated even within countries. Deviations from the LOP are large between cities within countries, moreso within Lesotho than within South Africa and Botswana. The within-country densities are of the order of +/- 40. Evidence points to transport costs as a major source of international market segmentation. The effect of distance is highly significant and concave as predicted by the gravity model. The results indicate that, for example, a distance of 100 km between the two cities results in a 15.2 percent deviation from LOP.

Evidence from this study shows that regional product markets remain segmented between these countries, despite geographical proximity and membership of the same customs union and monetary union in the case of South Africa and Lesotho. The additional distance due to the presence of 'the width of the border' between South Africa and Lesotho is 2554 km for the period 2004-2006 and 438 km for 2006-2008 while between Botswana and South Africa it is 15, 783 km for the period 2004-2006 and 14, 520 km for the period 2006-2008, after controlling for distance and other factors.

To evaluate the quantitative impact of monetary unions on product market integration, we use a differences-in-differences estimation approach to establish how changes in exchange and monetary policies in Botswana impact the border effect, while using the extent of price integration between South Africa and Lesotho as a control. The results provide sufficient evidence that closer alignment of exchange rates and interest rates are effective in increasing the integration of product markets in Botswana and South Africa. The estimates of the DD effect reveal that the exchange rate policy change resulted in a 2 percentage point decline in the border effect between Botswana and South Africa while the monetary policy change resulted in a 3.8 percentage point decline in the border effect between these countries.

Overall, the findings of this thesis provide a better understanding of the theory of price setting behaviour as it applies to developing countries, in particular, small landlocked low income countries such as Lesotho. The results also provide insight into the extent to which product markets in Botswana, Lesotho and South Africa are integrated, and the contribution of the monetary union to increasing this integration. Finally, the thesis provides insight into the influence on price setting behaviour of policies that affect inflation (such as monetary policy) and the integration of markets (monetary unions).

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5.2 Policy implications from the findings

Three important policy implications emerge from the findings. It is apparent from the results on price setting behaviour in Lesotho, that none of the dominant theories of price setting are entirely consistent with the facts found in the data. Further improvements can be made on current theories of price setting to incorporate different characteristics of price setting that are specific developing countries.

The relationship between price setting behaviour and inflation has important policy implications for macroeconomic policy. Price setting behaviour differs across sectors in Lesotho, suggesting that the impact of macroeconomic policy is felt differently across sectors. Macro models that incorporate short durations of price changes and allow for more prudent (for example less persistent) macroeconomic policies would be more appropriate to developing countries, particularly Lesotho.

Thirdly, the transmission mechanism of shocks from South Africa has implications for economic policy in Lesotho. As indicated, Lesotho essentially adopts monetary policy that is applied by South Africa. The transmission of these shocks to retail outlets in Lesotho may differ from the transmission to retail outlets in South Africa. Further, monetary policy in South Africa is implemented according to South African conditions. These shocks are not necessarily applicable for conditions in Lesotho.

It is important for the monetary authorities to understand the transmission mechanisms for how domestic prices are influenced by shocks for the implementation of monetary policy, particularly for a country that adopts another country's inflation targeting policy. There may be a misalignment between monetary policy instruments and the problems that are faced by Lesotho retailers in price setting decisions.

However, membership of the CMA does not allow Lesotho to make independent monetary policy decisions to respond to its domestic macroeconomic shocks although it mitigates the effect of external shocks. Therefore given no control over monetary policy and that price setting behaviour differs between Lesotho and South Africa; Lesotho may need to implement policies that enhance integration to ensure alignment between domestic inflationary conditions and those in South Africa, upon which monetary policy is implemented.

Finally, evidence reveals that product markets are clearly not fully integrated, despite joint membership in the SACU and the CMA, but evidence of declining border effects points to increasing market integration over time. Yet the observed increase in product market integration between Botswana and South Africa suggests that interest rate and exchange rate policy tools are effective channels through which monetary unions can increase integration

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within the region. Therefore, monetary unions are appropriate policies to enhance further integration in product markets between these countries.

5.3 Suggestions for further research

Substantial heterogeneity found in the literature of price setting behaviour suggests that markets are not fully integrated. The empirical evidence of the determinants of market friction, however, is almost entirely driven by studies of price setting behaviour in developed countries. This research on developing countries is scarce and has been constrained by the lack of available disaggregated product price data for these countries. However, this type of data has become more available in recent years.

To understand price setting behaviour at the most basic level, survey-based studies that link price setting behaviour to retail store characteristics (such as size, age, location, nationality of owner, retail chains) can be conducted for developing countries. This type of data can also enable research that investigates the role of market frictions and distribution networks in price differences between markets and regions in low income countries. Given the availability of appropriate data, the role of temporary price changes on price setting behaviour can also be analysed.

Another interesting dimension that can be explored is to analyse the impact of location on price setting behaviour. This study could be important for welfare implications in low-income economies where the majority of the poor live in the rural areas. Empirical evidence points to the existence of border effects even among highly integrated regions such as the European Union. Given this, cross-country studies can further explore sources of market segmentation in regional blocs in Africa could be of great importance for informing macroeconomic policies that can foster more integration between member countries.

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Appendix for chapter 1

Table 1.1: Average product prices in SA Rands for selected goods and services for cities in Lesotho, SA and Botswana (2002-2009)

	SOUTH AFRICA						BOTSWANA			LESOTHO			
PRODUCT DESCRIPTION	BLOEMFONTEIN	CAPE TOWN	DURBAN	JOHANNESBURG	PRETORIA	RUSTENBURG	GABORONE	LOBATSE	MAUN	MASERU	HLOTSE	MOHALES' HOEK	TEYA-TEYANENG
FOOD													
Brown bread, loaf		5.73	5.39	6.02	6.12	5.37	5.18	5.38	4.97	4.45	4.21	4.39	4.23
White bread, loaf		6.07	5.94	6.45	7.00	5.94	5.18	5.43	4.96	4.67	4.48	4.68	4.64
Cake flour, 2.5kg	20.05	14.39	15.16	15.46	15.26	16.44	32.39	33.09	33.55	15.00	14.88	15.10	14.37
Chai samp, 1kg	5.94	4.53	4.91	4.51	5.36	4.52	13.88	12.99	13.69	4.47	4.16	4.61	4.28
Fatty's and monis macaroni, 500g	7.26	7.67	6.49	8.91	7.30	7.80	7.75	7.91	7.89	6.84	7.12	7.12	6.93
Pocket soup,60g	2.51	2.39	2.39	2.34	2.92	1.87	2.60	2.71	2.83	6.46	6.03	7.22	6.43
White sugar, 2.5kg	14.68	15.21	14.85	14.46	14.36	14.91	16.20	16.59	16.94	14.62	14.38	15.16	14.51
Cross and Blackwell mayonnaise, 750ml	13.35	13.95	14.61	14.55	14.19	15.13		18.62	16.63	15.47	14.81	16.43	15.21
All gold tomato sauce, 375ml		8.96	8.26	8.93		9.67	9.86	9.79	9.59	8.15	8.23	8.33	7.66
Sunflower oil,750ml	14.38	10.84	10.39	11.03	14.23	11.69		19.41	15.03	11.52	14.72	12.41	11.28
Fruit juice, 1litre	10.01	8.52	9.74	9.58	8.88	10.58	8.73	8.73	9.64	8.30	8.64	9.12	8.41
Martell VSOP Brandy, 750 ml	68.32	63.80	78.89	65.92	63.43	95.12		80.38	81.86	75.22	71.02	117.43	81.83
White JC Leroux, 750ml	23.80	34.78	27.03	26.07	26.39		48.08	42.36	44.62	19.84	28.63	29.76	18.84
NON-FOOD													
Woods, 100ml	23.15	21.93	18.74	22.26	24.12		24.56	24.35	24.97	4.03	3.34	3.94	3.03
Toothbrush	7.58	11.17	17.42	18.93	10.73	18.05	8.01	7.67	6.54	13.57	13.72	20.28	12.19
Jik 750 ml	9.09	8.53	7.17	8.75	9.39	8.58	10.63	9.88	10.73	9.96	9.71	9.51	9.09
Toilet paper, 2ply		2.76	2.62	17.00	21.57			2.32	2.67	6.91	6.33	7.11	6.19
Diesel, 1litre	8.05	9.13		8.13	8.31		8.62		7.55	8.28	8.28	8.37	8.31
Portable radio recorder; radio cassette	485.63	448.04	465.96	595.39	380.99	373.77	266.19	169.42	117.49	2100.79	3671.66	1275.94	2793.07
Lounge suite	7192.62	4957.16	8633.71	7762.13	7843.26		7451.67	7279.86	7196.55	5935.78	6762.25	6475.74	6343.72
Wardrobe (3-door;3-shelves)	2221.21	1475.79	2342.84	2003.79	2079.61		1626.84		1490.46	1661.48	2847.36	1425.89	2184.34
Bath towel	41.45	46.75	41.39	44.15	53.69		39.74	34.06	34.04	124.32	58.65	42.60	43.67
School uniform, Children khaki, Short,	30.95	48.48	30.45		40.88	28.28	31.92	32.74	32.20	39.17	29.55	37.03	29.55
School uniform, White, Short Sleeve	34.13	43.66	26.04	42.18	39.58	25.63		31.29		111.19	70.59	89.75	64.48
Women's clothing, Simple cotton dress	115.83	118.39	126.55	198.34	227.77	122.86	239.52	193.78	130.37	115.89	52.49	89.30	
Women's footwear, Ladies' dress shoes	212.11	239.98	205.97	276.64	298.15	276.19	190.66	161.44	112.15	120.73	147.78	169.25	119.74
Men's footwear, Sportswear		63.74		125.49	120.44	142.45	189.60		118.66	197.41	106.71	74.73	84.53
Dry-cleaning, Suit		61.71		122.68	41.36		40.71	42.07	28.54	148.75	242.85	97.88	143.39

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Table 1.2: Average product prices in SA Rands for selected goods and services in Lesotho (2002-2009)

PRODUCT DESCRIPTION	BUTHA-BUTHE	HLOTSE	MAFETENG	MASERU	MOHALESHOEK	MOKHOTLONG	MOYENI	QACHASNECK	TEYA-TEYANENG	THABA-TSEKA
FOOD										
Brown bread, loaf	4.44	4.21	4.48	4.45	4.39	4.73	4.41	4.60	4.23	4.72
White bread, loaf	4.58	4.48	4.60	4.67	4.68	4.88	4.61	4.86	4.64	4.86
NAN,250g	26.31	28.72	33.77	27.52	33.74	37.40	31.40	35.55	34.07	
Jungleoats,500g	15.87	11.87	13.77	12.27	11.88	9.65	12.85	17.34	12.06	15.28
Fatty's and Monis macaroni,500g	7.23	7.12	6.77	6.84	7.12	7.36	7.38	7.65	6.93	7.00
White sugar, 2.5kg	14.65	14.38	14.74	14.62	15.16	15.89	16.08	16.13	14.51	19.18
All gold tomato sauce, 375ml	8.15	8.23	7.72	8.15	8.33	9.32	8.79	9.33	7.66	8.46
Cross and Blackwell mayonnaise,750ml	14.81	14.81	15.32	15.47	16.43	17.94	16.75	18.28	15.21	15.52
Sunflower oil,750ml	11.69	14.72	11.48	11.52	12.41	11.36	12.71	10.78	11.28	11.57
Gold star yeast,10g	1.56	1.70	1.49	1.59	1.59	1.70	1.66	1.74	1.47	1.53
Tomatoes, 1kg	5.45	5.15	6.04	7.63	6.93		9.50			
Beef,1kg	40.58	38.34	36.78	38.71	37.19	37.45	36.30	43.05	40.04	27.12
Lamb chops,1kg	30.40	42.64	41.71	57.67	47.35	41.41	43.84	60.10	47.47	
Chicken mixed portions,1kg	22.62	26.46	24.62	25.07	23.13	22.06	22.27	30.54	22.52	21.57
Cow milk in plastic bottle, 500 ml	3.98	3.74	4.24	3.68	4.86	4.90	4.86	5.25	3.59	4.86
Juice, fruitjuice,1litre	8.02	8.64	8.46	8.30	9.12	9.10	9.19	10.33	8.41	8.36
Martell VSOP brandy, 750 ml	71.02	70.21	75.22	117.43	58.67	76.26	77.81	81.83	92.08	
White JC Leroux,750ml	48.87	28.63	22.57	19.84	29.76	16.72	36.38	22.11	18.84	25.42
NON-FOOD										
Toothbrush	13.29	13.72	12.07	13.57	20.28		14.87	12.42	12.19	
Paraffin 1 L	7.38	7.13	8.40	7.91	7.16	8.55	8.77	10.06	7.87	7.89
Diesel,1litre	8.14	8.28	8.18	8.28	8.37	8.47	8.41	8.25	8.31	8.11
Electric refrigerator, 180 litres,	3286.70	2864.00	5065.36	2585.16	3668.21		4718.46	4108.85	5441.85	
Lounge suite		6762.25	5709.27	5935.78	6475.74	5528.54	5472.06	4873.72	6343.72	4661.72
Gas stove with 2 burner	1365.45	1256.36	1380.60	1856.71	1112.13	5031.41	1595.50	985.07	1663.42	994.40
Wardrobe, 3-doors; 3-shelves	4252.85	2847.36	2074.52	1661.48	1425.89	1169.68	2091.79	1417.32	2184.34	910.00
Paraffin stove	27.35	24.45	26.32	45.26	26.53		32.37	76.32	32.77	
Novel	78.79	146.28	117.56	97.64	96.29		102.35	174.08	158.99	
Bath towel	77.96	58.65	60.06	124.32	42.60	77.05	48.05	40.19	43.67	48.44
School uniform, White Short Sleeve	139.29	70.59	66.04	111.19	89.75	46.44	82.56	60.96	64.48	56.60
Women's clothing, Jean's skirt; cotton 100%	112.02	54.63	20.12	81.02			69.77	71.09	60.68	42.99
Men's footwear, Sportswear	84.14	529.85	106.71	197.41	74.73	116.13	82.49	97.85	84.53	77.73
Women's footwear, Ladies' dress shoes	217.79	147.78	67.99	120.73	169.25	114.79	131.60	211.24	119.74	63.92
Dry-cleaning, Suit	224.52	242.85	60.65	148.75	97.88	209.97	188.82	205.37	143.39	86.08

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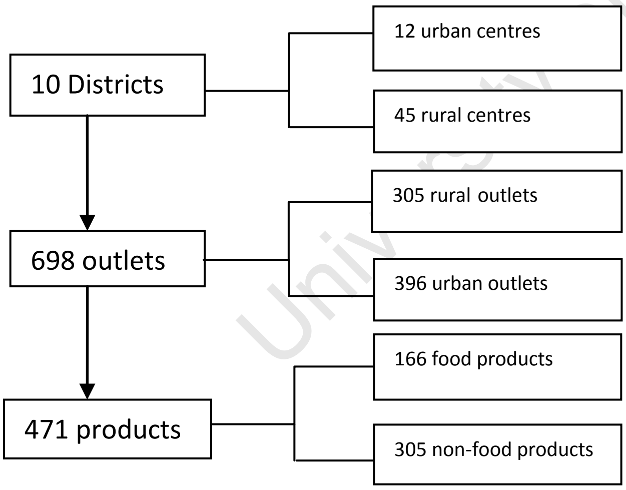
Appendix for chapter 2

Appendix 2.1: Monthly price data for CPI construction in Lesotho

Composition of the data

The Bureau of Statistics Lesotho (BOS) collects these prices every month from various retail outlets across the 10 districts of Lesotho. The distinctiveness of this data is that it is available by product, by retail outlet and by location. The unique outlet codes are set by the BOS for the outlets where the data is collected. The sample used in this thesis spans over the time period from March 2002 to December 2009 (93 months) and contains around 1,333,390 elementary price records. Each individual price record for an item has information on the date (month and year), retail outlet, district, product 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.



The raw data was collected in 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.

Method of data management

Missing observations, product and outlet substitution

BOS does not record any price for an item that is temporary out of stock. The price is instead imputed using the growth rate of the same item obtained from an outlet where the same item is available. An item that is permanently out of the sample may be replaced by an equivalent product at the same outlet or a different product at the same outlet but with the same characteristics or any other product that is deemed to be sufficiently similar at the same outlet. If there is no such item, the weights are re-allocated among the existing items within that group. BOS may also make replacement due to strategic sampling which involves substituting a product that is no longer representative, but this is usually a smaller proportion of the total substitutions.

Outlets may also exit the sample due to change of location, temporary or permanent shut down of operations or change of business activity. In this case, an outlet of similar activity is substituted with different outlet code.

Outliers

Outliers are considered as price changes that increase by more than 120 percent or decrease by more than 85 percent. To mitigate the problem of outliers, we applied the rule that specifies the gap between the log of price change and the median price of that price change. The ideal price would be with the smallest gap or preferably zero. Price changes that lie outside of the lower and upper bound of this difference was dropped out of the sample. This is cross-checked by visually checking through the seemingly large values. We also used the conservative rule of those observations that exceed the upper and lower quartile distribution plus three times the inter-quartile range.

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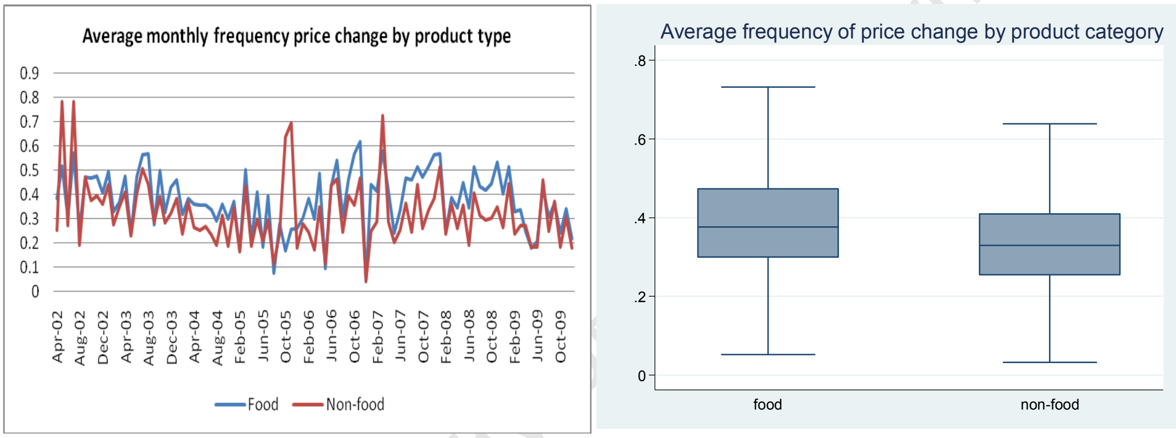
Temporary promotions

One of the limitations of this data is that it does not give information that allows us to identify price changes that are associated with temporary promotions and seasonal sales. All price changes in the data are therefore treated as regular changes. This limitation may reflect some noise in price setting process as the price changes are not due to changes in the fundamental price determining factors such as monetary policy.

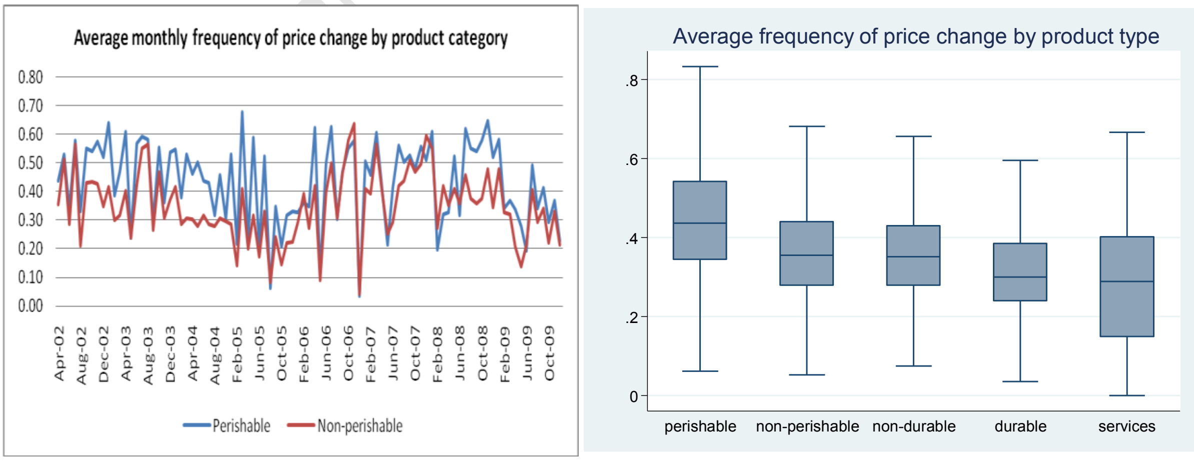
Appendix 2.2: Average frequency of price change

Figure 2.1 Average frequencies of price changes (by month and by product type)



(a) **(b)**

Figure 2.2 Average frequency of price change by product



(a) **(b)**

Figure 2.3 Average frequency of price change by dissagregated product classifications

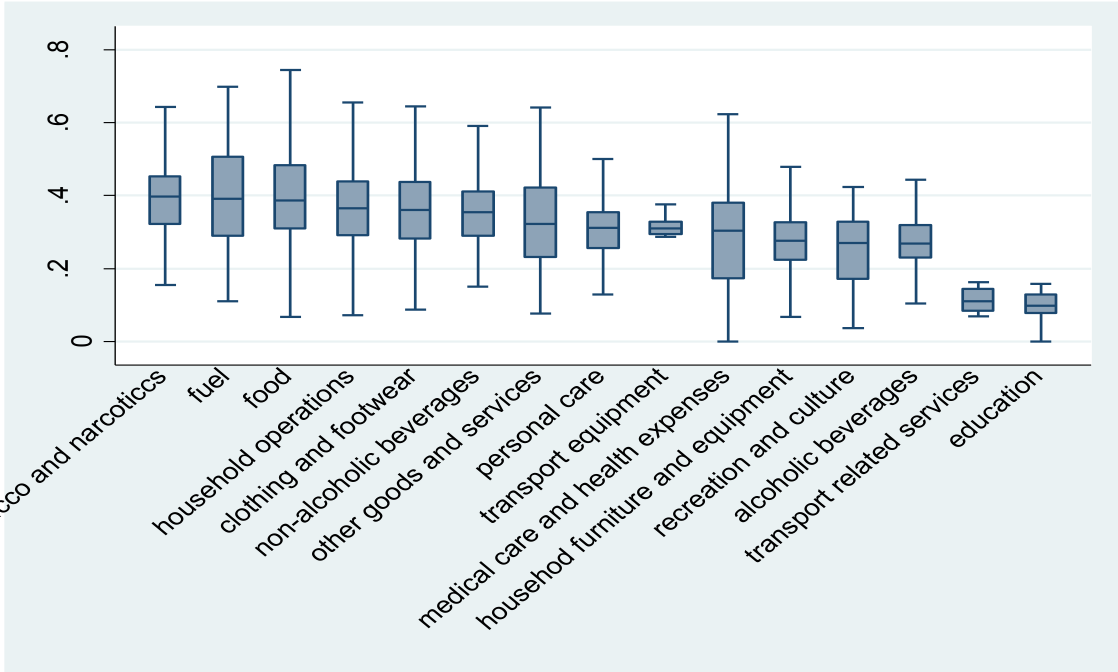
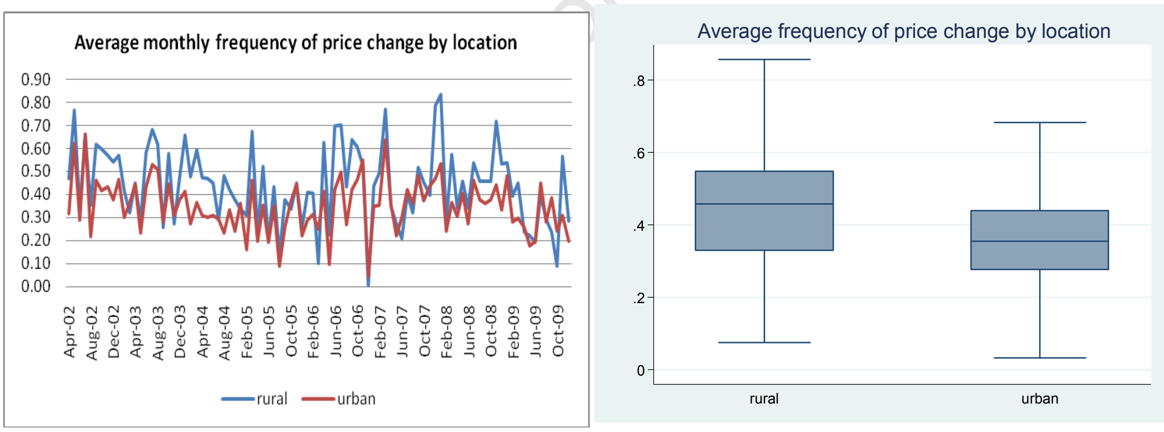


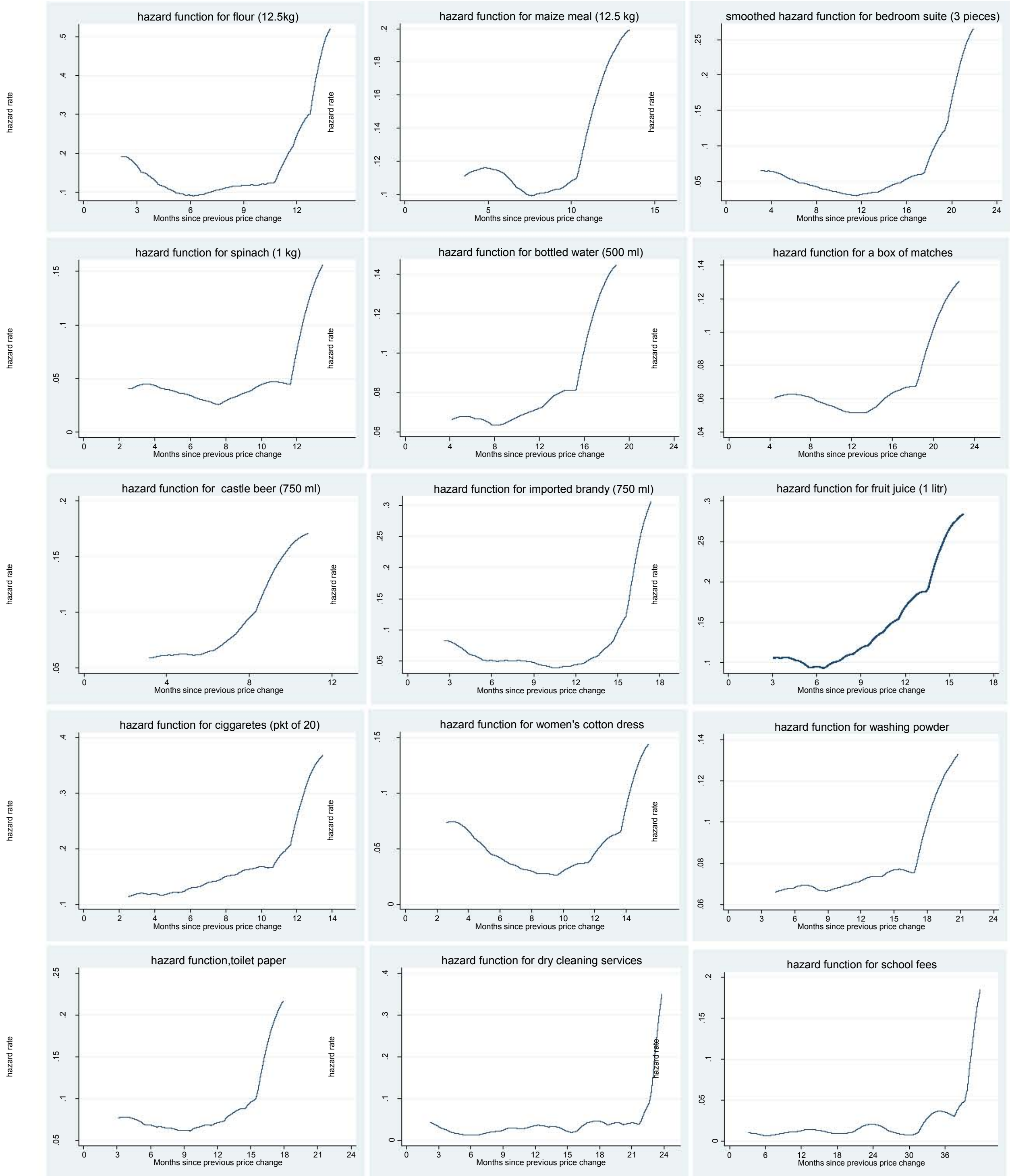
Figure 2.4 Average frequency of price changes by location



(a) **(b)**

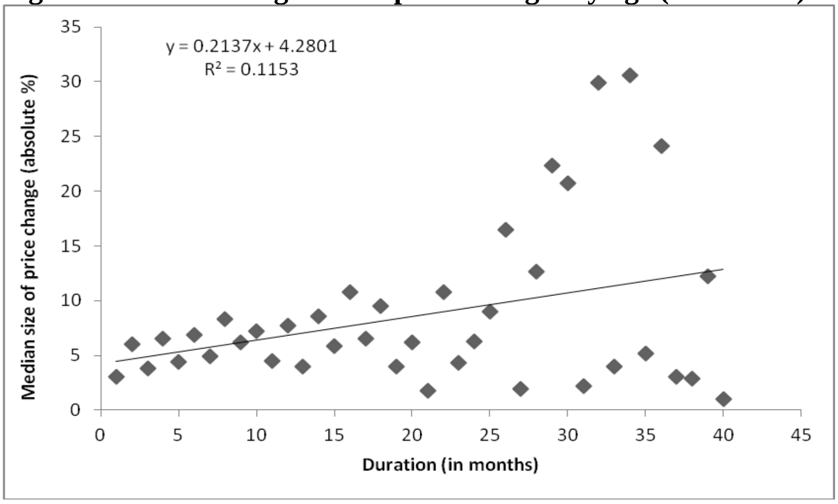
Appendix 2.3 Hazard functions for individual products

Figure 2.5: Smoothed hazard function on the selected individual products



Appendix 2.4: average size and duration

Figure 2.6: The average size of price changes by age (2002-2009)



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Appendix 2.5: CPI inflation in Lesotho and its components

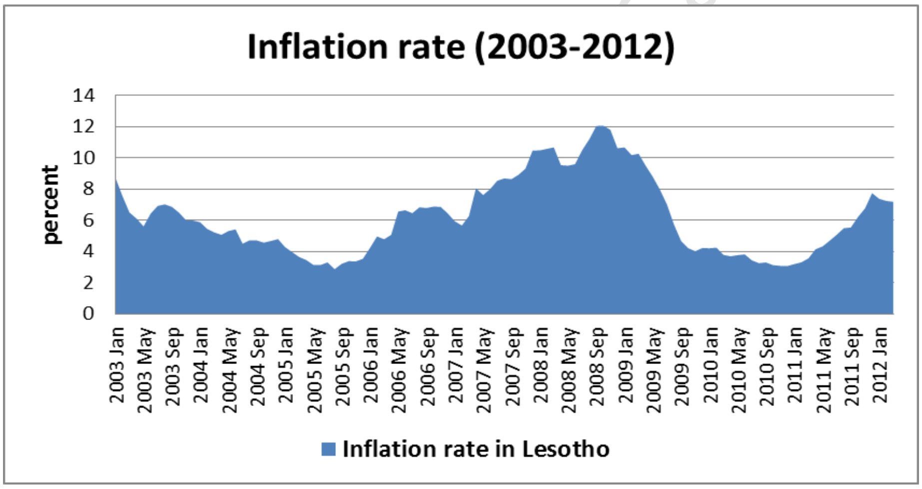

Table 2.1: Variance decomposition of inflation (%)

Variable	2002-2009	2002-2003	2004-2006	2007-2009
Fr_plus	0.50	0.50	0.47	0.61
Fr_minus	0.02	0.09	0.02	0.24
Dp_plus	0.46	0.37	0.42	0.15
Dp_minus	0.02	0.04	0.09	0.00

Appendix 2.6: The summary of data by individual outlets and products

Table 2.2: The frequency of price change and the implied mean duration of selected individual products

Product description	frequency of price change	mean duration (in months)
chicken, mixed portions,1kg	0.64	1.6
apples,1/2 class,1kg	0.63	1.6
bananas,1kg	0.59	1.7
potatoes,1kg	0.57	1.7
Petrol, per litre	0.57	1.8
Diesel,1litre	0.56	1.8
tomatoes,1kg	0.55	1.8
propane gas, B.P. domestic gas 9 kg	0.54	1.8
maizemeal,chai,12.5kg	0.54	1.8
onions,1kg	0.54	1.9
eggs,30s	0.52	1.9
beef,sausages,1kg	0.51	1.9
lamb chops,1kg	0.51	2.0
mutton chops,1kg	0.51	2.0
Paraffin 500ml	0.50	2.0
Cigarettes, Stuyvesant, packet of 20	0.38	2.6
women's footwear, Ladies' dress shoes	0.38	2.6
other fuel, Coal, one bag of 50 kg	0.36	2.8
accessories, women's woollen hats	0.36	2.8
women's clothing, Suits	0.36	2.8
oranges,1kg	0.35	2.9
women's clothing, Straight skirt; cotton	0.35	2.9
Brandy, Martell VSOP, 750 ml	0.34	2.9
toilet paper,2ply	0.34	2.9
bread, brown, loaf	0.31	3.2
Pen	0.28	3.6
other furniture, Coal stove with 4 plates	0.20	5.0
Dry cleaning of 1 pair of trousers	0.19	5.2
Charge for car maintenance, oil and grease	0.19	5.4
Freezer, electric	0.14	7.0
school uniform, Woollen Jersey	0.14	7.2
Consultation fee, adults, private doctor	0.11	8.9
Taxi fares, local	0.11	8.9
High school fees	0.11	9.1
eyewear, consultation fee (private clinic	0.08	12.1
Secondary school fees	0.08	12.3
local home brew	0.08	13.1
tableware, mugs, non-glass	0.07	14.0
Subscription to clubs	0.05	20.0
Consultation with Traditional doctor	0.03	39.5
consultation fee, adults, hospital services	0.02	51.0
Consultation fee, government hospitals	0.01	70.0

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Table 2.2: List of retail outlets by location

Outlet type	rural	urban	Total
Hardware	0	1	1
Pharmacy	0	4	4
accommodation	0	4	4
alcoholic beverages	1	1	2
bank	0	1	1
bookshop	1	9	10
butchery	4	20	24
car dealer	0	1	1
clothing	2	10	12
clothing and footwear	3	21	24
domestic services	0	3	3
dry cleaning	0	5	5
entertainment	0	2	2
footwear	0	7	7
fruits and vegetables	1	5	6
fuel station	1	16	17
funeral parlour	0	2	2
furniture	0	4	4
furniture and hardware	0	3	3
grocery	9	58	67
hair salon	1	12	13
hardware	1	12	13
hospital	0	1	1
hotel	0	1	1
household furniture and appliances	0	14	14
liquor store	2	19	21
meals	0	2	2
medical services	1	8	9
motor parts and repairs	0	14	14
pharmacy	0	5	5
postal services	0	1	1
recreation and culture	0	3	3
restaurant	1	3	4
school	0	21	21
shoe repairs	0	9	9
take-away food outlet	0	2	2
telecommunications	0	1	1
transport services	0	12	12
Total	**28**	**317**	**345**

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Appendix for chapter 3

Appendix 3.1: Tests for multicolinierity

Table 3.1.1: Correlation coefficients for the Lesotho data

	Freq	*dlp*	*dlp(t-1)*	*dlp(t-2)*	*Ex_dlp*	*Un_dlp*	*national_dlp*	*dlp_national(t-1)*
Frequency of price change	1							
Inflation in Lesotho (dlp)	0.0451	1						
	0.000							
Inflation in Lesotho, t-1 (dlp(t-1))	-0.0009	-0.0248	1					
	0.6073	0.000						
Inflation in Lesotho, t-2 (dlp(t-2))	0.0054	0.0043	-0.2552	1				
	0.0026	0.0167	0.000					
Expected inflation (un_dlp)	0.0393	0.2617	0.0948	0.0549	1			
	0.000	0.000	0.000	0.000				
Unanticipated inflation (un_dlp)	0.0357	0.962	-0.0531	-0.0112	-0.0122	1		
	0.000	0.000	0.000	0.000	0.000			
national inflation, (dlp_national)	0.0496	**0.5427**	0.0037	0.0149	0.2291	0.4881	1	
	0.000	**0.000**	0.033	0.000	0.000	0.000		
national inflation, t-1 (dlp_national(t-1))	0.024	0.0282	0.0735	0.0148	0.2024	-0.028	0.0547	1
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

Table 3.1.2: Correlation coefficients (Lesotho and South Africa)

	Freq (Lesotho)	*Freq (SA)*	*dlp_les*	*dlp_les(t-1))*	*dlp_les(t-2))*	*dlprice(SA)*	*dlp_sa(t-1))*	*dlp_sa(t-2)*	*ex_dlp(SA)*	*un_dlp(SA)*	*dlp_national*
Frequency of price change (Lesotho)	1										
Frequency of price change (SA)	0.0807	1									
	0.000										
Inflation in Lesotho (dlp)	0.0507	0.0202	1								
	0.000	0.000									
Inflation in lesotho, t-1 (dlp(t-1))	0.0011	0.0309	-0.1899	1							
	0.6514	0.000	0.000								
Inflation in lesotho, t-2 (dlp(t-2))	0.0006	0.0112	-0.0336	-0.2764	1						
	0.8201	0.0001	0.000	0.000							
Inflation in SA (dlprice)	0.021	0.2194	**0.0263**	0.025	0.0014	1					
	0.000	0.000	**0.000**	0.000	0.6246						
Inflation in SA (dlp_sa(t-1))	0.021	0.2194	0.0263	0.025	0.0014	1	1				
	0.000	0.000	0.000	0.000	0.625	0.000					
Inflation in SA (dlp_sa(t-2))	0.0244	0.0617	0.0192	0.04	0.0007	0.1125	0.1125	1			
	0.000	0.000	0.000	0.000	0.796	0.000	0.000				
Expected inflation (un_dlp)	0.0583	0.1696	0.0339	0.0742	0.0599	0.1224	0.1224	0.1255	1		
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000			
Unanticipated inflation (un_dlp)	0.0467	0.0514	0.0602	0.0071	-0.0195	0.0249	0.0249	0.0426	0.1901	1	
	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000		
national inflation (dlp_national)	0.0408	0.0604	0.3358	-0.025	-0.0079	**0.0773**	0.0773	0.0583	0.0952	0.1779	1
	0.000	0.000	0.000	0.000	0.002	**0.000**	0.000	0.000	0.000	0.000	

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Table 3.1.3: F-test statistics for equality of the coefficients

Test for equality of the coefficient		
Ho: the variables are jointly=0	F-statistic	P-value
dlp, dlprice	10.54	0.0028
dlp, dlp_national	52.40	0.0000
dlp_national, dlprice	17.70	0.0004

Table 3.1.4: Robustness test for bias in the inclusion of all inflation variables

dependent variable is the frequency of price change in Lesotho	Coefficient (1)	Coefficient (2)	Coefficient (3)	Coefficient (4)
Inflation in Lesotho (dlp)			0.160***	0.176***
			(0.036)	(0.036)
Inflation South Africa (dlp_sa)		0.077		0.120
		(0.074)		(0.080)
Inflation in Lesotho, t-1 (dlp(t-1))			0.090**	0.091**
			(0.035)	(0.036)
Inflation South Africa, t-1 (dlp_sa(t-1))		0.222*		0.250**
		(0.111)		(0.109)
Unanticipated inflation (un_dlp)	0.002***	0.003***	0.003***	0.003***
	(0.000)	(0.000)	(0.000)	(0.000)
Frequency South Africa (freqsa)		0.122***	0.131***	0.132***
		(0.028)	(0.030)	(0.028)
Frequency South Africa, t-1 (freqsa(t-1))		0.080***	0.094***	0.084***
		(0.018)	(0.014)	(0.017)
Frequency South Africa, t-2 (freqsa(t-2))		0.042*	0.034	0.037*
		(0.021)	(0.019)	(0.018)
national inflation (dlp_national)	0.674***	0.302***	0.166***	
	(0.132)	(0.040)	(0.029)	
national inflation, t-1 (dlp_national(t-1))	0.682***			
	(0.190)			
national inflation, t-2 (dlp_national(t-2))	0.636***			
	(0.153)			
national inflation, t-3 (dlp_national(t-3))	0.609**			
	(0.227)			
Constant	0.244***	0.489***	0.485***	0.486***
	(0.012)	(0.019)	(0.019)	(0.019)
Product, district and month fixed effects	Yes	Yes	Yes	Yes
Observations	339,862	138,436	131,663	131,663
R-squared	0.23	0.20	0.20	0.20
Adj. R-squared	0.23	0.20	0.20	0.20

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Appendix 3.2: regression analysis for price setting behaviour and inflation

Table 3.2.1: The frequency of price change and inflation using the standard deviation to estimate unexpected inflation

Dependant variable is the average frequency of price change	Coefficient (1)	Coefficient (2)	Coefficient (3)	Coefficient (4)
Inflation in Lesotho (dlp)	0.097***	0.112***	0.106***	0.098***
	(0.021)	(0.019)	(0.018)	(0.019)
Inflation in Lesotho, t-1 (dlp(t-1))		0.106***	0.102***	0.077***
		(0.019)	(0.018)	(0.017)
Inflation in Lesotho, t-2 (dlp(t-2))		0.063***	0.063***	0.056***
		(0.011)	(0.010)	(0.010)
Unanticipated inflation (un_dlp)			0.026***	0.025***
			(0.010)	(0.010)
national inflation (dlp_national)				0.686***
				(0.169)
national inflation, t-1 (dlp_national(t-1))				0.682***
				(0.196)
national inflation, t-2 (dlp_national(t-2))				0.450***
				(0.136)
national inflation, t-3 (dlp_national(t-3))				0.752**
				(0.288)
Constant	0.382***	0.368***	0.354***	0.344***
	(0.028)	(0.018)	(0.019)	(0.016)
Product, District and Month fixed effects	Yes	Yes	Yes	Yes
Observations	358,278	304,870	304,870	304,870
Adj. R-squared	0.18	0.18	0.19	0.19

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Table 3.2.2: The frequency of price changes and inflation between Lesotho and SA by product groups

dependent variable is the frequency of price change in Lesotho	Food (1)	Non-alcoholic beverages (2)	Alcoholic beverages (3)	Tobacco and narcotics (4)	Clothing and footwear (5)	Fuel (6)
Inflation Lesotho (dlp_les)	0.209***	0.313***	0.162	0.643*	0.051	0.204
	(0.036)	(0.113)	(0.118)	(0.390)	(0.035)	(0.145)
Inflation South Africa (dlp_sa)	0.055	-0.044	1.502	-1.054	0.949***	-0.258
	(0.069)	(0.250)	(2.273)	(0.955)	(0.208)	(0.286)
Inflation Lesotho, t-1 (dlp_les(t-1))	0.083**	0.312**	-0.102	-0.151	0.211***	0.438***
	(0.040)	(0.151)	(0.159)	(0.315)	(0.071)	(0.153)
Inflation South Africa, t-1 (dlp_sa(t-1))	0.063	0.623**	3.522	0.674	1.091***	0.710**
	(0.070)	(0.243)	(2.342)	(0.986)	(0.216)	(0.282)
Unexpected inflation (un_dlp)	0.004***	0.005***	0.002***	0.009***	0.002***	0.003***
	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)
Frequency South Africa (freqsa)	0.167***	0.057	0.098	0.162*	0.125	0.144***
	(0.014)	(0.036)	(0.210)	(0.092)	(0.076)	(0.042)
Frequency South Africa, t-1 (freqsa(t-1))	0.103***	0.026	-0.163	0.041	0.106	0.056
	(0.015)	(0.037)	(0.217)	(0.087)	(0.078)	(0.043)
Frequency South Africa, t-2 (freqsa(t-2))	0.047***	0.082**	0.319**	0.103*	-0.042	-0.014
	(0.014)	(0.038)	(0.142)	(0.061)	(0.067)	(0.045)
National inflation (dlp_national)	0.137***	0.322	0.035	1.916*	0.304***	0.002
	(0.053)	(0.221)	(0.269)	(1.011)	(0.106)	(0.098)
Constant	0.441***	0.419***	0.015	0.530***	0.500***	0.175***
	(0.018)	(0.061)	(0.072)	(0.084)	(0.049)	(0.040)
District and month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	79,553	9,133	1,881	3,849	8,806	8,303
Adj. R-squared	0.22	0.22	0.27	0.28	0.20	0.22

dependent variable is the frequency of price change in Lesotho	h/h furniture & equipment (7)	h/h operations (8)	Medical care services (9)	Recreation & culture (10)	Personal care (11)	other goods and services (12)
Inflation Lesotho (dlp_les)	0.030	0.146	0.093	0.032	0.158**	0.105
	(0.028)	(0.095)	(0.135)	(0.051)	(0.076)	(0.077)
Inflation South Africa (dlp_sa)	0.230***	0.484	0.585	1.786*	0.236*	0.419
	(0.075)	(0.458)	(0.358)	(1.060)	(0.126)	(0.927)
Inflation Lesotho, t-1 (dlp_les(t-1))	0.077	0.147	0.505	0.265**	0.219*	0.121
	(0.053)	(0.160)	(0.305)	(0.121)	(0.128)	(0.180)
Inflation South Africa, t-1 (dlp_sa(t-1))	0.067	0.315***	0.007	3.415***	0.099	0.944
	(0.095)	(0.381)	(0.005)	(1.076)	(0.353)	(1.762)
Unexpected inflation (un_dlp)	0.002***	0.003***	0.004*	0.002*	0.003***	0.002***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Frequency South Africa (freqsa)	0.137***	-0.023	-0.030	-0.388	-0.171***	0.351***
	(0.045)	(0.067)	(0.067)	(0.255)	(0.057)	(0.097)
Frequency South Africa, t-1 (freqsa(t-1))	0.069*	-0.091*	0.571*	-0.297	0.078	2.490
	(0.041)	(0.053)	(0.299)	(0.260)	(0.059)	(1.776)
Frequency South Africa, t-2 (freqsa(t-2))	0.069	-0.008	0.287	0.481*	0.025	0.802***
	(0.042)	(0.064)	(0.270)	(0.249)	(0.051)	(0.352)
National inflation (dlp_national)	0.229**	0.841**		-0.192	0.284	-0.374
	(0.090)	(0.411)		(0.327)	(0.229)	(0.474)
Constant	0.119***	0.541***	0.075	0.329***	0.310***	-0.484
	(0.038)	(0.096)	(0.090)	(0.123)	(0.067)	(0.321)
District and month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,587	3,994	665	1,230	5,112	1,550
Adj. R-squared	0.33	0.25	0.32	0.32	0.28	0.32

Notes: Notes: The dependent variable is the average frequency of price change for each product category. *dlp_les* represents local inflation in Lesotho; *dlp_sa* represents regional inflation while *dlp_national* represents national inflation in Lesotho. *** Significant at 1 percent level ** Significant at 5 percent level * significant at 10 percent level. Robust standard errors in parenthesis below the estimated

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Appendix for chapter 4

Appendix 4.1: difference-in-difference estimates

Table 4.1: Difference-in-Difference regression results on relative price dispersion by period (2004-2008)

	2004-2006		2006-2008	
The dependent variable is the std deviation of the log price difference	(1)	(2)	(1)	(2)
Log of distance	0.003	0.075***	0.004***	0.046***
	(0.003)	(0.024)	(0.001)	(0.009)
Square of distance		-0.006***		-0.005***
		(0.002)		(0.001)
Botswana-SA border effect (border)	0.297***	0.290***	0.185***	0.186***
	(0.026)	(0.020)	(0.019)	(0.019)
South Africa-Lesotho border (Les-SA)	-0.135***	-0.130***	-0.123***	-0.125***
	(0.021)	(0.020)	(0.018)	(0.018)
Within South Africa effect (within SA)	-0.005	-0.006	-0.098***	-0.100***
	(0.037)	(0.039)	(0.027)	(0.027)
Within Botswana effect (Dnon-cma)	-0.138***	-0.119***	-0.219***	-0.215***
	(0.037)	(0.036)	(0.030)	(0.030)
Dpost-shock	0.004	0.003	0.003	0.003
	(0.005)	(0.005)	(0.003)	(0.003)
*Botswana effect post-shock (Dnon-cma*Dpost-shock)*	0.014**	0.015**	-0.000	-0.000
	(0.007)	(0.007)	(0.003)	(0.003)
*South Africa-Lesotho border post-shock (border*Dpost-shock)*	0.001	0.002	0.031***	0.031***
	(0.010)	(0.010)	(0.006)	(0.006)
Botswana border effect post-shock (DD)	-0.009	-0.010	-0.023***	-0.023***
	(0.014)	(0.014)	(0.007)	(0.007)
Constant	0.300***	0.099	0.501***	0.366***
	(0.024)	(0.070)	(0.020)	(0.031)
City dummies	yes	yes	yes	yes
Observations	4,818	4,818	13,320	13,320
Adj. R-squared	0.46	0.46	0.59	0.59

Robust standard errors in parentheses. All the specifications include product and city dummies and exclude Botswana-Lesotho city-pair dummies. The data used in this case are collapsed by pre and post periods. *** p<0.01, ** p<0.05, * p<0.1

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Table 4.3: Pseudo DD estimates (2004-2008)

2004-2006		2006-2008	
month	**DD estimate**	**month**	**DD estimate**
2004m6	-0.014	2006m11	-0.021
2004m9	-0.014	2007m2	-0.032
2004m12	-0.012	2007m5	-0.038
2005m3	-0.013	2007m8	-0.038
2005m6	-0.02	2007m11	-0.039
2005m9	-0.02	2008m2	-0.042-
2005m12	-0.034	2008m5	-0.024
2006m3	-0.061	2008m8	-0.02
2006m6	-0.052	2008m11	-0.013

Appendix 4.2: list of homogeneous products

List of homogeneous products for period (2004-2008)

Product code	Product description	2004-2006 Number of observations	2006-2008 Number of observations
12020016581	Coca-Cola Soft drink can,340 ml	10,370	34,455
12020025811	Bottle (Coca-Cola),1litre	4,317	25,492
50320110	Paracetamol, 500mg,	4,556	34,368
11610175321	Spinach, 1 kg	5,281	
13100055811	Local home brew,1litre	5,472	38,220
80510016451	Toothpaste, 100ml	7,680	78,720
32200015811	Paraffin 1 L	7,879	39,592
13010036741	Gin (Gordon's), 750ml	10,062	51,545
11630045011	Canned peas (KOO),410g	12,331	82,410
11350011430	Cheddar processed cheese, per kg	13,243	48,131
61101061444	Diesel,1litre	17,671	59,267
13010016741	Imported brandy (Martell VSOP), 750 ml	18,370	71,292
13200026741	SA sparkling white wine (JC Leroux),750ml	20,284	77,733
11430016741	Sunflower oil,750ml	20,867	90,606
42007011101	Matches, one packet of ten	21,462	38,164
42003056741	Bleach (Jik), 750 ml	21,839	101,663
Total		**203,730**	**899,238**

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Appendix 4.3: Bilateral distances

Bilateral distances (in km) between big cities across Lesotho, Botswana and South Africa

CITY i	CITY j	DISTANCE (KM)	CITY i	CITY j	DISTANCE (KM)
BLOEMFONTEIN	HLOTSE	223	JOHANNESBURG	HLOTSE	362
BLOEMFONTEIN	MAFETENG	135	JOHANNESBURG	MAFETENG	507
BLOEMFONTEIN	MASERU	143	JOHANNESBURG	RUSTENBURG	122
CAPE TOWN	HLOTSE	1221	MAUN	BLOEMFONTEIN	1251
CAPE TOWN	MAFETENG	1088	MAUN	CAPE TOWN	2176
CAPE TOWN	MASERU	1142	MAUN	DURBAN	1687
DURBAN	HLOTSE	451	MAUN	HLOTSE	1640
DURBAN	MAFETENG	635	MAUN	JOHANNESBURG	1148
DURBAN	MASERU	534	MAUN	MAFETENG	1576
FRANCISTOWN	BLOEMFONTEIN	1028	MAUN	MASERU	1511
FRANCISTOWN	CAPE TOWN	1902	MAUN	RUSTENBURG	926
FRANCISTOWN	DURBAN	1268	MASERU	HLOTSE	110
FRANCISTOWN	HLOTSE	1105	MASERU	MAFETENG	78
FRANCISTOWN	JOHANNESBURG	728	RUSTENBURG	HLOTSE	475
FRANCISTOWN	MAFETENG	1203	RUSTENBURG	MAFETENG	595
FRANCISTOWN	MASERU	1126	RUSTENBURG	MASERU	496
GABORONE	BLOEMFONTEIN	592	SELIBE PHIKWE	BLOEMFONTEIN	997
GABORONE	CAPE TOWN	1466	SELIBE PHIKWE	CAPE TOWN	1871
GABORONE	DURBAN	928	SELIBE PHIKWE	HLOTSE	1115
GABORONE	HLOTSE	626	SELIBE PHIKWE	JOHANNESBURG	604
GABORONE	MAFETENG	727	SELIBE PHIKWE	MAFETENG	1274
GABORONE	RUSTENBURG	230	SELIBE PHIKWE	MASERU	1169
HLOTSE	MAFETENG	210	SELIBE PHIKWE	RUSTENBURG	504

Appendix 4.4: products list by country

LIST OF MAPPED PRODUCT ITEMS BY COUNTRY (LESOTHO, SOUTH AFRICA AND BOTSWANA)

LESOTHO		SOUTH AFRICA			BOTSWANA	
Product code	Product description	Product code	Product description	Unit description	Product code	Product description
11	bread, brown, loaf	11010025191	Brown bread	700 G	5	Brown bread (1 Loaf, Not sliced)
12	bread, white, loaf	11010015191	White bread	700 G	2	Bread, one white loaf, not sliced
71	macaroni, fattis and monis,500g	11040055141	Macaroni, plain	500 G	6	Spaghetti, 500g
81	rice,tastic,500g	11040015141	Rice	500 G	1	Rice, 1kg (TASTIC)
91	samp,chai,1kg	11040035321	Samp	1 Kg	10	Samp, 2.5kg
111	sorghum meal,1kg	11020055321	Sorghum-meal	1 Kg	8	Sorghum meal, 5kgs
131	beef,1kg	11110095321	Shin (with bone)	1 Kg	14	Beef, brisket per kg
132	rump steak,1kg	11110015321	Rump steak	1 Kg	12	Rump steak per kg
171	chicken, mixed portions,1kg	11150025321	Chicken portions	1 Kg	19	Chicken, frozen per kg
201	beef,minced,1kg	11170015321	Minced meat (specify type)	1 Kg	13	Steak mince per kg
212	fish,canned,215g	11230024801	Pilchards in tomato sauce	215 G	25	Tinned pilchards, 155g (LUCKY STAR)
222	fish, frozen (shrimps)	11250021430	Shrimps, frozen	Per Kg	24	Frozen hake fillets, 600g (SEA HARVEST)
231	Cow milk in plastic bottle 500 ml	11310016721	Fresh milk	500 Ml	26	Long-life milk, 500mls (ULTRA MEL)
261	milk,sour,500ml	11310026721	Maas (amasi)	500 Ml	32	Sour milk, INKOMAZI, 500 ml
292	eggs,12s	11360044001	Medium	1 Dozen	33	Eggs, one dozen, size 3
301	oil,sunflower,750ml	11430016741	Cooking oil	750 Ml	37	Sunflower cooking oil, 750ml bottle
311	cooking fat,175g	11430034841	Cooking fat, vegetable	250 G	38	Cooking fat 125g (HOLSUM)
312	butter,250g	11410014841	Butter, creamery, choice	250 G	34	Butter 250g, Bonnita
321	margarine,rama,250g	11420014841	Medium fat spread, tub	250 G	35	Soft margarine (FLORO), 500g
322	margarine,stork,250g	11420024841	Low fat spread, tub	250 G	36	Margarine 250g - not `soft'
331	apples,1/2class,1kg	11510015321	Apples	1 Kg	42	Apples, red, per kg
341	bananas,1kg	11520015321	Bananas	1 Kg	41	Bananas per kg
351	oranges,1kg	11530015321	Oranges	1 Kg	40	Oranges, per kg
452	beans, koo canned,410g	11630035011	Baked beans in tomato sauce	410 G	56	Baked beans, 420g (KOO)
454	peas, koo canned,410g	11630045011	Peas, canned (choice grade)	410 G	54	Tinned peas, 410g
491	cabbage,1kg	11610075321	Cabbage	1 Kg	50	Cabbage per kg
501	carrots, 1kg	11610095321	Carrots	1 Kg	52	Carrots per kg
541	tomatoes,1kg	11610055321	Tomatoes	1 Kg	51	Tomatoes per kg
551	onions,1kg	11610045321	Onions	1 Kg	53	Onions per kg
571	cheese, processed, Cheddar	11350011430	Cheddar cheese, first grade	Per Kg	31	Cheddar cheese per kg
581	Spinach, 1 kg	11610175321	Spinach	1 Kg	48	Spinach, per 500g
591	potatoes,1kg	11610015321	Potatoes	1 Kg	47	Potatoes per kg
611	sugar,white,2.5kg	11700015431	White sugar	2,5 Kg	58	Sugar, white, 2kg bag
621	sweets, mint	1191013651	Toffees, each, wrapped (e.g. wilson)	Each	62	WILSON'S X.X.X mints
622	Chewing Gum	1191014651	Glucose sweets, wrapped (e.g. "super c")	Each	61	Chewing gum (CHAPPIES) per one - small
632	coffee, coacoa with milkpowder,250g	11830014841	Cocoa	250 G	74	Coffee, RICOFFY in tin, 250g
641	tea, rooibos teabags,200g	11821034781	Tea bags, tagless	200 G	75	Tea leaves, 125g (FIVE ROSES)
642	tea, fiveroses teabags,200g	11821024781	Tea bags, tagged	200 G	76	Tea bags, 100 with tags (FIVE ROSES)
651	icecream,vanilla,500ml	11320026721	Full cream ice cream (specify flavour)	500 Ml	63	Ice cream, 2kg (VANILLA)
701	yeast,easybake,10g	11920054151	Yeast, instant	20 G	70	Instant Yeast 10g
721	salt,iodised,1kg	11920085321	Salt, fine, household, bag	1 Kg	66	Fine salt, 500g packet
731	yoghurt,175ml	11310076491	Yoghurt, flavoured	175 Ml	30	Yoghurt 175mls (CHAMBOURCY)
751	tomatosauce,allgold,375ml	11920226611	Tomato sauce	375 Ml	64	Tomato sauce, 375mls (ALL GOLD)
771	mayonaise, cross and blackwell,750ml	11920235221	Mayonnaise	750 G	65	Mayonnaise 750ml, Cross and Blackwell
821	pocket soup,60g	11920264411	SOUP POWDER not instant	60 G	68	Packet soup (KNORR) 66g
941	cereal,cornflakes,500g	11030045141	Cereal flakes (e.g. all-bran, corn flakes)	500 G	11	Corn Flakes, 500g box (KELLOGGS)
1022	juice, fruitjuice,1litre	11570015811	Fruit juice, 100% (specify)	1 L	81	Fruit juice, 1 litre
1031	mineralwater,still,500ml	12100016721	500 ml bottle	500 Ml	78	Mineral water valpre (Still spring water) 500mls
1041	softdrink, Coca-Cola can,340 ml	12020016581	Coca-cola soft drink	340 Ml	79	COCA COLA, 340ml can
1042	softdrink, Fanta bottle,1litre	12020025811	Fanta bottle	1 L	80	FANTA, 1 litre bottle (excl deposit)
1051	Concentrated drinks, Oros ,750ml	12300016741	Flavoured cool drink syrups (specify)	750 Ml	82	Orange squash, 750mls bottle
1064	beer, Amstel can, 340ml	13100016581	Lager (south african)	340 Ml	93	Beer 340mls (Hansa Pilsner)
1066	beer, Heinneken bottle,340ml	13100026581	Dark (english) beer	340 Ml	95	Windhoek Light Lager 340 ml can
1071	Brandy, Martell VSOP, 750 ml	13010016741	Brandy	750 Ml	85	Brandy, 750 mls (MARTELL V.O.)
1072	Whiskey, Johnny Walker Red Label,750ml	13020016741	Whisky	750 Ml	84	Whiskey, 750mls (HAIG or BELLS)
1073	Gin, Gordons, 750ml	13010036741	Gin	750 Ml	86	Gin, 750mls (GORDONS DRY GIN)
1081	Wine, non-Sparkling White,750ml	13200026741	Semi-sweet white wine	750 Ml	89	Wine, 750 mls (AUTUMN HARVEST-CRACKLING)
1082	Wine, Red Tassenberg,750ml	13200016741	Natural, dry red wine	750 Ml	87	Tassenberg 750mls
1083	Wine (Spackling), White JC Leroux,750 ml	13200036741	Sparkling wine	750 Ml	90	JC Leroux 750 mls (White Wine)
1084	Cider, Redds ,340ml	13300016581	Alcoholic fruit beverages	340 Ml	88	Hunters Dry 340 mls
1091	local home brew,1litre	13100055811	Sorghum beer - own container	1 L	94	Chibuku, 1 litre carton
1111	Cigarettes, Stuyvesant, pkt of 20	14030011191	Virginia type (specify)	Pack Of 20	96	Cigarettes, 20 Peter Stuyvesant Filter
1112	Cigarettes, Rothmans, pack of 20	14030021191	American type (specify)	Pack Of 20	97	Cigarettes, 20 ROTHMANS King-Size
1121	Pipe tobacco,BB,50 g	14200014331	Pipe tobacco	50 G	98	Tobacco, 100g (BOXER)
1154	men's clothing, casual trousers; cotton 35-65%, polyester 35-65%	2111003651	Men's trousers, long, summer natural fibre	Each	100	Men's trousers, polyester, size 4
1159	men's clothing, Underpant briefs; cotton 100%; multi pack of 3;	21180021251	Men's underpants, short	Pack Of 3	103	Men's brief, Medium size, pack of 3
11510	men's clothing, socks; cotton 35-65%, Acrylic 35-65%; length-mid-calf; not international brands	21180040	Men's socks, nylon	Pair	102	Men's socks
1181	women's clothing, Blouse/shirt ladies	2103002651	Women's summer, short sleeves, natural fibre	Each	106	Ladies blouse, cotton or polycotton, size 36
1261	women's clothing, Simple shirt dress; cotton 60-70%, polyester 30-40%;	2101005651	Women summer dress, (cotton and nylon)	Each	104	Ladies dress, polyester and cotton
1266	women's clothing, briefs; cotton 90%, spandex 10%; elastic waistband	2130802651	Women underpants	Each	109	Ladies briefs, polycotton
1274	children's clothing, Girls' straight dress; cotton 100%; short sleeve	2120103651	Girls' summer synthetic fibre	Each	114	Girls' dress, cotton or polycotton, size 28
1341	school uniform, Children khaki, Short,	2130911651	Boys' khaki Shorts	Each	112	Boys khaki shorts, size 6
1342	school uniform, White, Short Sleeve(school Uniform)	2130913651	Boys' khaki shirt - short sleeve	Each	113	Boys khaki shirt, size 6
1481	children's footwear, Boy's school shoes, black	2231001881	Genuine leather shoes	Pair	131	Boys leather school shoes, size 2

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Appendix 4.5: geographical map for SACU region