A Disaggregated Analysis of Product Price Integration in the Southern African Development Community

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Abstract

Empirical evidence on the extent to which product markets are integrated within Africa remains noticeably limited. This paper uses highly disaggregated retail price data for 32 narrowly defined products collected at the district level in five SADC countries (Botswana, Malawi, South Africa, Tanzania and Zambia) and Uganda to assess the extent to which product prices are integrated within and between these countries. We find evidence of large and persistent absolute deviations from the law of one price (LOP) both within and between each of the six countries. We also find that price dispersion is higher between the six countries in comparison to within individual countries. Simple econometric estimates indicate that, on average, absolute price deviations between country pairs are smaller for countries adjacent to each other and for countries that share common membership in the Southern African Customs Union, the Common Market for Eastern and Southern Africa or the East African Community. We find no evidence that product prices in the region have become more integrated between 2001 and 2011, despite the liberalization of tariffs under the SADC Protocol on Trade. This implies that trade liberalization may not be sufficient on its own to generate greater product market integration within the region.

Key words: Product market integration, price dispersion, retail prices, law of one price, African regional integration, Southern African Development Community.

JEL codes: F14, F15

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1 Introduction

Significant progress has been made over the past two decades in advancing the broader vision of regional integration in the Southern African Development Community (SADC). This has been evident in notable reductions in tariffs on intra-SADC trade; a process that accelerated following the introduction of the SADC Protocol on Trade in 2000.\(^1\) It is not clear, however, whether these tariff reductions have been accompanied by greater integration of product markets in the region. Integrated product markets are characterised by the absence of (or very low) barriers to commerce and the movement of goods. More integrated product markets are expected to experience higher volumes of bilateral trade, stronger competition and greater convergence in relative prices.

The general consensus based on trade flows is that African product markets are fragmented (Hartzenberg, 2011; World Bank, 2012). In SADC, the volume of intra-regional trade remains relatively low. Furthermore, trade flows within the region are highly concentrated both in terms of product coverage – the majority of intra-SADC trade occurs in the form of trade in resource-based products (Gillson, 2012) – and the dominance of trade between the Southern African Customs Union (SACU) countries (Behar & Edwards, 2011).\(^2\)

Importantly, however, diagnoses of the level of market integration based on the volume of trade flows between countries can be misleading since trade volumes may be an endogenous outcome of market integration, and are also influenced by unrelated factors such as government expenditure, exchange rates, donor funding and rules of origin (Edwards & Rankin, 2012). The latter are particularly onerous in the SADC context and may indirectly affect trade flows in the region (Flatters & Kirk, 2003).

Alternatively, product market integration can be measured by analysing the behaviour of relative prices or price levels (Knetter & Slaughter, 2001). More integrated markets have more similar price levels or price changes. To date, the vast majority of empirical price-based analyses of product market integration have focused on industrialised countries (see for instance Engel et al., 2005; Crucini, Shintani & Tsuruga, 2008; Gopinath et al., 2010; Burstein & Jaimovich, 2012). In contrast, only limited attention has been given to this area in the context of developing countries, particularly in Africa.\(^3\) As a result, little is known about product price dispersion within and between countries in the region. In

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\(^1\) The signatories to the Protocol agreed on schedules to phase down tariff barriers over a 12-year period beginning in 2000. The twelve SADC Member States to originally ratify the SADC Protocol on Trade in 2000 were: Botswana, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe. Angola acceded to the Protocol in 2003 but, to date, has opted not to implement it.

\(^2\) Levels of intra-SADC trade have been rising gradually. Moreover, the level of intra-SADC trade is actually relatively high when the geography of the region and the limited size of its individual markets are taken into account (Faroutain & Pritchett, 1993; Behar & Edwards, 2011).

\(^3\) This has been primarily due to data limitations – particularly related to a lack of high-frequency data on narrowly defined goods – which have precluded research on product price dispersion and product market integration within and between African countries. Notable exceptions are Aker et al. (2010); Edwards & Rankin (2012); and Versailles (2012).
addition, there remains a lack of knowledge on the impact of mechanisms designed to enhance regional integration – such as regional trade and monetary agreements – on product market integration in Africa.

This paper uses highly disaggregated retail price data collected at the district level for five SADC countries (Botswana, Malawi, South Africa, Tanzania and Zambia) and Uganda to address the lack of price-based studies of product market integration in Africa. The primary focus is on assessing the extent to which product prices are integrated within and between these countries. This is particularly pertinent in the African context, where transport costs are high and other market rigidities that hamper the flow of goods – stemming from factors such as poor infrastructure, regulatory barriers and inefficient border controls – may segment markets (Portugal-Perez & Wilson, 2008; Versailles, 2012).

The use of disaggregated retail price data in this paper presents a number of advantages over previous studies that are based on price index data. By using actual price level data the paper is able to analyse absolute deviations from the law of one price (LOP) within and between African countries; while also being able to account for possible heterogeneity across products. In this way, the paper extends the available evidence on product market integration in Africa, and the SADC region in particular. This, in turn, makes an important contribution to the debate on regional integration on the continent.

The results presented in the paper indicate that product prices are dispersed both within and between the six African countries. This is reflected in large and persistent absolute deviations from the LOP, which are greater between countries than across districts within the same country. Within the six countries, product prices differed from the country mean by 25% on average in 2009; while between country price deviations averaged 41% in that year. Across products, the paper finds evidence of considerable heterogeneity in price dispersion, even within smaller sub-groups of homogenous and differentiated products. In 2009, for instance, the absolute value of between country price deviations ranged from 0.10 for a bath towel and 0.17 for a colour television to 0.62 for 1kg of cabbage, 0.85 for a ladies dress and 1.03 for a consultation with a private doctor.

Geographic proximity (measured by bordering and non-bordering countries) and shared membership in regional trade and monetary agreements is found to reduce absolute price deviations between bilateral country pairs. However, there is no evidence that product prices in the region have become more integrated between 2001 and 2011, despite the liberalization of tariffs under the SADC Protocol on Trade. This implies that trade liberalization may not be sufficient on its own to generate greater product market integration within the region.

The remainder of the paper is structured as follows. Section 2 outlines the basic theoretical concepts that underpin the analysis of product price integration. This is followed in Section 3 by a discussion of the key findings in the relevant empirical literature. Section 4 provides a detailed explanation of the main features of the price data used in the analysis of product price integration. Thereafter, the conceptual framework and empirical methodology that forms the basis of the descriptive analysis is outlined in Section 5. Section 6 presents the results from the analysis of product price integration, and Section
2 Theoretical Background

In theory, progress towards greater market integration should be reflected in lower price differentials for similar products across markets. This assertion is derived from the theoretical benchmark of the LOP, which states that for any good $i$:

$$P_i = E P_i^*$$  \hspace{1cm} (1)

where $P_i$ is the domestic currency price, $E$ is the home currency price of foreign currency and $P_i^*$ is the foreign currency price. This framework can be used to consider variation in prices within and between countries (the nominal exchange rate, $E$, is equal to one in the within country case).

In essence, the LOP implies that identical goods should sell for the same price (when measured in a common currency) in different markets. The equalization of prices across markets suggested by the LOP is underpinned by the potential for arbitrage. In the absence of barriers to arbitrage between markets, buyers faced with the option to purchase similar goods in different markets will purchase a good from the market in which it is priced the lowest, subject to the cost of transportation to their home market (Bradford & Lawrence, 2004). Thus, arbitrage forces should ensure that prices for similar goods converge across well-integrated markets, as the absence of such convergence would entice buyers to purchase equivalent goods at a lower price in a different market (Knetter & Slaughter, 2001; Rogers & Smith, 2001; Parsley & Wei, 2002; Bradford & Lawrence, 2004; Engel et al., 2005). In this context, market integration is expected to reduce the size of deviations from the LOP and mean that countries face more similar relative prices for traded goods (Knetter & Slaughter, 2001).

In practice, however, a variety of factors may lead to deviations from the LOP, reflected in dispersion in the prices of similar goods across locations. Price dispersion may arise due to the presence of direct barriers such as distance or transport costs (Dumas, 1992; Engel & Rogers, 1996; Crucini et al., 2005a; Bergin & Glick, 2007; Anderson, Schaefer & Smith, 2013); cost differences between markets—arising, for example, through variation in factor prices; heterogeneity in market structures; differences in income levels, language and cultural differences; or variation in the density of ethnic networks (Aker et al., 2010; Anderson, Davies & Smith, 2012).

For a variety of reasons, these factors may be magnified in the case of markets located in different countries. For instance, additional transaction costs generated by the presence of political boundaries may hinder arbitrage and drive a wedge between prices across countries.\footnote{These transaction costs may take the form of direct costs stemming from barriers to trade (such as tariffs or quotas); non-tariff barriers (such as bureaucratic red tape, subsidies, health and safety standards and regulations, or cumbersome customs procedures) and other trade restrictions (Rogoff, 1996; Engel & Rogers, 1996; Rogers & Smith, 2001; Borraz, 2006); or non-pecuniary transaction costs such as exchange rate risk (Anderson, Davies & Smith, 2012).} Furthermore, nominal exchange rate
variability in cases where final goods prices are sticky in local currency terms can generate movements in the good-level real exchange rate and cause cross-border prices of similar goods to fluctuate in line with the exchange rate (Engel & Rogers, 1996; Rogers & Smith, 2001; Engel et al., 2005; Engel & Rogers, 2004; Borraz, 2006).

3 Empirical Literature

The existing body of price-based research on product market integration can be organised into two broad segments based on the nature of the data used. Specifically, there is a clear divide between studies based on price index data and research that has used disaggregated data on product price levels.

3.1 Aggregate PPP studies using price index data

Much of the early focus in the international literature involved studies using price index data to test for aggregate purchasing power parity (PPP) in relative terms (Frenkel, 1981; Krugman, 1987; Wei & Parsley, 1995; Rogoff, 1996; Asplund & Friberg, 2001; Rogers & Smith, 2001). For relative PPP to hold, which is expected in the long-run for integrated markets, the rate of growth in domestic and foreign prices (converted into the domestic currency) must be equal (Edwards & Rankin, 2012). In studies based on price index data, volatility in aggregate relative prices (measured as the standard deviation of the log of aggregate relative prices between two markets or locations) is most commonly used to measure deviations from PPP. Greater volatility in aggregate relative prices across locations is indicative of markets that are not well integrated.

On balance, studies using price index data find large and volatile short-run deviations from PPP. They suggest that aggregate consumer goods prices do not co-move together and have not converged to the extent expected given the level of globalization in the world economy. Furthermore, where convergence in prices has occurred, it has generally happened at a slow pace (Rogoff, 1996). In Africa, the evidence from aggregate PPP studies is mixed, but does provide some support for increased price integration within Sub-Saharan Africa (SAA) (Holmes, 2000; Nagayasu, 2002; Bahmani-Oskooee & Gelan, 2006; Chang et al., 2006).

Importantly, however, studies based on price index data suffer from several shortcomings. Price indices can only be used to compare rates of inflation across locations and not to examine differences in price levels (Engel et al., 2005). Moreover, given that consumer price index (CPI) data is typically based on sub-indexes of fairly broad categories of goods, which may not be standardized across countries, evidence of dispersion in relative prices between countries based on price index data may reflect variation in the product and quality composition of the indices, rather than actual price differences for common products.

Rogoff (1996) notes that deviations from PPP tend to dampen out at a rate of 15% per year.
Additionally, the use of price indexes can induce aggregation bias and overstate cross-country dispersion in relative prices by collapsing within-country volatility in relative prices and preserving the variation arising from cross-country differences (Evans, 2001; Cegłowski, 2003; Broda & Weinstein, 2008; Chahrour & Stevens, 2012). Finally, when price index data is used, it is not possible to conclude whether observed changes in deviations in relative prices signify price convergence or divergence across countries unless PPP holds in the base year (Rogoff, 1996; Knetter & Slaughter, 2001; Edwards & Rankin, 2012).

3.2 Empirical evidence on the LOP across markets within and between countries based on disaggregated price level data

In recognition of the shortcomings associated with price index data, the focus in the literature has shifted to the use of disaggregated data on actual price levels. Some large cross-country studies using price level data have shown that global price dispersion has been uneven over time (Knetter & Slaughter, 2001; Bergin & Glick, 2007). A number of studies have also found evidence of much greater volatility in product-level real exchange rates when compared to volatility in nominal exchange rates, which suggests that markets are segmented internationally (Broda & Weinstein, 2008; Gopinath et al., 2010; Burstein & Jaimovich, 2012).

These conclusions are backed by widespread evidence documenting failures in the LOP in studies that use disaggregated product price level data (Isard, 1977; Richardson, 1978; Giovanni, 1988; Froot, Kim and Rogoff, 1995; Parsley & Wei, 2002; Engel et al., 2005; Crucini et al., 2005a; Crucini et al., 2005b; Bergin & Glick, 2007; Crucini & Telmer, 2012; Cavallo, Neiman & Rigobon, 2013). Engel et al. (2005) find a 7% difference in product price levels across cities in the United States and Canada. Focusing on East Asia, Moon (2013) uses disaggregated price data for 111 tradable products in ten East Asian countries over the period between 1990 and 2011 and computes a mean price differential across all products of approximately 0.62 in 2011 – a value significantly larger than his equivalent estimate for the European Union (0.38).

The existing empirical evidence from studies using price level data overwhelmingly indicates that prices are far more dispersed between countries than within countries (Gopinath et al., 2010; Anderson, Davies & Smith, 2012; Burstein & Jaimovich, 2012; Crucini & Yılmazkuday, 2013). Focusing only on the United States and Canada, Gopinath et al. (2010) use price level data for 4221 highly disaggregated products sold in 325 grocery stores operated by a single retail chain in both countries. They report mean absolute price gaps (averaged over all products) of 8.7% across stores within the United States and 3% across stores within Canada; both of which are significantly smaller than the equivalent mean absolute price gap of 22.2% for United States-Canada store pairs. In a large multi-country study based on price level data for 200
products covering 142 cities, Anderson, Davies and Smith’s (2012) estimates of mean price dispersion across city pairs located in the same country are notably smaller (at roughly 0.30) in comparison to the mean absolute price deviation of 0.56 that they compute for city pairs located in different countries (and 0.44 when restricted to between country OECD city pairs).

**Price dispersion and product market integration in Africa**

To date, very little research has been undertaken to investigate product market integration in Africa using disaggregated product price level data. One exception is a study by Aker et al. (2014), who use disaggregated monthly price data for two commodities (millet and cowpea) to assess product market integration across the border between Niger and Nigeria. The authors find increased price dispersion in markets for millet and cowpea across the international border. Using a market-pair regression approach, they estimate the effect of the Niger-Nigeria border on price dispersion (conditional on transport costs and other characteristics) to be between 2.5% and 3% for millet and cowpeas. They also find that ethnicity has important effects on price dispersion – with ethnic differences generating internal barriers to trade within Niger; and common ethnicities facilitating market integration in the case of cross-border markets between Niger and Nigeria.

Another important exception is Versailles’ (2012) study on Eastern Africa in which he tests the LOP across countries using disaggregated monthly product price level data for 24 goods in 39 cities in four EAC Member States: Burundi, Kenya, Rwanda and Uganda. His estimate of average price dispersion across city pairs within the same country (0.243) is notably lower than the equivalent estimate of between country price deviations (0.443) for the 2004 to 2008 period. He finds that national borders in the region cause product prices to deviate by between 13% and 20%, on average, from the LOP.

Finally, Edwards and Rankin (2012) assess product market integration in Africa using disaggregated retail prices for more than 200 products across 13 African cities in 14 countries from 1990 to 2008. Their sample only includes annual price observations and covers a relatively dispersed set of countries, while not including within country variation in prices. They find evidence of increased product market integration on the continent, but note that much of the movement towards greater integration was concentrated in North Africa during the early 1990s.

What is missing from the literature on product market integration in Africa is a study focused on SADC. While several studies have assessed market integration in SADC using quantity based measures of integration (such as the degree to which SADC countries trade with each other), there is a lack of price-based studies that use actual price level data to examine product market integration in the region. We extend the literature by using highly disaggregated retail price data to measure the extent to which product prices are integrated within and between SADC countries.

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6 When considering a single market on either side of the Niger-Nigeria border, and adopting a regression discontinuity design, the authors’ estimated border effect on price dispersion climbs to between 17% and 26% in the case of millet and marginally higher for cowpeas.
4 Data Description

To measure dispersion in product prices across the SADC region, this paper utilises highly disaggregated retail price data collected at the district level in Botswana, Malawi, South Africa, Tanzania, Zambia and Uganda. The raw data is constructed from retail level data used in the computation of each country’s CPI; and provides monthly observations for prices of a range of narrowly defined products, with the prices reported as average prices in individual districts. Importantly, for each country, the raw prices include value added tax (VAT) and, in the case of certain products, excise taxes as well. To aid comparability across countries, the prices used in the empirical analysis are recalculated net of VAT. However, for a small number of products (such as cigarettes and brandy) the excise taxes remain.

The organisation of the data along narrowly defined product descriptions means that it is possible to compare prices for similar products across markets. To do so, a detailed product mapping and matching process was undertaken to identify products (and units) common to all countries. The final dataset constructed through this process includes monthly price observations for 32 narrowly defined products spanning the period from December 2001 to August 2012. Table 1 outlines the time, product and district coverage of the sample by country.

The sample products cover a diverse range of categories: foods; clothing and textiles; machinery, equipment and electronics; other products; and services. Rauch’s (1999) highly disaggregated product classification scheme is used to distinguish between homogenous and differentiated products within the sample (see Table A in the Appendix). The key distinguishing factor between the two groups of products is the degree of product substitutability. Products that fall within the homogenous group are generally considered to be substitutable (even if in some cases they have certain unique attributes); while differentiated products are likely to have “many characteristics that vary across suppliers and may even be specifically tailored to the end-user’s needs” (Besedes & Prusa, 2006: 343).

The wide district coverage in the sample can be exploited to consider variation in prices within countries. However, there is heterogeneity in the number of districts for which price data is available within each country. The district coverage ranges from 46 districts in Botswana and 42 in Zambia to 15 in Malawi and 8 in Uganda (the Tanzanian data is only available at the national level). See Table B in the Appendix for a full list of the individual products and their units of measurement.

8Rauch argues that the possession of a reference price is what distinguishes homogenous from differentiated products. He divides homogenous products further into those for which the reference prices are quoted on organised exchanges and those whose reference prices are quoted only in trade publications. This paper does not distinguish between these two types of homogenous products, instead considering them simply as part of the homogenous product category.

9The potential influence of the variation in district coverage across countries is mitigated through the use of country average prices (calculated annually across all districts) in the
The membership of the six countries in multilateral trade arrangements spans a number of different regional trade groupings: SADC, SACU, the Common Market for Eastern and Southern Africa (COMESA) and the EAC. At least two of the six countries are members of each of these regional trade groupings. Furthermore, there are a number of examples of overlapping membership in which countries are members of more than one trade grouping (see Table C in the Appendix). The variation in country membership across regional trade groupings presents an opportunity to unpack the implications of common membership in various regional trade arrangements for product price integration across countries.

It is important to take cognisance of two limitations in the data. First, despite the efforts made to derive a common set of matched products across all six countries, the final set of products, while highly similar across countries, may still not be perfectly homogenous. In many cases, the original product descriptions provided in the raw country price data are devoid of detail on brand or other product-specific characteristics. As a result, potentially important product-level differences in quality or brand name may remain across locations, and could contribute to any observed dispersion in product prices across locations. This is, however, likely to be less of a concern within countries.

To address this concern, the bulk of the empirical analyses of price dispersion within and between countries are based on calculations of the average price deviations across all products. Product specific differences are therefore more likely to be averaged out. In addition, the robustness of the regression results presented later is tested using sub-sets of products in specific groups (traded products versus non-traded services; homogenous versus differentiated products) and controls for country specific characteristics.

Another noteworthy shortcoming in the raw country data for Tanzania is that the unit of measurement for individual products is not provided. As a result, depending on the nature of the product in question, observed price differentials between the Tanzanian products and those in other countries may arise purely due to differences in the units of denomination (which are common across all other countries) rather than from transaction and trade costs or other relevant factors. Recognising this problem, the Tanzanian product prices are excluded from the calculations of the mean SADC product prices (see Section 5).

5 Conceptual Framework and Empirical Methodology

The absolute price level reflects the relative cost of an identical product between two locations at a particular point in time. Empirically, the relative price of product $i$ between districts $j$ and $k$ at time $t$ can be calculated as the difference between country price dispersion calculations (see Section 5).
in the log prices of product $i$ between the two districts:

$$RP_{i,jk,t} = p_{i,j,t} - p_{i,k,t}$$  \hspace{1cm} (2)

If the absolute version of the LOP holds, the value of $RP_{i,jk,t}$ in equation (2) should be equal to zero. A deviation from the LOP will be reflected in an absolute value of $RP_{i,jk,t}$ that differs from zero.

The simple relative price measure in equation (2) forms the conceptual basis for the subsequent analysis of price dispersion within and between countries. Focusing initially on price dispersion within countries, the within country relative price of product $i$ in district $j$ in country $c$ at time $t$ is represented as the deviation in the price of product $i$ in district $j$ from the country mean price for that product at a particular point in time:

$$RPW_{i,j,c,t} = p_{i,j,c,t} - \bar{p}_{i,c,t} = p_{i,j,c,t} - \frac{\sum_{j=1}^{J_c} p_{i,j,t}}{J_c}$$  \hspace{1cm} (3)

where $p_{i,j,c,t}$ is the log price of product $i$ in district $j$ in country $c$ at time $t$; $\bar{p}_{i,c,t}$ is the mean log price of product $i$ across all districts in country $c$; and $J_c$ denotes the number of districts in country $c$. For each product, country and time combination, the average within country price dispersion is then computed as the mean of the absolute values of the individual within country relative price deviations for product $i$ across all districts in country $c$ at time $t$:

$$MADW_{i,c,t} = \frac{\sum_{j=1}^{J_c} |RPW_{i,j,c,t}|}{J_c} = \frac{\sum_{j=1}^{J_c} |p_{i,j,c,t} - \bar{p}_{i,c,t}|}{J_c}$$  \hspace{1cm} (4)

A similar approach is used to measure price dispersion between countries. For each product, country and time combination, the between country relative price $RPB_{i,c,t}$ is measured as:

$$RPB_{i,c,t} = \bar{p}_{i,c,t} - \bar{p}^{*}_{i,t} = \frac{\sum_{j=1}^{J_c} p_{i,j,c,t}}{J_c} - \frac{\sum_{c=1}^{C} \bar{p}_{i,c,t}}{C}$$  \hspace{1cm} (5)

where $\bar{p}^{*}_{i,t}$ is the average log price of product $i$ across all SADC countries (excluding Tanzania). The mean absolute price deviation for product $i$ across all countries at time $t$, $MADB_{i,t}$, is then calculated as the mean of the absolute values of the individual between country relative price deviations across all countries $C$:

$$MADB_{i,t} = \frac{\sum_{c=1}^{C} |RPB_{i,c,t}|}{C} = \frac{\sum_{c=1}^{C} |\bar{p}_{i,c,t} - \bar{p}^{*}_{i,t}|}{C} = \frac{\sum_{c=1}^{C} \left( \frac{\sum_{j=1}^{J_c} p_{i,j,c,t}}{J_c} - \frac{\sum_{c=1}^{C} \bar{p}_{i,c,t}}{C} \right)}{C}$$  \hspace{1cm} (6)

\footnote{All price deviations are calculated as time-averaged (over all months) annual price deviations.}
The formulae in equations (3) through (6) form the basis for the descriptive analysis of product price integration in SADC presented in the following section. Using these basic measures of product price deviations across markets (either within or between countries), a number of different aspects of price dispersion in the region are investigated.

6 Analysis and Results

To provide a preliminary perspective on country level variation in prices for individual products, Table B in the Appendix compares average prices (converted into US$) in each country in 2008 for all products included in the matched sample. In the case of certain products – in both the homogenous and differentiated categories – there is significant variation in common currency prices across countries. For example, the average price of an electric iron in 2008 ranged from US$ 11.84 in Botswana to US$ 32.67 in South Africa. In contrast, for some products, variation in prices between countries is low. For instance, the average price for 50ml of shoe polish was US$ 0.78 in Zambia, US$ 0.79 in Botswana and US$ 0.81 in Malawi in 2008.

In general, however, product prices are dispersed across the six countries, and the size of the dispersion varies depending on the product in question. While it is important not to draw any serious conclusions from a simple cross-sectional comparison of price levels, it is nevertheless an interesting point of departure.

The descriptive analysis and results presented in the following sub-section provide a more formal empirical perspective of country and product-level dispersion in prices within and between countries. It then moves to a cursory assessment of the importance of shared borders and common membership in regional trade groupings for product price integration. Finally, results are presented from an analysis of the degree of absolute price convergence over time for the sample of African countries.

6.1 Country level comparison of price dispersion within and between SADC countries

To provide an initial, cross-country perspective on variation in product prices within and between countries and over time, a country level comparison of average price dispersion across all products for the period from 2006 to 2009 is presented in Figure 1. The within and between country price deviations presented in Figure 1 are confined to the 2006-2009 period for ease of comparison as this is the period in which data is available for all six countries. In the case of price dispersion within each country, this involves computing the average of the within country absolute price deviation, $MADW_{i,c,t}$, across all products: $E_i[MADW_{i,c,t}]$. For between country price dispersion, the measure for each

\[11\] The year 2008 is chosen as it provides the most recent time period for which the largest possible sample of common products across all countries is available.
country is calculated as the average of the absolute value of the $RPB_{i,c,t}$ across all products: $E_i[|\bar{p}_{i,c,t} - \bar{p}_{i,t}|]$. 

**Price dispersion within countries**

The average values of the within country absolute price deviations differ across the six countries. In 2009, average price dispersion across districts within each country was lowest in South Africa (at 0.19) and highest in Malawi (at 0.32). Across all countries — excluding Tanzania (where the product price data is only available at the national level) — product prices differed from the country mean by 25% on average in 2009.

These values are similar to those obtained in other multi-country studies using disaggregated price level data. Also in Africa, Versailles (2012) reports a value of 0.24 for average price dispersion across city-pairs within four EAC countries (Burundi, Kenya, Rwanda and Uganda). Outside of Africa, Anderson, Davies and Smith (2012) who, using a disaggregated dataset spanning almost 200 products and services across 142 cities internationally, find mean price dispersion over city pairs within the same country to be around 0.30.

The average values of within country absolute price deviations in each country have remained fairly stable over time. This suggests that internally, product prices within the African countries have not, on average, become more integrated. This is the case for both the 2006-2009 period and the full sample period from 2001 to 2011.

**Price dispersion within versus between countries**

Average dispersion in prices between countries is substantially higher than across districts within countries. This finding is consistent with the empirical literature (see recent studies by Gopinath et al., 2010; Anderson, Davies & Smith, 2012; Burstein & Jaimovich, 2012; Crucini & Yilmazkuday, 2013). For the five SADC countries in 2009, the magnitude of deviations in the mean country prices from the SADC mean price ranged from 0.27 in Zambia to 0.56 in Malawi. Across all six countries, country mean product prices differed from the SADC mean by 0.42 on average between 2006 and 2009 — with the value falling marginally from 0.44 in 2006 to 0.41 in 2009.

These findings are in line with the general evidence in the literature of widespread deviations from the LOP between countries. Furthermore, the magnitude of the between country price deviations are quite similar to those reported in other studies. In Africa, Versailles (2012) reports a very similar value of 0.44 for average between country price dispersion across 24 products in four EAC countries. Focusing on 13 African countries, Edwards and Rankin (2012) estimate absolute value average log price deviations from the LOP (relative to the average log SSA price) of 0.24 between 2005 and 2008. Focusing on East Asia, Moon (2013) computes mean price differentials across ten countries in the region that ranged between 0.59 and 0.61 over the period from 2006 to 2009. Using a much larger sample of 142 cities in countries across multiple continents, Anderson, Davies and Smith (2012) estimate a mean absolute price differential (over all goods and location pairs) between countries of 0.56 (and 0.44 when restricted to OECD countries).

For most countries in the sample, the magnitude of the between country
price deviation measures has remained fairly similar over time. For the 2006-2009 period, the size of deviations in the country mean price from the SADC mean increased marginally in Botswana (from 0.29 in 2006 to 0.34 in 2009) and South Africa (from 0.44 in 2006 to 0.5 in 2009). By comparison, country mean price deviations from the SADC mean price declined (mostly by small amounts) in the case of Malawi (from 0.6 to 0.56), Tanzania (from 0.63 to 0.44), Uganda (from 0.36 to 0.35) and Zambia (from 0.31 to 0.27) over the same period. The evidence of large and persistent LOP deviations between countries would seem to suggest that product prices in the SADC region have not become more integrated over the sample period.

6.2 Comparison of price dispersion across products

The price deviation measures presented above are computed using average prices across all products. While instructive in providing an aggregate, country-level picture of price dispersion within and between the six countries, they may mask important differences in price dispersion at the product level. For instance, in theory LOP deviations should be larger for less tradable goods and for goods that use more non-tradable inputs in production (Engel, 1999; Crucini et al., 2005b). Mindful of this, product-specific price deviation measures within and between countries for each product $i$ are also computed. First, to compare within country, product-level dispersion in prices, the mean across all countries of the individual within country relative price deviations for product $i$ across all districts within country $c$ at time $t$ is computed as:

$$MAD_{i,t} = \frac{\sum_{c=1}^{C} MADW_{i,c,t}}{C}$$

(7)

where $C$ denotes the number of countries in the sample. This yields one observation, $MAD_{i,t}$, at time $t$ for each of the 32 products. The mean product-level dispersion in prices between countries is measured as the mean absolute price deviation for product $i$ across all countries at time $t$, $MADB_{i,t}$, as in equation (6).

The product-specific values of the within and between country price dispersion measures are presented in Table 2. For the majority of products and in almost all years, price dispersion within countries is notably lower than dispersion in prices between countries. In 2009, this was the case for 27 of the 32 products. Interestingly, in 2009 the products for which the values of mean within country price dispersion exceeded between country price deviations are all in the differentiated products group.

Focusing on price dispersion between countries and looking at the variation across products, the values in Table 2 reveal considerable heterogeneity at the product level, even within the smaller sub-sets of products that are common to a particular group. In 2009, the mean value of between country price deviations

12The general observation that the size of between country price deviations has remained relatively stable over time holds for the full sample period from 2001 to 2011 as well.
(from the SADC mean price) was highest for the non-traded services group (at 0.71). The high level of between-country dispersion in prices for non-traded services is consistent with the theoretical literature, as well as empirical evidence provided in studies such as Crucini et al. (2005b).

Interestingly, the between-country price deviations are larger, on average, for the broad group of homogenous products (0.44 in 2009) in comparison to the differentiated products (0.34 in 2009). This is driven, in part, by the relatively high between-country price deviations for the food products in the homogenous group (which averaged 0.48 in 2009); \(^{13}\) and the comparatively lower between-country price deviations for the machinery, equipment and electronics (averaging 0.26 in 2009) and other products (average of 0.21 in 2009) in the differentiated products group.

One possible explanation for the relatively high level of price dispersion for food products in the region is that, with the exception of rice, all of the food products in the homogenous group are perishable fresh fruits and vegetables. These products are less tradable given that they are typically subject to fast deterioration and high transport costs. Furthermore, they may be subject to non-tariff barriers (NTBs) that inhibit arbitrage between countries.\(^ {14}\) In support of this view, Versailles (2012) shows empirically that markets for fruits and vegetables are less integrated in the EAC in comparison to staple foods, and that NTBs are more important for these products compared to staple foods, other food items and other products (such as beer, soda, cigarettes, charcoal and petrol). Similarly, Edwards and Rankin (2012) observe large deviations in retail prices from the regional average for fresh fruit and vegetables for their sample of SSA cities.\(^ {15}\)

There is considerable heterogeneity across products in the trends in product price integration over time. Average between-country price deviations declined from 2006 to 2009 for 19 of the 32 products in the sample and increased for the remaining 13 products. Many of the products (13 out of 19) for which between-country price dispersion declined over this period are part of the differentiated products group.

A visual perspective of product-specific trends in price dispersion between countries over time is given by the kernel density estimates of \(\text{RPB}_{i,c,t}\) for the homogenous, differentiated and traded product (which includes both homogenous and differentiated products) groups presented in Figure A in the Appendix. The figure presents kernel density estimates of distributions of product-by-product deviations in the mean price of product \(i\) in country \(c\) from the mean SADC price (excluding Tanzania) for that product in 2006 and 2009 (thus plot-

\(^{13}\)In comparable work on Africa, Versailles (2012) reports larger deviations from the LOP both within and between countries for fruits and vegetables in comparison to staple foods, other food items and other products.

\(^{14}\)Examples of NTBs potentially affecting fruits and vegetables are phyto-sanitary standards or problems related to the issuance of certificates of origin to traders for perishable products.

\(^{15}\)Price differentials for fresh produce have been found to be higher even between markets within countries. For example, when computing mean absolute price differentials by product across 25 cities within Canada, Ceglowski (2003) finds higher average price differences for fresh produce items in comparison to non-perishables and non-food items.
ting one observation for each product in the particular group in each country in each year). In general, the plots for the traded products and the more disaggregated homogeneous and differentiated product groups provide little evidence of product market integration in the region; with no obvious narrowing of the range of the country product price deviations from the mean SADC price between 2006 and 2009.

6.3 The importance of a shared border and common membership in regional trade groupings for product price integration

The stylized facts in the theoretical and empirical literature on price dispersion and product market integration indicate that traditional trade costs (typically proxied by distance) contribute to dispersion in product-level retail prices across markets. This implies that adjacent countries, and those separated by smaller distances, are likely to experience less dispersion in product prices over more geographically disparate countries. There is also a body of evidence in the empirical literature to suggest that common membership in regional trade and monetary agreements may reduce product price dispersion across locations in different countries (Parsley & Wei, 2002; Boad, 2004; Bergin & Glick, 2007; Versailles, 2012).

This section presents a number of simple empirical estimates to test whether these key stylized features hold in the African context. In order to do so, a dataset was constructed containing product price deviations for all combinations of bilateral country pairs involving the six countries (amounting to a total of 15 country pair combinations). To provide an initial perspective, the average of the mean absolute price deviations (across all products) for specific groups of bilateral country pairs is computed for each year. Figure 2 compares this measure for bilateral pairs of bordering and non-bordering countries, as well as against the average across all bilateral country pairs, for the period from 2002-2010.

Figure 2 shows that, on average (across all products), relative price deviations between bordering countries are lower in comparison to countries that are not adjacent to each other. In 2009, the mean absolute value of the price deviations for non-bordering country pairs was 0.70 compared to 0.52 in the case of countries that share a border – a difference of 0.18.

Table 3 presents a comparison of the average of the mean absolute price deviations for bilateral country pairs that share common membership in specific regional trade and monetary agreements against those that are not both members of the respective groupings. The results indicate that price dispersion (averaged over all products) is lower between countries that share common membership in any one of the SACU, COMESA or EAC formations. However, the same does not hold in the case of countries that are members of both SADC and COMESA.

There are notable differences between the three regional trade formations.
Looking over the shorter period from 2006 to 2009 in which data is available for all possible combinations of bilateral country pairs, price differences between SACU members averaged 0.37, and were substantially lower than the equivalent average price differences between the COMESA (0.54) and EAC (0.49) members.\footnote{16}

These relationships are tested more formally through simple econometric estimates to isolate the influences of proximity and common regional trade and monetary agreements on price deviations between countries. The relationship is estimated over the period from 2001 to 2011 using annual averages of the monthly price data.\footnote{17} The average of the mean absolute price deviation across all products for bilateral country pair \((jk)\) in year \(t\), \(\bar{RP}_{jk,t}\), is selected as the dependent variable. The basic model is specified as:

\[
\bar{RP}_{jk,t} = \alpha + \beta_1 \ln(\text{dist}_{jk}) + \beta_2 \text{bordering}_{jk} + \beta_3 \text{SACU}_{jk} + \beta_4 \text{COMESA}_{jk} \\
+ \beta_5 \text{EAC}_{jk} + \beta_6 \ln(\text{gpc}_{jk,t}) + \beta_7 \ln(\text{pop}_{jk,t}) + \varepsilon_{jk,t}
\]

(8)

where \(\text{dist}_{jk}\) is the log of the bilateral distance between the respective capital cities for country pair \((jk)\); \(\text{bordering}_{jk}\) is a dummy variable equal to one if the two countries in country pair \((jk)\) are adjacent bordering countries and zero otherwise; \(\text{SACU}_{jk}\), \(\text{COMESA}_{jk}\) and \(\text{EAC}_{jk}\) are dummy variables equal to one if the two countries in country pair \((jk)\) share common membership in SACU, COMESA or the EAC, respectively; \(\text{gpc}_{jk,t}\) is the log of the product of GDP per capita in countries \(j\) and \(k\) at time \(t\); and \(\text{pop}_{jk,t}\) is the log of the product of the total populations of countries \(j\) and \(k\) at time \(t\).\footnote{18}

The estimation results are presented in Table 4. Due to a high level of correlation between the distance and bordering variables, these variables are included in the regressions separately, with the regressions including only the bordering variable presented in columns (1) and (2) and those including only the distance variable presented in columns (3) and (4). All four regressions are estimated with the inclusion of time fixed effects.

In general, the results conform to expectations and corroborate both the earlier findings and the stylized facts in the literature. Average absolute price deviations between country pairs are smaller for countries adjacent to each other. Depending on the specification, prices are between 10.9% and 18.5% lower for neighbouring country pairs in comparison to non-neighbours.

\footnote{16}The value for the EAC is quite similar to Versailles’ (2012) estimate of 0.44 for the average deviation from the LOP between bilateral country pairs covering four of the five EAC Member States.

\footnote{17}This is the full period for which data is available for at least one bilateral country pair.

\footnote{18}The GDP per capita variable is included to account for the potential impact that the distribution of income may have on the consumption of quality differentiated products within narrowly defined product categories. Countries with higher mean income distributions are likely to consume higher priced goods (Choi, Hummels & Xiang, 2008). In turn, the population variable is included to capture the possible effect of market size on prices – product prices may be comparatively lower in larger markets (Melitz & Ottaviano, 2005). Moreover, both the GDP per capita and population variables provide measures of country size, which is important given that the gravity model of bilateral trade suggests that trade is positively associated with size.
Furthermore, average absolute price deviations between country pairs are smaller for countries that share common membership in one of the SACU, COMESA or EAC formations. Prices are between 17.1% and 19% lower for COMESA country pairs (depending on the specification), between 21.6% and 29.7% lower for EAC country pairs, and between 22.5% and 31.4% lower for SACU country pairs in comparison to country pairs that do not share common membership in these groupings.

The distance variable is only significant when included in the regressions on its own. In these cases, the positive coefficients indicate that price dispersion between country pairs increases the further apart the two countries are from each other. This is in line with existing evidence in the empirical literature, and supports the theoretical argument that price dispersion increases with distance as transportation costs and barriers to arbitrage between markets rise.

As a further test, regressions are estimated to investigate whether these relationships differ between tradable products and non-tradable services, and between differentiated versus homogenous products. Intuitively, one would expect that prices would be more integrated for tradable products than for services, given that the former can be traded across country borders. Similarly, it is likely that prices will be more integrated in the case of homogenous products compared to those in the differentiated category, since the former are generally more substitutable while there is likely to be greater scope for prices to diverge on the basis of quality or other characteristics in the case of the latter.

The results from the separate product sub-group regressions presented in Table 5 are based on the model specified in equation (8) (excluding the regressions with the distance variable). In each case, the dependent variable is the average of the mean absolute price deviation across all products in the specific product sub-group for bilateral country pair ($\overline{jk}$).

The regression results for the product sub-groups are generally weaker than those reported earlier for the pooled sample containing average price deviations across all products. Looking first at the regressions for traded products versus those for services, the effect of sharing a border in reducing price dispersion is significant in the case of services – prices for services are more integrated between countries that are adjacent to each other – but not for traded products. In the case of traded products, the insignificant coefficient on the bordering dummy may be due to the fact that products in the traded group can theoretically move relatively easily between countries within the region (contingent, of course, on the size and nature of tariff and NTBs to trade), which potentially reduces the price integrating effect for markets located adjacent, and thus closer, together.

Price dispersion is significantly lower between the COMESA and EAC country pairs in the case of the traded products group (but not for the SACU country pairs). For the services group, this is only true for countries that share common membership in COMESA. Taken together, the results suggest that prices for traded products are more integrated that those for services among the EAC countries; while the price integrating effect of shared membership in COMESA is evident for both the traded and services groupings (albeit comparatively larger and stronger in terms of significance in the case of services).
In the case of the homogenous group, price dispersion is significantly lower between country pairs that are both members of SACU or the EAC. However, for the differentiated products, this is only the case for the COMESA country pairs. These results imply that the prices of homogenous products are more integrated within the SACU and EAC formations; while those for differentiated products are more integrated within COMESA.

6.4 Price convergence over time

It is also instructive to investigate the degree of absolute price convergence over time within the sample of African countries. A decline in absolute price dispersion across the sample period would suggest that product prices (and hence product markets) are becoming more integrated in the region; as would be anticipated given the reduction in tariffs under the SADC Protocol on Trade.

The pooled dataset of bilateral country pairs with variation in the mean absolute price deviations across all products, $\overline{RP}_{jk,t}$ is used to investigate whether product prices have converged over the full sample period from 2001 to 2011 as well as over the shorter period between 2006 and 2009. The shorter period from 2006 to 2009 includes product price deviations for all 15 possible bilateral country pair combinations. This involves regressing the absolute value of the mean LOP deviation across all products on a time trend. Additional regressions that include interactions between the time trend and dummies for the various regional trade and monetary agreements (SADC, SACU, COMESA and the EAC) are also estimated. The full specification is as follows:

$$\overline{RP}_{jk,t} = \alpha + \beta_1 \text{year} + \beta_2 \text{year} \times \text{SADC}_{jk} + \beta_3 \text{year} \times \text{SACU}_{jk} + \beta_4 \text{year} \times \text{COMESA}_{jk} + \beta_5 \text{year} \times \text{EAC}_{jk} + \varepsilon_{jk,t}$$

(9)

where $\text{year}$ is the time trend variable; and $\text{SADC}_{jk}, \text{SACU}_{jk}, \text{COMESA}_{jk}$ and $\text{EAC}_{jk}$ are dummy variables equal to one if the two countries in country pair $(jk)$ share common membership in SADC, SACU, COMESA or the EAC and zero otherwise. The regressions are estimated with country pair fixed effects so that the estimates explain the within country pair variation in absolute price dispersion over time.

The results for the full sample period (see columns (1) and (2) in Table 6) indicate that product prices did not become more integrated in the region between 2001 and 2011. In fact, in the basic specification the coefficient on the time trend variable is positive and significant, indicating that absolute price dispersion between countries increased over the 2001-2011 period. This is in line with the evidence presented in Figure 2, which shows a gradual rise in price dispersion between the sampled countries from 2002 to 2010.

The coefficients on the interaction terms in column (2) suggest the result that prices became less integrated in the region over the full sample period is driven by the COMESA country pairs. Aside from the interaction involving the COMESA dummy, the estimated coefficients on the SADC, SACU and EAC interaction terms are not significantly different from zero, and thus provide no
evidence of increased or decreased product price integration between country pairs that share membership in one of these regional trade and monetary agreements.

Similar results are obtained when the sample is restricted to the 2006-2009 period (columns (3) and (4) in Table 6). While the sign on the coefficient on the time trend variable is negative, the estimated coefficient is not statistically significant. Again, this does not provide any evidence to suggest that product prices became more integrated in the region between 2006 and 2009.

The overall finding of a lack of price convergence in the region over time is consistent with the earlier evidence that the magnitude of between country price deviations has remained fairly similar over the sample period (see sections 6.1 and 6.2). However, the absence of price convergence in the region is somewhat at odds with the evidence in other disaggregated price-based studies of product market integration in Africa. In comparable work on Eastern Africa, Versailles (2012) finds reduced deviations from the LOP over the period between 2004 and 2008 (which coincides with the advent of the customs union in the region in 2005) between two members of the EAC Customs Union (Kenya and Uganda).

Looking more broadly at retail price convergence in Africa, Edwards and Rankin (2012) find evidence of improved product market integration – reflected in declining average volatility of real exchange rates between two periods (1985-1996 and 1997-2008) – within several regional trade and monetary formations including SADC, the EAC and COMESA, as well as the CFA Franc zone and the Economic Community of West African States. More generally, they find evidence of convergence over time in both absolute and relative prices within their sample of SSA and North African countries. However, the authors note that much of the convergence occurred during the 1990s and was concentrated in North African cities; with the degree of absolute price convergence lower within SSA.

7 Conclusion

This paper uses highly disaggregated retail price data collected at the district level in six African countries to provide a descriptive analysis of the extent to which product prices are integrated within and between countries in the region. In doing so, the paper extends the literature on product market integration to Africa, and the SADC region in particular; thereby addressing the lack of knowledge about product price dispersion both within and between countries on the continent.

In line with the balance of evidence in the international literature, the paper finds large and persistent deviations from the LOP – both within and between – the African countries. On average over all products, there is dispersion in product prices across districts within each country. It is also shown that the

19 It is, however, consistent, with some comparable studies that focus on other regions over a similar time period. Moon (2013), for example, finds little evidence of convergence in the prices of tradable products in East Asia between 1990 and 2011.
average values of within country absolute price deviations have remained fairly stable over time; suggesting that, internally, product prices within each of the countries have not, on average, become more integrated.

Also consistent with the international literature, dispersion in product prices is found to be substantially greater between markets located in different SADC countries in comparison to price differentials across markets within the same country. In general, the price dispersion estimates for the six countries are quite similar to those computed in comparable work in the empirical literature.

These broad findings are replicated when the sampled products are considered individually. Price dispersion between countries is shown to be highest for non-traded services, followed by homogenous and differentiated products, respectively. However, even within these sub-groups there is a great deal of heterogeneity across products.

The paper also explored the relationships between cross-country price dispersion, the proximity of countries to each other, and whether or not they share membership in various regional trade and monetary agreements. The results from simple econometric estimates indicate that, on average, absolute price deviations between country pairs are smaller for countries adjacent to each other and for countries that share common membership in any one of SACU, COMESA or the EAC. These findings are consistent with evidence in the international literature that suggests that shared membership in regional trade and monetary agreements may reduce product price dispersion across locations in different countries.

In conclusion, the paper shows that product prices in the region remain dispersed. When all six countries are considered together, there is no evidence to suggest that product prices have become more integrated over the sample period, despite the liberalization of tariffs under the SADC Protocol on Trade. This implies that trade liberalization may not be sufficient on its own to generate greater product market integration within the region.

References


Table 1: Time, district and product coverage, by country

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<th>Country</th>
<th>Timeframe</th>
<th>Number of Districts</th>
<th>Number of Matched Products</th>
<th>Original Number of Products</th>
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</table>

Notes: The Tanzanian data represents national average prices by product. Price data is missing in the Tanzanian dataset for the months of August and September 2006. In the case of certain countries, the original number of products in the raw datasets varies by district.

Table 2: Comparison of product-level price dispersion within and between countries, 2006-2009

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<td>0.66</td>
<td>0.25</td>
<td>0.60</td>
</tr>
<tr>
<td>ladies dress</td>
<td>0.40</td>
<td>0.71</td>
<td>0.36</td>
<td>0.74</td>
<td>0.38</td>
<td>0.77</td>
<td>0.37</td>
<td>0.85</td>
</tr>
<tr>
<td>men's shirt</td>
<td>0.33</td>
<td>0.33</td>
<td>0.30</td>
<td>0.29</td>
<td>0.27</td>
<td>0.30</td>
<td>0.27</td>
<td>0.30</td>
</tr>
<tr>
<td>men's suit</td>
<td>0.50</td>
<td>0.49</td>
<td>0.44</td>
<td>0.47</td>
<td>0.38</td>
<td>0.52</td>
<td>0.48</td>
<td>0.51</td>
</tr>
<tr>
<td>men's trousers</td>
<td>0.30</td>
<td>0.41</td>
<td>0.25</td>
<td>0.38</td>
<td>0.27</td>
<td>0.26</td>
<td>0.28</td>
<td>0.37</td>
</tr>
</tbody>
</table>
Table 3: Comparisons of average mean absolute price deviations – membership in regional trade agreements, 2002-2010

<table>
<thead>
<tr>
<th>SACU</th>
<th>COMESA</th>
<th>EAC</th>
<th>SADC &amp; COMESA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not both SACU</td>
<td>Both SACU</td>
<td>Not both COMESA</td>
</tr>
<tr>
<td>2002</td>
<td>0.46</td>
<td>-</td>
<td>0.51</td>
</tr>
<tr>
<td>2003</td>
<td>0.60</td>
<td>-</td>
<td>0.71</td>
</tr>
<tr>
<td>2004</td>
<td>0.70</td>
<td>-</td>
<td>0.75</td>
</tr>
<tr>
<td>2005</td>
<td>0.67</td>
<td>-</td>
<td>0.76</td>
</tr>
<tr>
<td>2006</td>
<td>0.67</td>
<td>0.37</td>
<td>0.67</td>
</tr>
<tr>
<td>2007</td>
<td>0.68</td>
<td>0.34</td>
<td>0.69</td>
</tr>
<tr>
<td>2008</td>
<td>0.63</td>
<td>0.31</td>
<td>0.61</td>
</tr>
<tr>
<td>2009</td>
<td>0.64</td>
<td>0.47</td>
<td>0.65</td>
</tr>
<tr>
<td>2010</td>
<td>0.73</td>
<td>-</td>
<td>0.79</td>
</tr>
</tbody>
</table>
Table 4: Regressions with mean absolute price deviations across all products for bilateral country pairs as dependent variable

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>bordering</td>
<td>-0.185***</td>
<td>-0.109**</td>
<td>0.141***</td>
<td>0.00107</td>
</tr>
<tr>
<td></td>
<td>(0.0418)</td>
<td>(0.0443)</td>
<td>(0.0386)</td>
<td>(0.0545)</td>
</tr>
<tr>
<td>log distance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SACU</td>
<td>-0.225*</td>
<td>-0.314*</td>
<td>-0.00351</td>
<td>0.00719</td>
</tr>
<tr>
<td></td>
<td>(0.114)</td>
<td>(0.158)</td>
<td>(0.0231)</td>
<td>(0.0244)</td>
</tr>
<tr>
<td>COMESA</td>
<td>-0.190**</td>
<td>-0.171**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0778)</td>
<td>(0.0804)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAC</td>
<td>-0.216**</td>
<td>-0.297***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0897)</td>
<td>(0.0900)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>log GDP per capita</td>
<td>-0.00351</td>
<td>0.0288</td>
<td>0.0288</td>
<td>0.0395**</td>
</tr>
<tr>
<td></td>
<td>(0.115)</td>
<td>(0.165)</td>
<td>(0.0174)</td>
<td>(0.0183)</td>
</tr>
<tr>
<td>log population</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>constant</td>
<td>0.720***</td>
<td>-0.153</td>
<td>-0.367</td>
<td>-0.712</td>
</tr>
<tr>
<td></td>
<td>(0.0262)</td>
<td>(0.685)</td>
<td>(0.278)</td>
<td>(0.682)</td>
</tr>
<tr>
<td>Observations</td>
<td>96</td>
<td>96</td>
<td>96</td>
<td>96</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.232</td>
<td>0.412</td>
<td>0.184</td>
<td>0.366</td>
</tr>
<tr>
<td>Year fixed effects</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

Notes: Standard errors are in parentheses. Significance at the 10 percent, 5 percent and 1 percent levels is denoted by *, ** and *** respectively. The SADC dummy is the omitted category.

Table 5: Product sub-group regressions with mean absolute price deviations across all sub-group products for bilateral country pairs as dependent variable

<table>
<thead>
<tr>
<th></th>
<th>Traded products versus non-traded services</th>
<th>Homogenous versus differentiated products</th>
</tr>
</thead>
<tbody>
<tr>
<td>bordering</td>
<td>-0.0720</td>
<td>-0.0937</td>
</tr>
<tr>
<td></td>
<td>(0.0447)</td>
<td>(0.0640)</td>
</tr>
<tr>
<td>SACU</td>
<td>-0.182</td>
<td>-0.313*</td>
</tr>
<tr>
<td></td>
<td>(0.115)</td>
<td>(0.165)</td>
</tr>
<tr>
<td>COMESA</td>
<td>-0.155*</td>
<td>-0.171</td>
</tr>
<tr>
<td></td>
<td>(0.0784)</td>
<td>(0.112)</td>
</tr>
<tr>
<td>EAC</td>
<td>-0.245***</td>
<td>-0.361***</td>
</tr>
<tr>
<td></td>
<td>(0.0904)</td>
<td>(0.129)</td>
</tr>
<tr>
<td>log GDP per capita</td>
<td>-0.0132</td>
<td>-0.0276</td>
</tr>
<tr>
<td></td>
<td>(0.0233)</td>
<td>(0.0333)</td>
</tr>
<tr>
<td>log population</td>
<td>0.0423***</td>
<td>0.0228</td>
</tr>
<tr>
<td></td>
<td>(0.0176)</td>
<td>(0.0251)</td>
</tr>
<tr>
<td>constant</td>
<td>-0.521</td>
<td>0.422</td>
</tr>
<tr>
<td></td>
<td>(0.690)</td>
<td>(0.988)</td>
</tr>
<tr>
<td>Observations</td>
<td>96</td>
<td>96</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.364</td>
<td>0.340</td>
</tr>
</tbody>
</table>

Notes: Standard errors are in parentheses. Significance at the 10 percent, 5 percent and 1 percent levels is denoted by *, ** and *** respectively. The SADC dummy is the omitted category.
Table 6: Trend in mean absolute price dispersion (across all products) between bilateral country pairs, 2001-2011 and 2006-2009

<table>
<thead>
<tr>
<th></th>
<th>2001-2011</th>
<th>2006-2009</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>year</td>
<td>0.0178***</td>
<td>-0.00685</td>
<td>-0.0109</td>
<td>-0.0114</td>
</tr>
<tr>
<td></td>
<td>(0.00501)</td>
<td>(0.0138)</td>
<td>(0.00816)</td>
<td>(0.0198)</td>
</tr>
<tr>
<td>year*SADC</td>
<td>0.0174</td>
<td>-0.00799</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0135)</td>
<td>(0.0213)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>year*SACU</td>
<td>0.0168</td>
<td>0.0468</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0447)</td>
<td>(0.0339)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>year*COMESA</td>
<td>0.0342***</td>
<td>0.0173</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0113)</td>
<td>(0.0233)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>year*EAC</td>
<td>-0.00359</td>
<td>-0.0108</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0274)</td>
<td>(0.0377)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>96</td>
<td>96</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.804</td>
<td>0.828</td>
<td>0.906</td>
<td>0.912</td>
</tr>
<tr>
<td>Country pair fixed effects</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

Notes: Standard errors are in parentheses. Significance at the 10 percent, 5 percent and 1 percent levels is denoted by *, ** and *** respectively.

Figure 1: Comparison of mean absolute price deviations within and between countries, 2006-2009

Mean price deviations within and between countries, 2006-2009

Notes: Data is only available at the national level in Tanzania. Hence, within country dispersion in prices across districts in Tanzania is zero, and is omitted.
Figure 2: Comparison of average mean absolute price deviations – bordering versus non-bordering country pairs, 2002-2010

Average mean absolute relative price deviations for bordering versus non-bordering countries

Average mean absolute relative price deviation

2002 2003 2004 2005 2006 2007 2008 2009 2010

Non-Bordering  Bordering  All countries
## Appendix

### Table A: Classification of sampled products

<table>
<thead>
<tr>
<th>Classification according to Rauch (1999)</th>
<th>Product</th>
<th>Final classification</th>
<th>Product sub-group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goods traded on an organized exchange (homogenous goods)</td>
<td>bananas</td>
<td>homogenous</td>
<td>food</td>
</tr>
<tr>
<td></td>
<td>potatoes</td>
<td>homogenous</td>
<td>food</td>
</tr>
<tr>
<td></td>
<td>rice</td>
<td>homogenous</td>
<td>food</td>
</tr>
<tr>
<td>Referenced priced</td>
<td>brandy</td>
<td>homogenous</td>
<td>other products</td>
</tr>
<tr>
<td></td>
<td>cabbage</td>
<td>homogenous</td>
<td>food</td>
</tr>
<tr>
<td></td>
<td>cigarettes</td>
<td>homogenous</td>
<td>other products</td>
</tr>
<tr>
<td></td>
<td>onions</td>
<td>homogenous</td>
<td>food</td>
</tr>
<tr>
<td></td>
<td>oranges</td>
<td>homogenous</td>
<td>food</td>
</tr>
<tr>
<td></td>
<td>paraffin</td>
<td>homogenous</td>
<td>other products</td>
</tr>
<tr>
<td></td>
<td>pineapples</td>
<td>homogenous</td>
<td>food</td>
</tr>
<tr>
<td></td>
<td>tomatoes</td>
<td>homogenous</td>
<td>food</td>
</tr>
<tr>
<td>Differentiated products</td>
<td>bath towel</td>
<td>differentiated</td>
<td>clothing and textiles</td>
</tr>
<tr>
<td></td>
<td>blanket</td>
<td>differentiated</td>
<td>clothing and textiles</td>
</tr>
<tr>
<td></td>
<td>boy's shirt</td>
<td>differentiated</td>
<td>clothing and textiles</td>
</tr>
<tr>
<td></td>
<td>brassiere</td>
<td>differentiated</td>
<td>clothing and textiles</td>
</tr>
<tr>
<td></td>
<td>colour film (36 exposure)</td>
<td>differentiated</td>
<td>machinery, equipment and electronics</td>
</tr>
<tr>
<td></td>
<td>colour television</td>
<td>differentiated</td>
<td>machinery, equipment and electronics</td>
</tr>
<tr>
<td></td>
<td>electric iron</td>
<td>differentiated</td>
<td>machinery, equipment and electronics</td>
</tr>
<tr>
<td></td>
<td>electric kettle</td>
<td>differentiated</td>
<td>machinery, equipment and electronics</td>
</tr>
<tr>
<td></td>
<td>girl's dress</td>
<td>differentiated</td>
<td>clothing and textiles</td>
</tr>
<tr>
<td></td>
<td>ladies dress</td>
<td>differentiated</td>
<td>clothing and textiles</td>
</tr>
<tr>
<td></td>
<td>lounge suite</td>
<td>differentiated</td>
<td>other products</td>
</tr>
<tr>
<td></td>
<td>margarine</td>
<td>differentiated</td>
<td>food</td>
</tr>
<tr>
<td></td>
<td>men's shirt</td>
<td>differentiated</td>
<td>clothing and textiles</td>
</tr>
<tr>
<td></td>
<td>men's suit</td>
<td>differentiated</td>
<td>clothing and textiles</td>
</tr>
<tr>
<td></td>
<td>men's trousers</td>
<td>differentiated</td>
<td>clothing and textiles</td>
</tr>
<tr>
<td></td>
<td>newspaper</td>
<td>differentiated</td>
<td>other products</td>
</tr>
<tr>
<td></td>
<td>radio cassette recorder</td>
<td>differentiated</td>
<td>machinery, equipment and electronics</td>
</tr>
<tr>
<td></td>
<td>refrigerator</td>
<td>differentiated</td>
<td>machinery, equipment and electronics</td>
</tr>
<tr>
<td></td>
<td>shoe polish</td>
<td>differentiated</td>
<td>other products</td>
</tr>
<tr>
<td>N/A</td>
<td>consultation fee for private doctor</td>
<td>non-traded</td>
<td>services</td>
</tr>
<tr>
<td></td>
<td>men's haircut</td>
<td>non-traded</td>
<td>services</td>
</tr>
<tr>
<td>Product</td>
<td>Unit</td>
<td>Botswana</td>
<td>Malawi</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------</td>
<td>----------</td>
<td>--------</td>
</tr>
<tr>
<td><strong>Homogenous products</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Food</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bananas</td>
<td>1 kg</td>
<td>0.70</td>
<td>0.19</td>
</tr>
<tr>
<td>cabbage</td>
<td>1 kg</td>
<td>0.68</td>
<td>0.15</td>
</tr>
<tr>
<td>onions</td>
<td>1 kg</td>
<td>0.97</td>
<td>0.38</td>
</tr>
<tr>
<td>oranges</td>
<td>1 kg</td>
<td>0.63</td>
<td>0.16</td>
</tr>
<tr>
<td>pineapples</td>
<td>1 kg</td>
<td>0.77</td>
<td>0.37</td>
</tr>
<tr>
<td>potatoes</td>
<td>1 kg</td>
<td>0.81</td>
<td>0.20</td>
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<tr>
<td>rice</td>
<td>1 kg</td>
<td>1.58</td>
<td>0.40</td>
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<tr>
<td>tomatoes</td>
<td>1 kg</td>
<td>1.13</td>
<td>0.23</td>
</tr>
<tr>
<td><strong>Other products</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>brandy</td>
<td>750 ml</td>
<td>10.68</td>
<td>8.99</td>
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<tr>
<td>cigarettes</td>
<td>20</td>
<td>2.38</td>
<td>0.64</td>
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<tr>
<td>paraffin</td>
<td>1 litre</td>
<td>1.01</td>
<td>0.87</td>
</tr>
<tr>
<td><strong>Differentiated products</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Food</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>margarine</td>
<td>250 g</td>
<td>0.99</td>
<td>1.08</td>
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<td><strong>Clothing and textiles</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bath towel</td>
<td>each</td>
<td>4.34</td>
<td>4.71</td>
</tr>
<tr>
<td>blanket</td>
<td>each</td>
<td>17.38</td>
<td>11.61</td>
</tr>
<tr>
<td>boy's shirt</td>
<td>each</td>
<td>2.70</td>
<td>1.61</td>
</tr>
<tr>
<td>brassiere</td>
<td>each</td>
<td>3.77</td>
<td>1.37</td>
</tr>
<tr>
<td>girl's dress</td>
<td>each</td>
<td>5.30</td>
<td>1.23</td>
</tr>
<tr>
<td>ladies dress</td>
<td>each</td>
<td>13.03</td>
<td>3.24</td>
</tr>
<tr>
<td>men's shirt</td>
<td>each</td>
<td>5.82</td>
<td>3.15</td>
</tr>
<tr>
<td>men's suit</td>
<td>each</td>
<td>84.98</td>
<td>25.31</td>
</tr>
<tr>
<td>men's trousers</td>
<td>pair</td>
<td>9.54</td>
<td>4.41</td>
</tr>
<tr>
<td><strong>Machinery, equipment and electronics</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>colour film (36 exposure)</td>
<td>each</td>
<td>3.44</td>
<td>1.73</td>
</tr>
<tr>
<td>colour television (21 inch)</td>
<td>each</td>
<td>184.62</td>
<td>221.97</td>
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<tr>
<td>electric iron</td>
<td>each</td>
<td>11.84</td>
<td>21.54</td>
</tr>
<tr>
<td>electric kettle</td>
<td>each</td>
<td>12.99</td>
<td>22.92</td>
</tr>
<tr>
<td>radio cassette recorder</td>
<td>each</td>
<td>24.95</td>
<td>54.87</td>
</tr>
<tr>
<td>refrigerator</td>
<td>each</td>
<td>403.33</td>
<td>471.59</td>
</tr>
<tr>
<td><strong>Other products</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lounge suite</td>
<td>3 piece</td>
<td>705.18</td>
<td>662.81</td>
</tr>
<tr>
<td>newspaper</td>
<td>each</td>
<td>0.43</td>
<td>0.47</td>
</tr>
<tr>
<td>shoe polish</td>
<td>50 ml</td>
<td>0.79</td>
<td>0.81</td>
</tr>
<tr>
<td><strong>Services</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>consultation fee for private doctor</td>
<td>1 service</td>
<td>14.85</td>
<td>2.70</td>
</tr>
<tr>
<td>men's haircut</td>
<td>1 service</td>
<td>1.67</td>
<td>0.35</td>
</tr>
</tbody>
</table>

Notes: Product price for each country calculated as the mean price across all districts and all months. Data on the unit denomination for Tanzanian products is unavailable.
Table C: Country membership in regional trade groupings

<table>
<thead>
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Figure A: Kernel density estimates of distributions of product-by-product price deviations by product group, 2006 and 2009

Note: For each product group, the kernel density estimates plot deviations in the mean price of each product $i$ in country $c$ from the mean SADC price for that product, $\Delta P_{i,c}$, within that group.