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Article

The Size of the Border and Product Market Integration Between Lesotho and South Africa: A Production–Consumption Approach

Mamello A. Nchake[a,b,*], Lawrence Edwards[c], and Tresor N. Kaya[c]

[a]Department of Economics, National University of Lesotho, Maseru, Lesotho, [b]School of Economics, University of Cape Town, Cape Town, South Africa, and [c]School of Economics, University of Cape Town, Rondebosch, Cape Town, South Africa

*Corresponding author: Mamello A. Nchake. E-mail: mnchake@yahoo.com

Abstract

Despite efforts to increase integration within Africa, product markets remain segmented between countries. This paper examines the magnitude of price gaps, known as the border effect, between Lesotho and South Africa using retail price data for 49 products in 35 cities over the period 2006–2009. Using a production–consumption pair approach, we estimate that crossing the border between South Africa and Lesotho is associated with an absolute product price gap that widened from 18% in 2006 to 24% in 2009. The structure of relative prices also differs markedly revealing a lack of convergence to a common set of internal relative prices. These results are robust to the choice of alternative production centres in South Africa and the imposition of distance thresholds between region pairs. The results indicate that the border between South Africa and Lesotho remains an impediment to trade flows and price competition, despite their joint membership in a customs union and monetary area.

Key words: product market integration, trade costs, retail prices, border effect, price differences, distance

JEL classification: F14, F15

1. Introduction

African economies have long embraced regional integration as a component of their development strategies. While significant advances were made by the Regional Economic Communities (RECs) in implementing free trade agreements in accordance with the 1991

Abuja Treaty, progress towards establishing customs unions and monetary unions faltered.[1] There is now renewed interest in pushing the integration agenda forward through a Pan-Africa Continental Free Trade Area (CFTA) that aims to establish a single continental market for goods and services, with free movement of business persons and investments (Economic Commission for Africa, 2013).

Underpinning this initiative is the concern that product markets in Africa remain fragmented (Brenton and Isik, 2012; Balchin *et al.*, 2015) with intra-African trade low and concentrated in terms of product and country composition (Gillson, 2012; Economic Commission for Africa, 2013). The view is that intra-African trade flows are disproportionately (relative to trade with the rest of the world) impeded by very high internal trade and transit costs associated with underdeveloped infrastructure, uncompetitive transport services, poor trade facilitation, restrictive border procedures and tariff barriers. Consequently, eliminating intra-Africa tariff barriers and reducing costs of trading across borders feature high on the priority list of policy makers in their efforts to implement the CFTA. This is reflected in the African Union endorsed Action Plan on Boosting Intra-Africa Trade (BIAT).[2] The rationale is that these policies will substantially enhance intra-African trade flows.

There is much empirical evidence that high trade costs and border controls do impede African countries' trade with the rest of the world and with themselves (Limao and Venables, 2001; Longo and Sekkat, 2004; Njinkeu *et al.*, 2008; Portugal-Perez and Wilson, 2009). For example, Limao and Venables (2001) argue that high trade costs associated with infrastructure problems largely explain the relatively low levels of African trade. Similarly, Portugal-Perez and Wilson (2009) apply a gravity model to bilateral trade flows in Africa and estimate that high trade costs impose a greater impediment to trade flows in Africa than tariff barriers.

Price-based studies on the integration of product markets in Africa provide further support. National borders have been shown to segment product markets ('the border effect') with prices of similar products deviating by 7–30% across African borders (Versailles, 2012; Aker *et al.*, 2014; Brenton *et al.*, 2014; Balchin *et al.*, 2015). The one limitation of the price-based border-effect studies, however, is that the estimates of border effects capture the cumulative effect of many policies or barriers to integration, not only those attributable to border procedures. For example, price gaps may reflect differences in import tariff, sales tax or value added tax, product market regulations and exchange rates, in addition to costs

1 Under the 1991 Abuja Treaty, African leaders concretised the 1980 Lagos Plan of Action and committed to the establishment of an African Economic Community through the integration of Regional Economic Communities (RECs). There are currently eight RECs: Arab Maghreb Union (UMA), Common Market for Eastern and Southern Africa (COMESA), Community of Sahel-Saharan States (CEN-SAD), East African Community (EAC), Economic Community of Central African States (ECCAS), Economic Community of West African States (ECOWAS), Intergovernmental Authority on Development (IGAD) and the Southern African Development Community (SADC). These are characterised by overlapping membership of countries and different stages of integration.

2 The BIAT was endorsed during the 18th Ordinary Session of the Assembly of Heads of State and Government of the African Union, held in Addis Ababa, Ethiopia in January 2012. The BIAT targets seven clusters: trade policy, trade facilitation, productive capacity, trade related infrastructure, trade finance, trade information, and factor market integration. It was also during this Summit that the decision to establish a CFTA by 2017 was adopted.

associated with complying with border regulations. It is therefore not possible to easily identify which of these policy interventions matter the most. A deeper understanding of which barriers affect intra-African trade is an important step towards the implementation of well-targeted policies to improve regional integration (Brenton *et al.*, 2014).

In this paper, we provide new insight into the effectiveness of extensive regional integration schemes in integrating product markets in Africa. We use the oldest customs union in world, namely the Southern African Customs Unions (SACU) that was established in 1910, as the case study. We compare prices of 49 highly disaggregated products across 35 cities and towns in Lesotho and South Africa over the period 2006–2009. Lesotho is an 'island-state' within the borders of South Africa and is highly dependent on South African as a source of products with over 80% of their imported consumer products sourced from South Africa.[3] Many of these goods are sold by South African retail chains that have a strong presence in the Lesotho market. While restrictions on the right to work in each country remain, there is, nevertheless, a high degree of mobility of people (no visas are required) across the border. Finally, in addition to being member of the customs union, both countries have adopted the same VAT rates and pursue a common monetary and exchange rate policy through their membership of the Common Monetary Area (CMA).

The country pairs present a 'benchmark' case of integration espoused by many of the Regional Economic Communities within Africa. The border effect is expected to be zero as it devoid of distortions arising from differences in tariff rates, VAT rates and exchange rates. In this paper, we assess whether the integration policies have been sufficient to properly integrate product markets between the two countries.

The study makes additional contributions to the related empirical literature. Most studies using price data in developing economies, particularly in Africa, do not account for the spatial relationship between consumption and production locations (see for example Versailles (2012) and Balchin *et al.* (2015)). Rather, they include all price pairs across cities, or price pairs up to a distance threshold. This approach results in selection biases that lower estimates of the role of distance and raise estimates of the border effect (Anderson *et al.*, 2010; Kano *et al.*, 2013; Borraz *et al.*, 2016). To resolve this, we look at the prices of goods consumed in Lesotho that are sourced from production centres in South Africa. We test the robustness of the results using alternative production centres within South Africa and the imposition of different distance thresholds between city-pairs. As a further robustness test, the paper compares the structure of relative prices between South Africa and Lesotho as in integrated markets, prices are expected to converge to a common set of internal relative prices. Consequently, we estimate more precise measures of the role of distance and borders in driving product price gaps between regions.

3 Data on Lesotho's imports from South Africa shows that over the past decade, the majority of Lesotho's consumer products are sources from South Africa. For example, Lesotho's trade deficit for South Africa's imports range from 6.9 billion US$ in 2009 to 11.4 billion US$ in 2015 with a high proportion of these products covering clothing and footwear, foodstuffs and vegetable products. The data are obtained from the South Africa's department of trade and industry as well as downloaded from the UNCTAD depository of trade statistics (2014). Accessed from: http://knoema.com/UNCTADIMPTOTAL2014/merchandise-trade-matrix-imports-and-exports-of-total-all-products-annual-1995-2013

The results show that price gaps remain large between Lesotho and South Africa. Crossing the border between South Africa and Lesotho is associated with an absolute product price gap of 21.5%. This border-effect has increased over the period, rising from 18% in 2006 to 29% in 2009. Relative prices also differ markedly between South Africa and Lesotho, compared to within South Africa. These findings are robust to the choice of alternative production centres in South Africa. Our regressions also reveal evidence of lower transport costs within the region, as reflected by the low distance coefficients estimated. These trade costs are however high in comparison to developed countries in North America and Europe and pose a further impediment to the integration of product markets within and between South Africa and Lesotho.

The results are surprising. They reveal that product markets remain segmented between Lesotho and South Africa despite their geographical proximity and joint membership in the customs union and monetary area. We surmise that the continued use of border controls to monitor the flow of goods, the concentration in the retail market, plus the use by Lesotho of quantitative restrictions on imports create frictions to trade and allow firms to segment markets.

The remainder of this paper is structured as follows: Section 2 reviews the theory and empirical evidence on estimating product market integration and border effects. Section 3 outlines the identification strategy and empirical analysis, while Section 4 describes the data and presents descriptive statistics on the integration of product markets. Section 5 presents the empirical estimates and tests the robustness of the results. Section 6 extends the analysis of border effects to cover relative price integration. Finally, Section 7 concludes the paper and discusses policy implications.

2. Theory and evidence

The central theory behind the price-based measure of product market integration is the Law of one Price (henceforth, LOP). According to the LOP, prices of similar products expressed in the same currency should, under competitive conditions and no transport costs, equalise across all locations, nationally and internationally. In practice, the LOP does not hold as product prices are affected by trade costs and other impediments to trade. Nevertheless, even in this case, the price gap across markets should not exceed the transactions costs. This relationship is denoted by the arbitrage condition:

$$|P_{ikt} - P_{jkt}| \leq t_{ijk} \tag{1}$$

where P_{ikt} and P_{jkt} are the prices (in common currency) of product k, in location i and j, respectively, and t_{ijk} is the transaction cost involved in trading the product between the locations.[4] The inequality condition in equation (1) states that the absolute value of price gaps between two markets is bounded by the no-arbitrage condition (Baulch, 1997). If optimal prices between two markets (i and j) lie within the constraint, then their price gaps are smaller than trade costs and no trade takes place. If price differences exceed trade costs,

4 Generally, these include all border-related (such as delays and burdens of doing business in another country and under another legal system) and non-border related (such as distance and geographical irregularities) costs that are incurred in transporting the good from the origin to final destination.

then economic agents arbitrage away the price gaps by trading the product between the markets.

The common approach to estimating the impact of trade costs on price gaps within and between countries has been to impose the equality constraint in equation (1) on all price pairs and estimate a gravity style model such as:

$$\left|p_{ikt} - p_{jkt}\right| = \alpha_0 + \alpha_1 \mathrm{ldist}_{ij} + \alpha_2 \mathrm{border}_{ij} + \gamma_k + \gamma_t + \varepsilon_{ijt} \quad (2)$$

where p_{ikt} and p_{jkt} are the log prices (in common currency) of product k, in location i and j respectively; ldist_{ij} is the log bilateral distance between locations i and j; and border is a dummy variable equal to one if locations i and j are in different countries. The 'border-effect' coefficient α_2 measures the marginal price gap between countries relative to the mean price gap within countries (captured by α_0) that is not explained by distance. Gorodnichenko and Tesar (2009) extend this by including a country-specific fixed effect. They do this to account for differences in within-country distributions of prices in the countries. [5]

Earlier research using this approach was based on price index data, such as the consumer or producer price index. Engel and Rogers (1996), for example, examine the nature of deviations from Purchasing Power Parity using 14 disaggregated consumer price indices for the 23 US and Canada cities over the period 1978–1994. Their results reveal that crossing the US–Canada border was equivalent to shipping a good 75,000 miles, although Gorodnichenko and Tesar (2009) estimate that this falls to 47 km once cross-country heterogeneity in relative prices is accounted for. Other studies using price index data include Engel and Rogers (2001) and Beck and Weber (2001) for Europe, Parsley and Wei (2001) for central Asia, and Rogers and Smith (2001) for the North American Free Trade Agreement (NAFTA) countries.

However, the use of price indices to measure product market integration is problematic as they cannot be used to measure differences in price levels. Further, their use induces potential aggregation bias and amplifies cross-country deviations in relative prices (Knetter and Slaughter, 2001; Engel *et al.*, 2005; Broda and Weinstein, 2008). Other studies have applied the gravity model to estimate the border effect using disaggregated price level data (Parsley and Wei, 2001; Ceglowski, 2003; Crucini *et al.*, 2003; 2005a; Crucini *et al.*, 2010; Gopinath *et al.*, 2011). Using this type of data allows for a comparison of differences in price levels of goods across locations while accounting for heterogeneity across products.

A further critique of the earlier literature is their inclusion of all price pairs when estimating equation (2). This effectively imposes an equality constraint between price gaps and transaction cost differences for all price pairs. This is inconsistent with equation (1) where the price gap for some price pairs is less than the bilateral transaction costs. The inclusion of price pairs where the transaction cost is not binding, leads to a downward selection bias in the distance coefficient estimates and an upward bias in the border effect.

Consequently, recent literature has pursued alternative approaches to deal with this selection bias. The first approach restricts the sample to include only production and

5 They argue that the omission of a country-specific effect to account for differences in price distributions within each country biases the estimate of the border-effect upwards. The coefficient α_2 in their extension measures the marginal price gap between countries relative to the mean price gap within the omitted country.

consumption market pairs, as in Anderson *et al.* (2010, 2013) and Kano *et al.* (2013). For example, using data from the Economist Intelligence Unit (EIU), across 15 US cities, Anderson *et al.* (2010) find a rise in the distance coefficient once the sample is restricted to consumption–production pairs.

Borraz *et al.* (2016) propose an alternative approach where they categorise price pairs into distance bins and then estimate the relationship using quantile regressions. They apply this approach using 202 products in 333 supermarkets within cities in Uruguay. Consistent with their expectations, the inclusion of all price pairs leads to an overestimate the distance-equivalent border effect between cities. When the upper quintiles of the price distribution within each distance bin are used, the border effect becomes small and insignificant.

A third approach is proposed by Atkin and Donaldson (2015), who extend the production–consumption pair method to account for imperfect competition and varying mark-ups across locations. Using data for the US, Nigeria and Ethiopia, they point out that trade costs are not accurately estimated using price gaps for production–consumption centres if traders charge varying mark-ups.

These applications have primarily been used to calculate intra-national trade costs, and not inter-national trade costs. One reason is that price pairs across countries for equivalent products are difficult to obtain. The research on Africa using price level data is also limited. Exceptions include Versailles (2012) who analyses the sources of LOP deviations using disaggregated monthly product prices for 24 goods in 39 cities across four East African (EAC) countries (Burundi, Kenya, Rwanda and Uganda). He estimates an average border-effect of 13.6% over the period 2004 to 2008. Brenton *et al.* (2014) estimate lower border effects for Central and Eastern Africa (7%) using three agricultural products. Using narrowly defined agricultural products, Aker *et al.* (2014) calculate border-related price gaps of 17% for millet 26% for cowpeas (26%) between Niger and Nigeria. Finally, Balchin *et al.* (2015) estimate an 11.8% border-related price difference for 24 products in four Southern African Development Community (SADC) countries (Botswana, Zambia, Malawi and South Africa) over the period 2006–2009.

Apart from Aker *et al.* (2014) who focus on a very narrow set of agricultural products, these studies on border-effects in Africa do not deal with the selection bias associated with the inclusion of all price-pairs. This paper extends this literature by estimating the deviations from LOP within and across Lesotho and South Africa, using the production–consumption approach. Consequently, it is able to control for selection biases that affect the magnitude of the border effect. To our knowledge, our study is the first to use this approach to estimate the size of the cross-country border effect using a wide range of product price data in Africa.

3. Data description and sources

To conduct the analysis, we draw on disaggregated product price data obtained from the Bureau of Lesotho and Statistics South Africa. The price database is made up of monthly product prices used for the construction of the consumer price indices (CPI) of Lesotho and South Africa. The prices are expressed in terms of the South African Rand (ZAR) and are defined by detailed product descriptions, including units (and in the case of Lesotho, brand names). This allow for a comparison of prices of similar products across locations and

Table 1: Description of Data for Lesotho and South Africa

Variable	South Africa	Lesotho
Period of analysis	2006–2009	2006–2009
Number of cities and towns	25	10
Number of product groups	10	10
Number of products	49	49

across time. The two datasets are then matched using unique product descriptions created using individual product and unit names.[6]

Distances between city-pairs are calculated using data obtained from Google maps (https://maps.google.co.za/) and travel math (www.travelmath.com/).[7] Distance is calculated as the shortest distance by road between the centroids of the cities. For example, the shortest distance by road between Maseru, the capital of Lesotho and Vereeniging is 366 km.[8]

The final database used in the empirical analysis comprises of monthly price observations for 49 narrowly defined products over 35 towns/cities in South Africa (25) and Lesotho (10) over the period 2006–2009. Table 1 presents the summary information. We take averages of the monthly data to construct annual average and then calculate relative prices using annual averages. Table A1 in the Appendix provide more detailed descriptions of each product.

Products are categorised into 10 different groups including food products, alcoholic beverages, clothing and footwear, household furniture and equipment as presented in Table 2. All products are traded between South Africa and Lesotho. The bulk of the products comprise of food items (25 products) followed by household furniture and equipment items (six products) and then clothing and footwear items (five products). Overall, the sample comprises of just under 35 thousand production–consumption price pairs. This is fraction of the complete set of possible price pairs (over 600 thousand) commonly included in empirical estimates.

4. Empirical methodology

4.1 Identification strategy

This paper adopts a production–consumption approach based on the framework of Anderson and van Wincoop (2004) and Anderson *et al.* (2013). A key requirement in this approach is identifying sources of production for each product. This poses a particular challenge to this study. Firstly, while South Africa is the main production hub in the region, production of certain products takes place in multiple locations within the country (e.g., beer is produced in all the cities). Secondly, while we have specific brand information for some products sold in Lesotho, we lack the brand-level information for products in South

6 For a detailed list of product descriptions, see Table A1 in the Appendix

7 For the purpose of consistency, we refer to all locations as cities.

8 We also use driving time as an alternative measure of distance. We do not report these estimations in the paper as the results are qualitatively similar. The results will be provided by the authors upon request.

Table 2: Number of Products By Product Groups

Product groups	Number of observations		Number of products	
	All pairs	Prod–cons pairs	Frequency	Percent
Alcoholic beverages	30,005	1,961	3	6.1
Clothing and footwear	72,388	4,465	5	10.2
Food	344,013	18,114	25	51.0
Household furniture and equipment	67,945	3,294	6	12.2
Household operations	26,210	1,375	2	4.1
Non-alcoholic beverages	23,734	1,272	2	4.1
Other goods and services	5,581	65	1	2.0
Personal care	31,004	2,275	2	4.1
Tobacco and narcotics	27,476	1,761	2	4.1
Transport equipment	5,740	274	1	2.0
Total	634,096	34,856	49	100

Note: The first column (all pairs) includes manual relative prices for all city-pairs. The second column only includes price pairs between Vereeniging (in South Africa) and all other towns/cities in the database.

Africa. The matching of products across South Africa and Lesotho is based on the product description that is only defined by product name and unit. It is thus difficult to identify the exact production centre of the South African products.

We therefore adopt an alternative strategy by selecting production centres that are most suitable to the nature of our data. We identify Vereeniging, a town in the Gauteng province within South Africa, as the main source for all the products in the sample. Vereeniging is located within the Sedibeng district that is one of the main industrial hubs in South Africa and produces the largest share of production in manufacturing.[9] It is located within the Gauteng industrial zone through the OR Tambo and City Deep terminals. This provides manufacturers in this area with efficient logistics and distribution services for the movement of goods to importing locations.[10] Vereeniging also lies on the main transport route from these areas to Lesotho. Consequently, Vereeniging is regarded as a suitable proxy for the production hub of the products used in the analysis. Nevertheless, we test the robustness of our findings to alternative production hubs, including Bloemfontein, Pretoria and Vanderbijlpark.

4.2 Empirical specification

Given this background, we estimate the following spatial relationship:

$$\left|p_{ckt} - p_{pkt}\right| = \alpha_0 + \alpha_1 \mathrm{ldist}_{pc} + \alpha_2 \mathrm{ldist2}_{pc} + \alpha_3 \mathrm{border}_{pc} + \gamma_k + \gamma_t + \varepsilon_{pct} \quad (3)$$

where $|p_{ckt} - p_{pkt}|$ is the absolute mean log price difference between production city (p) (Vereeniging) and consumption city (c) located in either South Africa or Lesotho. ldist_{pc} represents the log distance from Vereeniging to the consumption location and is included to control for transport costs. The square of log of distance ($\mathrm{ldist2}_{pc}$) is included to account

9 See Table A2, for a more detailed breakdown of sectoral contributions for each district.

10 The distance from Vereeniging to City Deep industrial zone terminal is 61 km (around 44-min drive) and to OR Tambo terminal is 80 km (or 56-min drive).

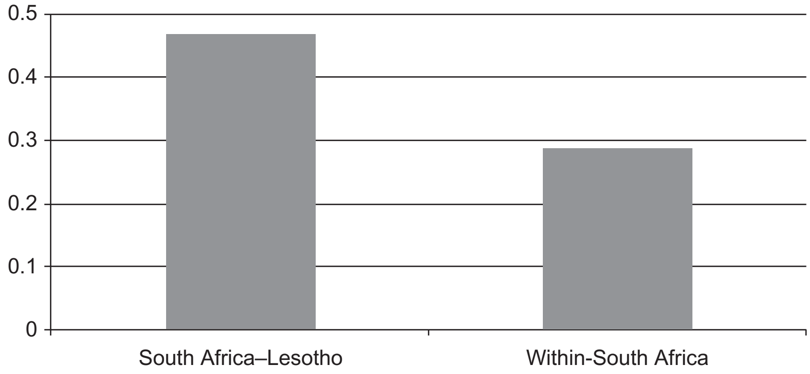

Figure 1: Descriptive Statistics for Price Dispersion Between Production and Consumption Cities, 2006–2009
Note: South Africa–Lesotho average log price differences are between Vereeniging and Lesotho cities and within South Africa price gaps are between Vereeniging and other South African cities

for potential non-linear relationships between price differences and distance in line with the results found by Garmendia *et al.* (2012) and Gallego and Llano (2014).

To capture the border effect, the specification includes a dummy variable border_{pc} equal to one for city-pairs between Vereeniging and locations in Lesotho and zero for all other city-pairs. This variable measures the border related trade costs conditional on transport costs. Its coefficient (α_3) captures the effect of national borders between Lesotho and South Africa on price differences relative to the constant (α_0) that measures price gaps within South Africa. To control for time-invariant heterogeneity across products, product dummies (γ_k) are included. Month dummies (γ_t) are also included to control for cyclical factors that are common to both countries. The standard errors reported are clustered at city level to account for the possibility that the regression errors are not independent within the cities.

5. Results

5.1 Descriptive statistics

5.1.1 Product price differences within and between countries

We provide an initial description of the degree of product market integration between production and consumption city-pairs by calculating the mean of the absolute log deviation from LOP using equation (1). The average across all products in the sample for the entire period from 2006 to 2009 as illustrated in Figure 1.

The diagram underscores the presence of substantial barriers to integration between the two countries. Price differences are larger between Vereeniging–Lesotho city-pairs than price difference between Vereeniging and city-pairs within South Africa. Over the period 2006–2009, the average absolute deviations from LOP is 33% for production–consumption pairs within South Africa compared to 52% for production–consumption pairs between South Africa and Lesotho.[11]

11 The average log price differences are converted to percentage differences by taking the exponents and subtracting 1.

Table 3: Mean Absolute Price Deviations Across Production–consumption City-Pairs by Product Group, % Differences

Product group	South Africa–Lesotho	Within-South Africa	All city-pairs (average)
Alcoholic beverages	45.6	24.5	30.3
Clothing and footwear	92.1	80.0	83.1
Food	29.3	13.9	18.4
Household furniture and equipment	184.6	75.8	101.4
Household operations	58.6	38.8	44.3
Non-alcoholic beverages	30.1	13.8	18.4
Other goods and services	513.5	156.8	278.5
Personal care	351.8	86.3	129.8
Tobacco and narcotics	47.0	19.8	29.3
Transport equipment	56.5	47.8	51.4

Note: The sample includes production–consumption city-pairs only. Percentage differences are calculated as the exponent of the mean log price difference minus 1.

These estimates are comparable with other studies within Africa. Versailles (2012), for example, finds for the East African Community (EAC) a mean absolute deviation in prices of 28% across cities within countries but a 56% price gap between countries. Balchin *et al.* (2015) also report a higher mean absolute price difference of 70% between the four Southern African Development Community (SADC) member countries compared to 34% within countries. Outside Africa, Anderson *et al.* (2016) calculate a mean deviation in prices 75% across 142 cities around the world (55% for OECD countries).

5.1.2 Product price differences by product group

The mean deviation in Table 3 ignores potentially important differences in price gaps across product types (Engel, 1999; Crucini *et al.*, 2005b). Table 3 presents the mean absolute price deviations from the LOP (expressed as percentage differences) by product groups defined by the United Nations Classification of Individual Consumption according to Purpose (COIOP). The sample includes production–consumption city-pairs only.

The results reveal substantial heterogeneity in price gaps across product category.[12] As shown in the final column, average product price differences for all production–consumption city-pairs in the sample are larger for personal care (129.8%), other goods and services (278.5%), household furniture and equipment (101.4%) and clothing and footwear (83.1%). This could be due to variations in product quality found within these product groups. Price differences are much lower for food products (18.4 %) and non-alcoholic beverages (18.4%). In all cases the price gaps between production and consumption centres within South Africa are lower than between South Africa and Lesotho. For example, the mean price gap for food products is 29.3% between the production centre in South Africa and towns/cities in Lesotho compared to 13.9% between other cities within South Africa.

12 Estimated retail price differences for individual products are presented in Table A1 in the Appendix.

Table 4: Mean Absolute Producer–Consumer Price Deviations Within and Between Countries, Across Time, % Differences

Country-pairs	2006	2007	2008	2009	All periods
South Africa–Lesotho	50.2	56.4	58.9	70.1	59.8
Within-South Africa	28.4	29.2	28.7	42.2	33.1

Note: The sample includes only production–consumption city-pairs in the sample. South Africa–Lesotho city-pairs consist of city-pairs between Vereeniging and towns and cities within Lesotho. Within-South Africa city-pairs include city-pairs between Vereeniging and other South Africa cities and towns. Percentage differences are calculated as the exponent of the mean log price difference minus 1.

5.1.3 Product price differences across time

Table 4 presents the trends in mean producer–consumer retail price differences within and between countries over time. Production–consumption price gaps are rising within South Africa as well as between South Africa and Lesotho. The mean absolute price difference between Vereeniging and cities/town in Lesotho rose steadily from 50.2% in 2006 to 70.1% in 2009. Similarly, the price gap between Vereeniging and other cities within South Africa rose from 28.4% to 42.2%, although this increase was concentrated in the period 2008–2009.

Overall, the results reveal evidence of substantial heterogeneity within and between the two countries as well as across products. The results also show rising price gaps between the two countries over the period of analysis. However, we cannot make substantial conclusion based on these results without controlling for distance and for other factors, including heterogeneity in prices. The next section, therefore, turns to the regression results.

5.2 Regression results

Table 5 presents the baseline regression results. For comparative purposes, the first column presents the estimation results that include price pairs between all cities in the sample. This result corresponds to the approach commonly followed in the literature. The second column presents results based on the production–consumption approach.

The distance effect is concave and statistically significant in both estimates.[13] However, as per our expectations, the distance effect is stronger for the production–consumption pair approach (column 2) compared to the standard approach (column 1). For example, travelling a distance of 400 km between cities (roughly the distance from Vereeniging to Maseru) generates approximately a 10% price difference when using the production–consumption based estimates compared to a 4% price difference when using the estimates based on all city-pairs.[14] The *downward bias* in estimates of the distance coefficient arising from the inclusion of all price-pairs, as opposed to production–consumption price-pairs, corroborates what is found in the international literature.

13 Interesting to note is that the greatest price gap is exactly around 360 km (where further increases in distance at the margin have no impact on the price gap), which is roughly the distance between Vereeniging and Maseru.

14 The percentage price difference for every 400 km distance between city-pairs is obtained using $\alpha_1 * \ln(400) - \alpha_2 * (\ln(400))^2$

Table 5: Regression Estimates on Trade Costs and Price Differences

Dependent variable: mean absolute log price difference	(1)	(2)
Log of distance (ldist)	0.013**	0.035**
	(0.006)	(0.015)
Log of distance (ldist2)	−0.001***	−0.003**
	(0.001)	(0.002)
Lesotho–SA border effect (border)	0.171***	0.195***
	(0.001)	(0.007)
Within South Africa effect (DSA)	−0.018***	
	(0.002)	
Constant	0.178***	0.043
	(0.019)	(0.040)
Product FE	Yes	Yes
Month FE	Yes	Yes
Observations	634,096	34,856
Adj. *R*-squared	0.36	0.41

Notes: Column 1 presents the results from the standard gravity approach, pooling all city-pairs in the sample and accounting for cross-country heterogeneity. Columns 2 presents the results from the production–consumption approach where the consumption centre is Vereeniging. The dependent variable is computed at the product, month and city level. All regressions are estimated with product and month fixed effects. Robust standard errors in parenthesis are clustered at the city level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Our distance coefficient suggests that the distance elasticity for every 400 km between Lesotho and South Africa is low but relatively high compared to those in advanced economies. Anderson *et al.* (2013) report a distance elasticity of 9% between production and consumption centres across the US cities. Inanc and Zachariadis (2012) estimate the distance elasticity of 7% across eight EU countries. Within countries, Ceglowski (2003) estimates distance elasticity of 2% between production and consumption centres in Canada while Kano *et al.* (2013) find 5% of distance elasticity across the Japanese cities.

The border effect estimate from the production–consumption pair estimation is also larger compared to the coefficient obtained using the pooled city-pairs. Crossing the Lesotho–South Africa border generates an additional 21.5% price differences between spatial city-pairs compared to 18.6% price differences obtained using all bilateral city-pairs. This implies that using the pooled approach leads to a *downward bias* of the border effect equivalent to 2.9 percentage points. Other studies, although they do not directly estimate the impact of national borders, also find downwards biased estimates of price differences across countries when using the non-spatial approach (Inanc and Zachariadis, 2012; Atkin and Donaldson, 2015). The goodness of fit also improves with the production–consumption estimates (*R*-squared improves from 0.36 to 0.41).

These results corroborate the available literature that combining the spatially relevant source-to-destination location pairs with other location pairs biases the distance and border effect estimates *downwards*. The results also provide an important insight about the significance of trade costs in Africa. Border effects are large between South Africa and Lesotho, despite their joint membership in a customs union and monetary area.

Table 6: Regression Estimates Using Alternative Production Centres

Dependent variable: mean absolute log price difference	(1) Vereeniging	(2) Pretoria	(3) Vanderbijlpark	(4) Bloemfontein
Log of distance (ldist)	0.035**	−0.056	0.023*	−0.369***
	(0.015)	(0.050)	(0.012)	(0.069)
Log of distance (ldist2)	−0.003**	0.004	−0.002**	0.031***
	(0.002)	(0.004)	(0.001)	(0.006)
Lesotho–SA border effect (border)	0.195***	0.191***	0.178***	0.188***
	(0.007)	(0.005)	(0.008)	(0.007)
Constant	0.043	0.336**	0.060	1.224***
	(0.040)	(0.154)	(0.037)	(0.209)
Product dummies	Yes	Yes	Yes	Yes
Month dummies	Yes	Yes	Yes	Yes
Observations	34,856	39,921	30,006	36,547
Adj. R-squared	0.41	0.37	0.29	0.36

Notes: The dependent variable is computed at the product, month and city level. All regressions are estimated with product and month fixed effects. The corresponding standard errors in parentheses are clustered at city level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

5.3 Sensitivity analysis to choice of production centre

While Vereeniging is a dominant production centre in South Africa, we are unable to certify that the products sold in Lesotho originate from this centre. To test the robustness of our results, we use alternative production centres proximate to Lesotho, namely Vanderbijlpark, Pretoria and Bloemfontein. Table 6 presents the results using these alternative production centres.

The border coefficient is statistically significant for all regressions. However, the border effect is larger when using Vereeniging as a production centre (21.5%) than when using Vanderbijlpark, Pretoria and Bloemfontein as production centres (19.5%, 21.0% and 20.7% respectively). The R-squared also indicates that the model where Vereeniging is a production location is better compared to models that use alternative production centres.[15]

In contrast, the distance effect is significant and concave only when Vanderbijlpark and Vereeniging are selected as a production centres. These two towns share similar characteristics in terms of geographical proximity and commercial distribution. The results obtained for Pretoria and Bloemfontein are consistent with the fact that Pretoria is more of an administrative city than a production centre, while Bloemfontein has a relatively underdeveloped industrial sector. Retail prices in these cities are not necessarily good proxies for production prices. Overall, the results suggest that Vereeniging is a suitable choice as production centre.

5.4 Border effect overtime

In the preceding analysis, we found that the average border effect across the whole period (2006–2009) is significant and large. We now turn to an assessment of how the border

15 We also estimate equation (6) using Cape Town and Durban as alternative production centres but these results are not reported in the paper. However, the results can be provided upon request from the authors.

effect has changed over time. This is important in assessing how the degree of integration between the two countries changes over time. To answer this question, we extend equation (3) to include interactions of the border dummy with year dummies. The coefficients on these interaction terms reflect the marginal effect relative to the base year 2006. The results are presented in Table 7.

From column 1, the results reveal a rising border-effect over time with significant and increasing marginal coefficients in each year after 2006. The results imply increase in border-induced price difference from 17.5% in 2006 to 23.5% in 2009. These increases occurred despite the trade and monetary integration of the two countries.

6. Relative price integration

The indicator of product market integration used in the analysis so far measures the extent to which product prices differ in absolute levels across the cities. An alternative approach to evaluating product market integration is to assess whether there has been convergence towards a common set of internal relative prices. This approach is referred to as relative price integration (Knetter and Slaughter, 2001; Edwards and Rankin, 2016).

To measure relative price differences, we calculate the cross-sectional standard deviation of log price differences *across* products for each production–consumption city-pair. This measure is denoted as $sd_k(p_{pkt} - p_{ckt}|pc)$. A decline in the standard deviation of city-pair

Table 7: Regression Estimates for the Border Effect Overtime

Dependent variable: mean absolute log price difference	(1) Vereeniging	(2) Vanderbijlpark	(3) Pretoria	(4) Bloemfontein
Log of distance (ldist)	0.034***	0.026	0.007	−0.233
	(0.010)	(0.021)	(0.045)	(0.139)
Log of distance (ldist2)	−0.003***	−0.002	−0.001	0.019
	(0.001)	(0.002)	(0.004)	(0.012)
Lesotho–SA border effect	0.161***	0.144***	0.147***	0.177***
	(0.013)	(0.014)	(0.007)	(0.012)
Marginal border effect, 2007	0.030***	0.020*	0.029***	−0.010
	(0.010)	(0.013)	(0.008)	(0.010)
Marginal border effect, 2008	0.046***	0.048***	0.081***	0.036***
	(0.010)	(0.010)	(0.012)	(0.011)
Marginal border effect, 2009	0.050***	0.039***	0.020*	−0.001
	(0.011)	(0.014)	(0.010)	(0.011)
Constant	0.038*	0.091	0.168	0.894**
	(0.036)	(0.060)	(0.139)	(0.408)
Product FE	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes
Observations	34,856	30,006	39,921	36,547
Adj. R-squared	0.41	0.35	0.36	0.36

Notes: The dependent variable is computed at the product, month and city level. All regressions are estimated with product and month fixed effects. The coefficients on the interaction variables with year dummies represent the marginal effects relative to the border effect in 2006. The corresponding standard errors in parentheses are clustered at city level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

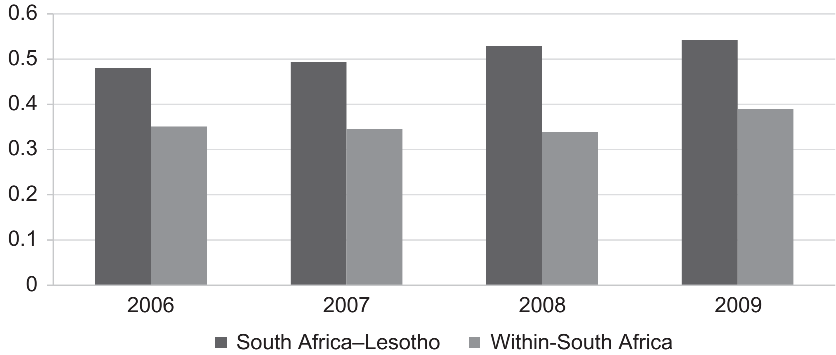

Figure 2: Standard Deviation of Relative Prices by Year, 2006–2009

relative prices denotes a convergence to a common set of internal relative prices driven, for example, by lower trade costs (Edwards and Rankin, 2016). If relative prices across products for a city-pair are the same, the standard deviation indicator will equal zero for that city-pair. This measure provides additional insight into product integration as it is possible for absolute prices to differ between cities/countries, while at the same time, for relative prices not to differ (e.g., this would occur if price gaps between a city-pair are proportionately the same for all products). It is also possible for deviations in absolute price to rise, while at the same time relative prices converge.

To analyse trends in relative prices, $sd_k(p_{pkt} - p_{ckt}|pc)$ is calculated for all production–consumption pairs (pc) in each year. Figure 2 presents the standard deviation of relative price differences for each year over the period 2006 to 2009.

Figure 2 reveals substantial differences in relative prices across goods within South Africa and between Lesotho and South Africa. The standard deviation is lower between production and consumption pairs in South Africa (0.36) than between South Africa and Lesotho (0.52). Relative prices also seem to be diverging, particularly between South Africa and Lesotho. The border therefore appears to impose costs that affect the average absolute price gap as well as relative price gaps and these affects are increasing over time.

To further tease out this relationship, we re-estimate equation (5) but with the standard deviation of log price differences as the dependent variable.[16] The results are presented in Table 8.

The results reveal a significant distortionary effect of the border on relative prices between South Africa and Lesotho, even after accounting for distance. According to the results presented in column 1, the border induces an additional 0.029 increase in the standard deviation of relative prices. This result remains robust to the use of alternative production centres. The results also find support for the distortionary effects of bilateral distance on relative prices as is shown by the significant coefficients for distance and distance-squared. In conclusion, the Lesotho–South Africa border not only distorts absolute prices, but also distorts relative prices.

16 $sd_k(p_{pkt} - p_{ckt|}|pc)_{pc,t} = \alpha_0 + \alpha_1 \text{ldist}_{pc} + \alpha_2 \text{ldist2}_{pc} + \alpha_3 \text{border}_{pc} + \gamma_k + \varepsilon_{pct}$

Table 8: Regression on Border Effect Estimates Using Relative Prices

Dependent variable: standard deviation of log relative prices	(1) Vereeniging	(2) Pretoria	(3) Vanderbijlpark	(4) Bloemfontein
Log of distance (ldist)	0.043***	0.041	0.047**	−0.094
	(0.010)	(0.055)	(0.023)	(0.107)
Log of distance (ldist2)	−0.005***	−0.003	−0.005*	0.009
	(0.001)	(0.005)	(0.003)	(0.009)
Lesotho–SA border effect (border)	0.029***	0.037***	0.014*	0.045***
	(0.008)	(0.004)	(0.007)	(0.009)
Constant	0.245***	−0.011	0.257***	0.500
	(0.025)	(0.166)	(0.051)	(0.323)
Product FE	Yes	Yes	Yes	Yes
Observations	2,459	2,592	2,461	2,554
Adj. R-squared	0.72	0.77	0.66	0.71

Notes: The dependent variable is computed at the city-pair level. All regressions are estimated with product fixed effects. The corresponding standard errors in parentheses are clustered at city level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

7. Conclusion

This paper examines the extent to which product markets are integrated between Lesotho and South Africa. Key to this study is the estimation of the magnitude of border effects, using the spatial production–consumption approach. The results reveal that product markets are not fully integrated between Lesotho and South Africa. Crossing the national border is on average associated with an increase in price differences between South Africa and Lesotho of 21.5% over the full 2006–2009 period. This average masks a border effect that is rose over time from 17.5% in 2006 to 23.5% in 2009. The structure of relative prices between South Africa and Lesotho also differs markedly and is rising over time, revealing a lack of convergence to a common set of internal relative prices. These results are robust to the choice of alternative production centres in South Africa.

The results indicate that the border between South Africa and Lesotho remains an impediment to trade flows and price competition, despite their joint membership in a customs union and monetary area. Three potential explanations underpin these results. Firstly, although Lesotho and South Africa are part of a customs union, goods must be declared at border posts between the two countries. Traders need to comply with various administrative procedures at the border and must present the single administrative document, a commercial invoice, import permits where applicable, an import VAT credit facility letter and a customs notification issued by the South African Revenue Services authorities. Import clearance was also conducted manually and not electronically over the period of this study. All these factors raise the cost of trading across the border.

Secondly, Lesotho imposes quantitative restrictions on the importation of from SACU members and other countries of various food products such as milk, sugar, bread, meat, fresh fruit, fresh vegetables, pulses, beans, peas, red meat, poultry and eggs. Import permits are granted for specific quantities for short periods (mostly one month) depending on the supply of locally produced goods (WTO, 2015). These import controls will drive a price wedge between goods sold in South Africa and Lesotho.

Thirdly, the South African supermarket industry is highly concentrated, particularly in the retail of food products (Das Neer, 2016). The market is dominated by five large supermarket chains that also operate in Lesotho. The imposition of quantitative restrictions on imports will act to preserve the market power of these chains and enable them to segment the product markets.

Further research is required to establish the primary sources of the price gaps. However, our research shows that trade agreements and monetary unions alone may not be sufficient to eliminate border related impediments to international trade and competition. Additional mechanisms, such as competition policy and improvements in border procedures are required to complement the reductions in tariffs.

Supplementary material

Supplementary material is available at *Journal of African Economies* online.

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