Tariff reform and Product Market Integration in Developing Countries: Evidence from Zambia 1993-1999:

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Abstract:

This applies the Law of One Price (LOOP) to investigate the extent and effects of borders and tariff reform on price dispersion in Zambia. Using micro price data of 307 products from 40 districts across Zambia, the study finds that the Law of One Price does not hold across regions. The dispersion of prices differs across product categories. The econometric estimates show that city border significantly contribute to price dispersion across regions. Prices tend to be more integrated across geographically close locations compared to distant places. The paper also finds that price dispersion across cities located in external border areas is lower than price dispersion across non border towns. Evidence also suggests that tariff liberalisation significantly reduced price dispersion across cities in Zambia

1.0. Introduction

Zambia presents a unique case study for an evaluation of the impact of trade reform on product market integration. After a long period of pursuing import-substitution policies from the late 1960s, the country embarked on a series of market oriented policy reforms in accordance with the structural adjustment programme agreed with the international financial institutions in 1991[2]. The reforms laid particular emphasis on internal and external market price incentives. To achieve these objectives, a package of extremely tight monetary and fiscal policies, privatisation and improved performance of state owned firms and the removal of commodity price controls were implemented (Adam, 1995). The second aspects of the package focused on the trade expansion through the liberalisation of the current and capital accounts. In this regard, the previous complicated system of foreign exchange regulations, import licensing and other nontariff barriers were removed while tariffs were gradually reduced. Within a relatively short period of four years, the tariffs across all products were aggressively cut with the economy-wide most favoured nation (MFN) average tariff rate falling from 28 to 13.5 percent between 1992 and 1996 (Musonda Flora and Christopher Adam, 1999).

The major purpose of the trade reforms and associated adjustment programs as designed by the IMF/World Bank in the case of Zambia and developing countries in general was to improve the functioning of the markets with a view of enhancing resource allocation and ultimately accelerate economic growth (Adam, 1995; Greenaway, Morgan, & Wright, 1997). A prerequisite for the movement of resources is that the markets within and across countries engaging in trade and economic liberalization become integrated failure to which prices cannot provide the appropriate signal for resource reallocation. In this case, the reform initiatives cannot work as envisioned. (Moodley, Kerr, & Gordon, 2000; Rogoff, 1996).

In a well functioning market, product prices have to converge to the Law of One Price by the forces of arbitrage. The same good should sell for the same price regardless of location, subject to transport costs, for the gains from trade to accrue across trading locations. In this

[2] Although the negotiations and implementation of the structural adjustment policies started in the 1980s, the depth and pace of the reforms gathered momentum in 1991/2 when a new reformist government came into power.

regard, product market integration will also be reflected in price data since the potential to arbitrage determines price differentials across locations and not the actual trade flows(Bergin & Glick, 2007; D. C. Parsley & Wei, 2001).

The question that arises from the foregoing is; has the above adjustment really occurred in the case of Zambia? Our empirical response to this question is guided by two objectives. The first is to model and quantitatively explain inter-city price dispersion within Zambia. We focus on the descriptive properties of the deviations from the LOP using micro price data. After describing the nature and extent of the good level intercity price differentials within the country, we then estimate the extent to which geographical factors are important in explaining the relative inter-city price differentials. Further, our model delivers an extra testable hypothesis that cities/districts sharing the same border render the law of one price valid.

The second objective of this paper is to assess the effect of tariffs on inter-city price variability at product level. While several reasons can be advanced for the existence of price dispersion across regions, it is generally agreed that some factors such as tariffs, the border effects and exchange rate variability affect international price variability more than intra-national price deviations. However, authors such as (Nicita, 2009; Topalova, 2010) observe, variation in the composition of production sectors generate different responses of district level trade exposure to exogenous changes in tariffs. This suggests that while a product faces a uniform tariff at national levels, the potential mark-up effects may differ from location to location within a country.

This study is related to the recently surging empirical literature on the LOP and the purchasing power parity. The literature largely deals with price convergence using two approaches. The first approach exploits longer time series properties of the panel data gauge if the PPP is valid. The second strand explores the cross sectional properties of price data to test whether the LOP holds. Most of the empirical evidence comes from the test of the law of one price in the area of international trade by authors such as (Asplund & Friberg, 2001; Engel & Rogers, 1996; Foad, 2010; Mahbub Morshed, 2007; D. C. Parsley & Wei, 2007). However, recent studies have extended the literature to markets within a country that are not explicitly exposed to exchange rate exposures and border effects e.g., (Ceglowski, 2004;

Crucini, Shintani, & Tsuruga, 2010; Fan & Wei, 2006; Gluschenko & Kulighina, 2010; Nagayasu & Inakura, 2009; D. C. Parsley & Wei, 1996).

Evidence from these papers typically show that the LOP does not always hold. In recent years, research advances have moved on from using consumer price indices to highly disaggregated price data for a number of traded and non-traded goods. Most of the literature deals with the experience of OECD countries. Evidence from developing countries especially Sub Saharan Africa is still limited. This research enriches the literature testing the LOP by focusing on intra-nation price dispersion of a developing country in an understudied SSA region using price data. The paper makes three main contributions to this literature. First, while the existing literature has largely used disaggregated data from developed and emerging countries, this paper sets to be among the first to use disaggregated data in SSA. The sample draws on monthly retail price data for 306 narrowly defined products observed across 40 locations within Zambia. This result will provide some empirical regularity against which the observed trends in developed countries can be gauged.

Second, the existing literature (Aker, Klein, O'Connell, & Yang, 2010; Ceglowski, 2004) have observed that provincial borders and ethnicity contribute to price dispersion within countries. This paper makes cognisance of the fact that proximity as well as cities having a port of entry of imports increases inter-city arbitrage compared to cities far apart and cities that do not have ports of entry. This study explicitly investigates these two internal border effects on price dispersion. In case of the former, our testable hypotheses are sharing common border increases price integration. For the later, we hypothesise that prices are more integrated among cities that have external borders compared to non-border cities, analogous to their effect on transport costs in both cases.

Third, this study covers the period of transition from a highly closed, centrally planned economy characterized by both internal and external distortions to a market oriented one. We investigate the potential effect of tariff liberalization on price structures in the economy on domestic price dispersion. While literature investigating the LOP across international borders have investigated this phenomenon, this sets to be the first study to explicitly model it in the context of intranational price dispersion. Theoretically, tariffs drive the wedge between prices in different locations. This occurs through several ways. Tariffs directly affect the deadweight

losses and firms' mark-ups of imported commodities through the competitive pressure created by new imports or firm entry and indirectly by the actual or perceived potential entry of new firms that threaten incumbent firms on the pricing of traded-goods in a region. Competition should foster price integration within borders. The testable hypothesis is that tariff liberalisation fosters prices to converge to the LOP among tradable commodities.

The rest of the paper is organised as follows. The next section describes our database. Section 3 presents the context of the study. It highlights the major policy reforms relevant to this study. Section 4 presents the theoretical framework guiding the empirical estimation of price dispersion and its determinants are investigated. The section also provides an overview of the empirical literature. In section 5, provides the empirical results with the first subsection highlighting the descriptive statistics and kernel estimates followed by the econometric and robustness analysis of price dispersion and its determinants. The conclusion is given in section 6.

2.0. Data Description

This analysis used two main disaggregated datasets of prices and tariffs drawn from two different sources. The empirical analysis uses retail price data collected from local markets by a government agency- the Central Statistical Office in Zambia. The data are collected monthly from towns, cities and villages for the computation of Zambia's consumer price index. The surveyed commodities cover most items in the nation's household basic needs basket. The dataset used in this paper is collected from 40 locations spread across all nine provinces in the country. The agency regularly expands the products collected. In this study only 306 products that were reported during the first month of the initial year are used, albeit with variations over time due to missing observations. The sample of our data covers the period January 1993 to December 1999[3].

The retail prices of are collected on a specific brand of a good (e.g., 350 ml of colgate) from a number of fixed set of outlets in each district or location. If data of a specific good is collected from several outlets on a location or district, then the district prices for that product

[3] During the study period, the number of products and districts were added to the survey. However, only those products that were recorded from the initial month are included in the study for consistence purposes.

are calculated as the simple averages of the surveyed prices across different retail shops. Price on public utilities such as water, sewerage, and electricity charges is collected often from the sole suppliers in respective areas. The data are three dimensional comprising the commodity, time, and district dimensions. The distance variable takes the shortest and most practical route available between any two areas, the greater cycle distance.

The actual applied tariff data for each product was constructed from official sources defined at harmonized system eight-digit product code for all the years under review. All traded products in the CPI basket are in the tariff database. Since the CPI and tariff codes, are different, a hand-matched concordance was constructed to link the two datasets at HS six digit level of disaggregation. Given the high level of disaggregation and often closely matched products in the tariff data base, some CPI products were matched to more than one HS code and took simple average tariff rate. For example the simple average tariff for fish was generated by matching the fish in the CPI basket to cuttle fish fresh or chilled, cuttle excluding fresh or chilled and other live fish at HS six digit level. As expected, no tariffs codes were linked to non-traded products mainly services such as education, heir cuts and take-away and food eaten within restaurants. The tariffs were then weighted by the global imports for the year 2000. This formed the basis of our analysis.

3.0. Context of the Study: Pricing and Tariff Policy Reforms

3.1. Pricing[4] and Macro-policy reforms

Prior to 1991, the Zambian government ran a command economy, virtually controlling almost all production and retailing activities established behind a complex system of import restrictions such as high tariffs, import bans and foreign exchange controls. During the mid-1970s, these policies were complemented by direct price controls and subsides on selected products produced by already inefficient state owned enterprises with a view to protect consumers and ensure equality of prices between rural and urban prices. The Prices and Incomes Commission (PIC) was mandated to set, control and monitor retail prices of goods across the nation for all goods distributed and sold by the state enterprises. However, some state manufacturing enterprises only required permission from their boards to change prices

[4] See World Bank (1984) and Jeffrey (1991) for detailed analysis of the pricing mechanisms

while exports and goods produced by the private sector were exempted from these price controls.

Prices changes by the PIC were made in line with the cost plus mark-up pricing principle {{80 World Bank 1984; 99 Kydd, Jonathan 1988}}. The private investors were caught between the price controller, state as a supplier and the state as a competitor {{100 Hawkins Jr.,Jeffrey J. 1991}}. The price controls were incompatible with macroeconomic stability and an investment climate necessary for economic growth. The state's investment model reduced competition and hampered the growth of private businesses {{100 Hawkins Jr.,Jeffrey J. 1991}}.

In the period 1983-85, the Zambian government moved in to reform the pricing policy as part of the stabilization and structural adjustment program under the auspices of the International Monetary Fund and the World Bank. By 1985, prices on key products, except for goods classed as essentials comprising mealie meal, wheat, bread, candles and farmgate prices, were removed[5]. In line with the agreement with the IMF government in 1986 attempted to remove price controls on the essential goods. This triggered political revolts towards the end of 1986 December 1986. Consequently, all pricing and economic reforms were suspended when the country severed its relationship with the international financial institutions in 1987 {{36 Kayizzi-Mugerwa, S. 1991; 79 Musonda Flora and Christopher Adam 1999}}

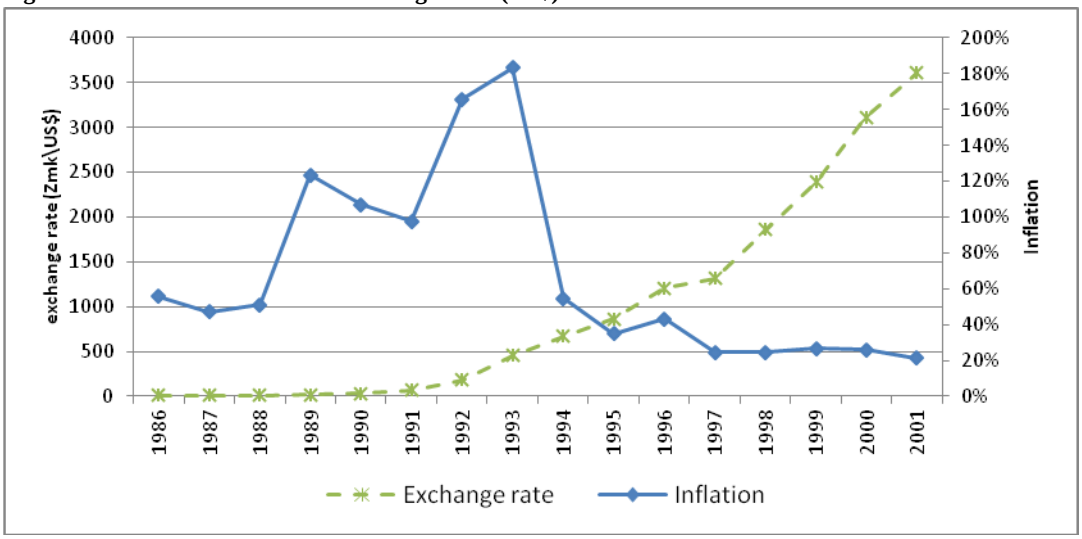
The new government that came into power in October 1991 embraced and accelerated the implementation of the structural adjustment and stabilization policies. The internal reforms set to enhance the role of the market and the private sector in among other sectors trade, investment and industry by putting prices right. The goods and asset markets were liberalized. The state owned manufacturing and retailing firms were gradually privatized between 1992 and 1996. This led to significant inflow of foreign direct investment and establishment of foreign commercial presence in the retailing sector[6].

[5] Any price changes for sugar, cooking oil, margarine and fats, clear and opaque beer, stockfeeds, soaps and detergents and domestically assembled vehicles required board approvals.

[6] Shoprite, South African chain stores, acquired the trading rights for most of the formerly state owned supermarkets in 1995 in urban areas.

The exchange rate controls were immediately removed resulting in substantial devaluation of the Kwacha. Liberalized markets meant that firms could pass exchange rate devaluations and associated costs into consumer prices, the inflation rate sharply rose from 50% in 1988 and reached a peak of 193% in 1993 (Figure 1). However, during the same year, government implemented a tight fiscal squeeze and a cash budget that committed government to balance its budget. These measures stopped inflation in its tracks making it to drop to 53% in 1994 (Adam, 1995)

Figure 1: Trend in Inflation and Exchange rates (US$) 1986 to 2001



Constructed from World Bank database

3.2. Tariff reforms

Although government hesitantly started trade reforms during the mid-1980s, the process gained pace in 1992 when significant import liberalization measures were announced. A new liberal system of non-tariff barriers was immediately implemented with the removal the complex system of exchange rate and import licensing controls. The tariffication and the transition from the SITC nomenclature to the harmonized system resulted in marginal tariff rises. For example, the economy wide trade weighted rate rose from 22.1 in 1991 to 25.8% in 1992. Nevertheless the period signaled the commencement of a period of tariff reform.

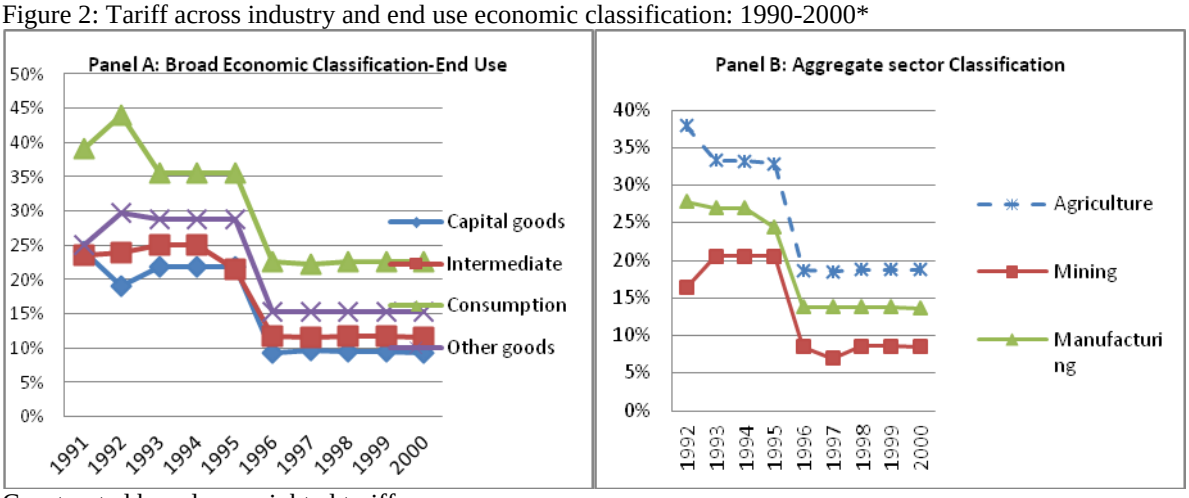
In the period 1992 -1996 government gradually reduce the tariffs with the rest of the World. For most of the period 1992-95, minor tariff changes were implemented and were aimed at

rationalizing and tiding up the tariff structure with minor tariff reductions. The simple weighted average rate fell from 25.8% in 1993 to 22.4% in 1995.

In 1996, tariffs were drastically reduction to a traded weighted economy wide average of 12.1% in 1996 when government returned to its major liberalization agenda. As Panel B in figure 2 shows, the sharp reductions in tariffs in 1996 involved all the sectors- agriculture, mining and manufacturing. The average weighted tariff on agriculture fell from 31.2% in 1995 to 17.3% in 1996 representing a 15% price inclusive tariff reductions. The rates in the manufacturing sector reduced from 21.7% to 11.6% during the same period. Tariff reductions varied across industries.

Panel A in figure 2 shows the changes in tariffs by end user category. Between 1995 and 1996, average weighted tariffs on capital and intermediate goods fell from 22.6% to 11.4% and 24.4% to 10.1% respectively. Consumer goods experienced the largest reductions in tariff with the weighted average falling from a high of 35% in 1995 to 22% in 1996[7]. These reductions are equivalent to a 15 percentage fall in tariff inclusive import prices.

Figure 2: Tariff across industry and end use economic classification: 1990-2000*



Constructed based on weighted tariffs

The strong and sudden fall in tariffs on consumer products presents an excellent basis for investigating the extent to which the substantial tariff reductions affected price integration. However, as figure 2 shows, the drastic tariff cuts did not eliminate tariff escalation that

[7] These changes are based on price inclusive tariff calculated as $(\Delta\tau = \log(1+\tau_2)/1+\tau_1)$ where τ is the tariff and τ_1 is the tariff rate in period 1 and τ_2 is the tariff rate in period 2.

remains high with weighted tariffs on final goods (21.9%) more than twice that on intermediate (10.1%) and capital goods (11%).

4.0. Theoretical Model and Empirical Literature

4.1. Theoretical Model

The study of market integration in international trade is traditionally modeled based on the aggregate trade flows conditioned on their various characteristics such as gross national income, income per capita (as in gravity models). However, the state of integration is expected to be reflected in price differentials across locations as traders move products to arbitrage any profit incentives. These dynamics have made price dispersion the preferred measure of market integration given that the arbitraging activities determine price dispersion and not the actual trade flows, which are in developing countries compounded by other factors such as government policies and donor spending other than factors that have little to do with openness and do not arise from the market integration efforts (Bergin & Glick, 2007; Edwards & Rankin, 2012). In addition, the trade flows, even in regional trade arrangements are affected by non tariff barriers such as rules of origin requirements.

In line with the price based studies, the theoretical framework guiding the empirical analysis is based on the Law of One Price (LOOP) and its aggregate variant, the purchasing power parity (PPP). The framework provides a natural benchmark for the analysis of the dynamic of relative prices through which, the degree of market integration can be analyzed (26 Ceglowski, J. 2004; 37 Goldberg, P.K. 1996; 1 Engel,Charles 2004). The principle states that in a world devoid of transactions and transport costs, relative price differentials should be arbitraged away so that identical products in different regions sharing the same price when expressed in the same currency. If prices across regions differ, arbitrageurs would make riskless profits from buying the goods in a low price area and reselling it where it is comparatively expensive.

The theoretical framework guiding the analysis of the potential links across district prices closely follows (Crucini, Telmer, & Zachariadis, 2005; Engel & Rogers, 1996; Engel & Rogers, 1996) . The model assumes that products in a consumption basket comprise both

tradable and nontradable inputs in the production process using a Cobb–Douglas production function. The framework asserts that under constant returns to scale and assuming a mark-up over the marginal cost, the unit price of good k at location i is given by:

$$P_{ki} = \mu_{ki} \left(\mathrm{P}_{\mathrm{ki}}^{\mathrm{N}}\right)^{\gamma_k} \left(\mathrm{P}_{\mathrm{ki}}^{\mathrm{T}}\right)^{(1-\gamma_{\mathrm{K}})} \qquad 1.0$$

where μ_{ki} captures the mark-up over cost, P stands for prices in local currency for product k in location i, the superscripts T and N refers to traded and nontraded inputs respectively. The superscripts γ and 1-γ represents the weights of the traded and non-traded inputs shares in the production of the good. Taking the logarithms of both sides of equation 1.0 and subtracting from the counterpart in location j at time t takes yields the LOP deviation for good k in locations i and j taking the form:

$$\begin{aligned} \mathrm{q}_{\mathrm{ijkt}} = \log\left(P_{ikt}/P_{jkt}\right) &= \mu_{ijkt} + \gamma_k \log\left(P_{it}^N/P_{jt}^N\right) + (1-\gamma_k)\log\left(P_{ikt}^T/P_{jkt}^T\right) \\ &= \mu_{ijkt} + \gamma_k \ln \mathrm{q}_{\mathrm{ijkt}}^{\mathrm{N}} + (1-\gamma_k) q_{\mathrm{ijkt}}^{\mathrm{T}} \end{aligned} \qquad 1.1$$

Equation 1.1 suggest that price differentials q_{ijkt} between city i and j for good k at time t is a linear combination of differences in traded and non-traded input prices accounting for the production shares (γ) of each input type. The price wedge is also exacerbated by price discrimination across regions due to pricing to the markets by firms that have market power μ. This schema is the basis of our empirical analysis of the degree and sources of intercity price dispersion.

In addition to these factors, theory has shown that the LOP fails for various reasons that include trade barriers such as tariffs, NTB and exchange rate volatility as sources(Goldberg & Verboven, 2005; Knetter & Slaughter, 2001) and firms setting different prices in different segmented markets (Helpman & Krugman, 1985; Krugman, 1986). Theory also suggests that price dispersion may persist due to lack of price transparency that allows firms to charge different prices in different locations. The lack of full information and some heterogeneity in buyers and or sellers of even homogenous products that is passed onto products allows for price dispersion to persist {{111 Allington, Nigel FB 2005}}. The effect of each element in the schema on price variability is briefly discussed in turn below.

Nontraded and Traded intermediate inputs

The q_{ijkt}^{N} represents the price differences in non-traded inputs specific to particular locations. By nature, nontrade inputs or products such as the cost of local transport services, and rental and wage costs that tend to be immobile and cannot be arbitraged and tend to vary across locations with price dispersion increasing in γ {{112 Rogoff, Kenneth 1996}}. In this regard q_{ijkt}^{N} can significantly vary across locations perpetuating the wedge between P_i^N and P_j^N and the overall dispersion of prices.

The variable q_{ijk}^{T} is the price deviation for traded intermediate inputs. By nature these inputs can be arbitraged and satisfy the law of one price (O'Connell & Wei, 2002)

. However, its degree of arbitrage is limited up to the trade costs so that the relative price differential of traded intermediate inputs between i and j reflects the shipping costs (TC) such that $\left|p_i^T - p_j^T\right| \leq TC_{ij}$. The transport costs support a band of no arbitrage, in which further arbitraging efforts doesn't pay. If the source and destinations are further apart, trade costs will be higher and price disparities will be larger than closer locations.

Empirical evidence investigating cross border market integration have found huge border effects that are driven by factors that include exchange rate variability, international trade barriers such tariffs and other nontariff barriers(Asplund & Friberg, 2001; Crucini et al., 2010; D. C. Parsley & Wei, 2001). Although these matter in international trade, they play a minor role in directly affecting domestic price integration directly. In our analysis we isolate tariffs as a variable of interest. Tariffs directly affect price of traded goods so that retail prices are an increasing function of tariffs and shipping costs so that $P_{ik}^{T} = P_{ik}^{T*}(1+\tau_k)+(1+TC)$ where τ_k is the tariff rate and P_{ik}^{T*} is the border price of good k. However, the effect of tariffs on intranational price disparities is likely to arise from the mark-ups over cost due to monopolistic pricing discussed below. The theoretical framework on tariffs and actual empirical analysis in the next sections is quite loose. However, it presents the intuition of the empirical analysis presented in the subsequent sections.

Price mark-ups and Tariffs

As already noted above, the retail price of goods can differ across locations if the market structure is imperfect and firms are able to exercise market power that enables them to add mark-ups μ_{ki} over costs across locations. This is true of most commodities in our database such as household supplies (e.g., Colgate toothpaste,) and electrical and household appliances (e.g., Philips 14 inch colour TV) that are branded and differentiated from potential substitutes sold across all districts in the country. Retailers alter mark-ups across cities to manage inventories, and or build up their customer base (O'Connell & Wei, 2002)

. In international trade, several such as industry concentration, market shares, home bias and trade restrictions such as tariffs raise the price mark-ups. These price adjustments create significant price variation across cities even within the same national borders. The supply curve for these commodities may not be similar across locations due to the differences in market conditions that increase the pricing power by the retailers. The imperfectly competitive retailer sets the price of a tradable good k in each market as a mark-up over marginal cost given by:

$$\mu_{ik} = (1+\mu_{ik})TC \qquad 1.2$$

As observed above there are two channels through which tariffs affect prices. First, tariffs raise the retail price of imported goods directly by taxing them. Second, tariffs indirectly affect prices by increasing the mark-ups over marginal costs charged by firms in an economy. In the case of India (Krishna & Mitra, 1998) found a positive ccorrelation between tariffs and mark-ups of up to a coefficient correlation 0.49. Mark-ups affect the pricing of products across national borders are a function of among other factors tariffs, market shares and trade costs.

$$\mu_{ik} = f(tariffs, TC, market\,\text{share}, \text{other factors}) \qquad 1.3$$

The structure in equation 1.3 suggests that a change in tariffs $(1+\tau)$ affects the firms' mark-ups in response to the shocks. Since production sectors generate different responses of district-level trade exposure to exogenous changes in tariff, we expect tariffs to also generate different mark-ups for heterogonous districts. In this case, tariffs should exert the price

variability across national districts, so that trade reforms foster intra-national price integration.

4.2. A brief review of related past empirical findings

The LOOP and the PPP has been subject of several empirical investigations in international and to a lesser extent intranational price parity. The two strands PPP and LOOP are commonly used in literature. The first approach has involved the exploration and exploitation of time series and unit root tests to ascertain whether prices have been converging towards the LOOP. The focus in developed countries has recently shifted from exploiting the PPP in international to domestic markets with new evidence coming from micro-retail price data sets and improved methodologies. Since our study is on domestic market integration we focus more but not limited to papers focusing on domestic market integration. The partial list of authors in the area reviewed below.

{{128 Pryor, Frederic L 1995}}estimates the LOP/PPP within five US cities using prices of 14 groups of products in 43 years after the Second World War. Based on various statistical tests such as price variations and the unit roots test, he concludes the U.S. retail markets did not become more any more integrated, in terms of price convergence. The coefficient of variations ranged from 3.7% to 15.5%. (Cecchetti, Mark, & Sonora, 2002)utilized a panel of consumer index data set of 19 cities in the US covering the period 1918 to 1995. The found the CPI to be stationary but surprisingly at a slow rate of half-life price convergence which they approximately at nine years. They attributed the persistence of price differentials to a host of factors such as transportation costs, differential speeds of adjustment to small and large shocks, and the inclusion of non-traded goods prices in the overall price indices.

Studies exploiting time series properties based on disaggregated retail prices within the USA such as {{22 Parsley,David C. 1996; 129 O'Connell, Paul GJ 2002}} provide evidence of long run price convergence with shorter half-lives. Moreover the rate of convergence is faster for traded goods than non-traded ones. Nonetheless, Parsley and Wei rejected the unit roots and found convergence to be slower for cities further apart with distance accounting for only

a small proportion of the slower convergence. {{135 Alessandria, George 2011; 125 Cecchetti,Stephen G. 2002}} sought to establish the source of price dispersion among US cities. Using new disaggregated CPI indices, they confirmed that distance between cities accounts for substantial variations in prices between city pairs. However, they established that price stickiness plays an even more significant role in the persistence of price differentials.

{{143 Crucini, Mario J 2010}}) reinforced this finding based on Japanese data. Using a narrowly defined range of products price data onto a single-country two-city model for more than 600 products collected from 71 Japanese cities, they found that nominal rigidities and transport costs predict the variations in prices. They estimated the distance effect of nominal rigidities to be as high as the width of the border effect in international literature. Using advanced statistical techniques and highly disaggregated data, {{136 Nagayasu, Jun 2009}} empirically analyzed the PPP –unit roots among highly homogenous Japanese municipalities. They estimate the half-life of a shock to be 2 years suggesting that the LOP/PPP holds. They attribute observed international price dispersion to barriers like tariffs and cultures.

In Canada, {{26 Ceglowski, J. 2004}} investigated the behavior of intranational price dispersion for 45 specific products across 25 cities. She found that most intercity relative prices are stationary around small mean values indication a faster long-run trend towards the PPP (with deviations from parity averaging under (10%) compared to international price dispersion. Using price dispersions, she found provincial borders and distance to be significant sources of in intercity price disparities. However, the inter-provincial border effect remained lower than that estimated for the US-Canadian border. She attributes the provincial price disparities to differences in provincial tax regimes and tighter provincial trading networks compared to national networks.

In the EU, a vast body of literature has investigated the effect of intra-EU monetary and trade reforms on intercity price dispersion within the region. Using a panel data set of 95 goods collected in 83 cities in the EU, {{114 Parsley, David C 2001}}found that the hard peg lowered price dispersion by 4.38%. The introduction of the Euro reduced dispersion by 8% which they estimate to be equal to 4% tariff reduction. {{146 Mathä, Thomas 2003}}shows that the monetary union increased price convergence across cities in four countries of the EU.

Nevertheless a percentage increase in distance increases price dispersion by 0.025%. Based on ten categories of consumer goods from 81 cities within the EU, Beck and Weber (2003) used the unit roots tests to confirm faster price convergence especially after the creation of the European Monetary Union that led to an 80% fall in price dispersion. However, complete convergence is frustrated by exchange rate volatility.

{{144 Goldberg, Pinelopi K 2005}}exploit a panel data set of car prices within the union and found strong evidence of convergence towards the LOOP at relatively high speed between 1991 and 1992 but diverged afterwards with a half-life of 1.3 years to 8 years. This is reinforced by Engel and Rogers (2004) who using 139 products found a fall in price dispersion during the early 1990s and little after 1999.

To the contrary, {{106 Lutz,Matthias 2004}} studies the effect of the monetary union on price convergence and its causes in the later study and finds a slow rate of price convergence in the EU. In 2004 he explores why price differentials persisted and established that the existence of borders and language differences, price setting in segmented markets and trade barriers to be responsible. Haskel, Jonathan (2001) attributes the differences to local costs. Similarly, Imbs et al (2004) investigate price dispersion for 3 brands of TVs using data for 15 EU states. They established that price dispersion was lower in the EU but most of the progress was achieved prior to the formation of the union. In their study of the good by good deviations from the LOP for over 1800 retail goods between all EU member states, Cruicini et al (2005) found that price dispersion n is negatively related with tradability of a good and positively related to the share of the non-traded inputs required to produce the good.

Literature on both intranational and international price dispersion in developing countries remains scant with all literature focusing on international price dispersion. Given the limited availability of such studies, some evidence is also gleaned from the analysis of price behavior in the international context. In 2006, {{147 Fan, C Simon 2006}}applied the panel unit root tests and nonlinear mean reversion methods to investigate the price convergence in China using micro data of 93 products used in the construction of CPI for 36 major cities. Their study found that prices did converge to the LOP in China in a large number of goods and services comparable to the level obtaining in the European countries, US and Canada. Based on a panel of 44 highly disaggregated product prices from 36 Chinese cities, {{154 Lan,

Yuexing 2010}}investigated the extent of price divergence in China and how long it takes prices to converge after idiosyncratic shocks. Their findings supports Fan and Wei (2006)'s results of price convergence in China. They find half-lives of a few months or less for most of the goods.

In Africa, (Edwards & Rankin, 2012)investigated the extent of price integration in Africa following major economic reforms experienced during the 1990s. Using data from 13 African cities in 12 countries, they found increased relative price integration across city-pars especially during the 1990s. {{131 Aker, Jenny 2010}} investigated the role of national borders and ethnicity in market segmentation and integration within and across countries along the Niger-Nigeria borders. Using the monthly price of millet and cowpeas, and regression discontinuity analytical methods, they found much lower border effects and higher market integration along border hosting people of the same ethnicity on both sides compared to markets within countries sharing different ethnicities. They also found that gender social cleavages and networks promote domestic and international price integration. These factors are more probable in the case of this study given the high cultural differences across regions in the country. These affect networks, preferences among others which have a bearing on price dispersion across regions. {{130 Versailles, Bruno 2012}}investigates the effect of price dispersion in East African Community. He re-enforced the importance of border in price dispersion.

4.3. Empirical Model

While the literature exploiting panel unit root tests attempt to detect price convergence by exploiting the time series properties of price differentials, the approach fails to fully account for the determinants of price dispersion. Thus our empirical strategy adopts recent innovations that modify the standard LOOP and PPP to take account of potential market frictions as used by among others(C. Simon Fan & Wei, 2006; Crucini & Zachariadisz, Chris I Telmeryand Marios, 2003; Engel & Rogers, 1996). Instead of exploiting the time series and unit roots properties to measure price convergence this paper empirically identifies price dispersion based on actual good–level bilateral relative price differences at a given time expressed as:

$$\log\left|(P_{ikt}/P_{jkt})\right| = q_{i,j,k,t} = \ln\left(p_{j,k,t}/p_{i,k,t}\right) = \left|\ln p_{j,k,t} - \ln p_{i,k,t}\right| \qquad 1.4$$

Where $j \text{ and } i = 1, 2, \ldots\ldots\ldots\ldots, n$ which is the number of districts and $q_{i,k,t}$ is the measure of dispersion. The variables, $p_{j,k,t}$ and $p_{i,k,t}$ are district level retail prices. In this framework markets are integrated if $q_{i,k,t} = 0$ otherwise the process of arbitrage should in theory trigger convergence.

After establishing the extent of price dispersion, the study turns to a regression analysis of the determinants of price dispersion. As observed above, retail process may differ across locations within a country for a variety of reasons including transactions costs (such as distance, information problems and local costs), ethnicity, population and consumption preference differences, and the presence of non-traded goods in consumer prices. As in Engel and Rogers (1996), the baseline equation used in determining the sources of variations in market pair price dispersion is:

$$q_{i,j,k,t} = \beta_0 + \beta_1 \ln(dist_{i,j}) + X'_{ijkt}\beta_2 + \lambda_k + \lambda_c + \lambda_t + \varepsilon_{i,j,k,t} \qquad 1.5$$

In equation 1.5, q_{ijkt} is the absolute deviation or measure of variability on good k between districts i and j at time t. The variable $dist_{ij}$ is the greater-circle bilateral distance between district j and I from which the price data was collected. It is measured in kilometers and has a range of 27.7 km for the shortest distance and 1617 km for the longest bilateral distance. The mean bilateral distance stood at 585.86 km. The variable captures the friction of trade as a proxy for the transactions costs. We expect $\beta_1 > 0$ if the LOP does not hold. Since price dispersion is affected by district, time and product, we control for these by introducing the fixed effect. In equation 1.3, λ_k is a dummy controlling for the cost of trade or specific fixed effect to good k. λ_c is the fixed effects accounting for the cost of trade specific to the characteristics of districts j and i such as the concentration of economic activities in localized regions.

There are reasons to expect that price dispersion varies with the city specific characteristics that justify the inclusion of the location or city effects. The districts have different levels of competition, income, productivity differentials which are compounded by the presence of nontraded inputs and cultural and ethnicity differences. In addition, {{151 Overman, Henry G 2003}} point out, industrialization in low income countries tend to be restricted to a few centers and only become less localized during later periods of development. These variations are apparent in our case study where industries are mainly clustered in a few towns along the line of rail. The inclusion of the city specific characteristics is equivalent to holding all these factors constant. In so doing the fixed effects account for the possibility that prices are systematically higher or more volatile in for instance relatively richer and more industrialized towns than hinterlands.

The variable X_{ijkt} comprise all variables that affect price differentials which in international literature comprise among others the exchange rate volatility, pricing to the market, Non tariff barriers, preferences and international borders. This study is protected from the cross border factors. However, like in international literature intranational price integration studies have investigated the role of provincial borders on price dispersion. For instance, {{26 Ceglowski, J. 2004}} investigated and found provincial borders to be significantly play a role in price dispersion. One reason is that the effective trade distance is systematically shorter than the average trade distances, the phenomenon referred to as to the location and clustering of production as posited by the economic geography literature {{151 Overman, Henry G 2003}}. This adjacent effect can also be manifested at district or city level. This leads us to we investigate the role of district borders or adjacent districts on price dispersion. Given the weak distribution network across distant cities, we expect cities sharing a common border (next to each other) to have a higher chance of inter-city price arbitrage compared to cities far apart, analogous to its effect on transport costs. Thus we test the hypothesis that cities/districts sharing the same border render the law of one price valid. We test this hypotheses by including the neighboring city binary variable *adjacent*. The cities are defined as being adjacent to each other if they share borders. In constructing this dummy, if cities geographically share borders, the dummy variable *adjacent,* takes the value of 1 (*adjacent=1)* and when they are not neighbors, the city pairs are given 0 (such that *adjacent* = 0)

In addition, we expect cities with international ports of entry of Zambian imports or "external borders" to have lower prices, and therefore more integrated compared to cities that do not have external borders, analogous to the trade costs. The testable hypothesis is that larger distances between cities that with and without external borders translate into larger transport costs that perpetuate price differentials. In case of "*external borders*" the binary variable R (=1) if both of the cities of the city-pair have international ports of entry and zero if either both or either of the cities have no external borders[8]. With this decomposition we estimate the following equation:

$$q_{i,j,k,t} = \beta_0 + \beta_1 \ln(dist_{i,j}) + \beta_2 adjacent + \beta_3 R + \lambda_k + \lambda_c + \lambda_t + \varepsilon_{i,j,k,t} \quad 1.6$$

Whereas we expect $\beta_1 > 0$, we expect β_2 and β_3 to be less than zero, suggesting that proximity and being a port of entry enhances price integration. Further, the coefficient of the year fixed effects from equation 1.6 is used to examine if price have been integrating over the years using 1993 as a base year. Since this study is concerned with the effect of tariff reforms on domestic price dispersion the import, weighted tariff rate (τ_{kt}) is included in equation 1.6. The local effect of tariffs is further isolated by the inclusion of interaction terms between tariff rates and the external border cities dummy. Tariff rates are also interacted with city borders. The regression equation becomes:

$$q_{i,j,k,t} = \beta_0 + \beta_1 \ln(dist_{i,j}) + \beta_2 adjacent + \beta_3 R + \beta_4 (1+\tau_{kt}) + \beta_5 (1+\tau_{kt}) * adjacent + \beta_6 (1+\tau_{kt}) * R + \lambda_k + \lambda_c + \lambda_t + \varepsilon_{i,j,k,t} \quad 1.7$$

In aggregates, we expect $\beta_4 > 0$ so that the reduction in tariffs lower price dispersion in the country. Tariff reduction expose retailers to foreign competition which increases the elasticity of demand in the domestic market reducing the market power and forcing firms to lower prices and foster market integration. This outcome is dependent on the market structure. The existence of retailers in the trading system may not guarantee lower prices especially if the market is characterized by imperfect competition which allows retailers to absorb the changes in prices in their mark.

[8] All districts that have international entry points were included regardless of the volume of imports. These are Livingstone, Lusaka, Ndola, Chililabombwe and Chipata. Note: no price data is collected from Nakonde, the town bordering with Tanzania.

5.0. Empirical Results

Following the above discussion, this section presents the analysis of the empirical results. For ease of analysis, all products are grouped into nontraded and traded commodities. The nontraded comprise services such as heir cuts, laundry charges, food in a restaurant. The tradables were further decomposed into eight subgroups. The group categorization closely follows the durability and tradability criteria by {{143 Crucini, Mario J 2010; 134 Parsley, David C 2007; 22 Parsley,David C. 1996; 111 Allington, Nigel FB 2005}}. Tradability increases with durability especially in developing countries like Zambia because durable goods can easily be transported in response to price differentials.

The products are grouped into perishable foods sub divided into fresh fruits and vegetables, and meat and fish. These products can't be stored for a long time like fresh vegetables and fruits, fresh milk and beacon, the next two subcategory of non-perishable foods comprised staples (such as maize meal, rice and millet) and other food category comprise processed products such as tinned beef, coffee ,and jam. The clothes and household supplies (tissues, washing soaps) are followed by household appliances and durables. While the former comprise items like fridges, television sets, the other durables class is composed of durables like vehicles, tables and beds. The complete list of these products is presented in table 1 in the appendix.

Our empirical analysis proceeds by the descriptive statistics and kernel density estimates of the extent of price dispersion. These estimates are followed by the regression analysis in the corresponding subsections.

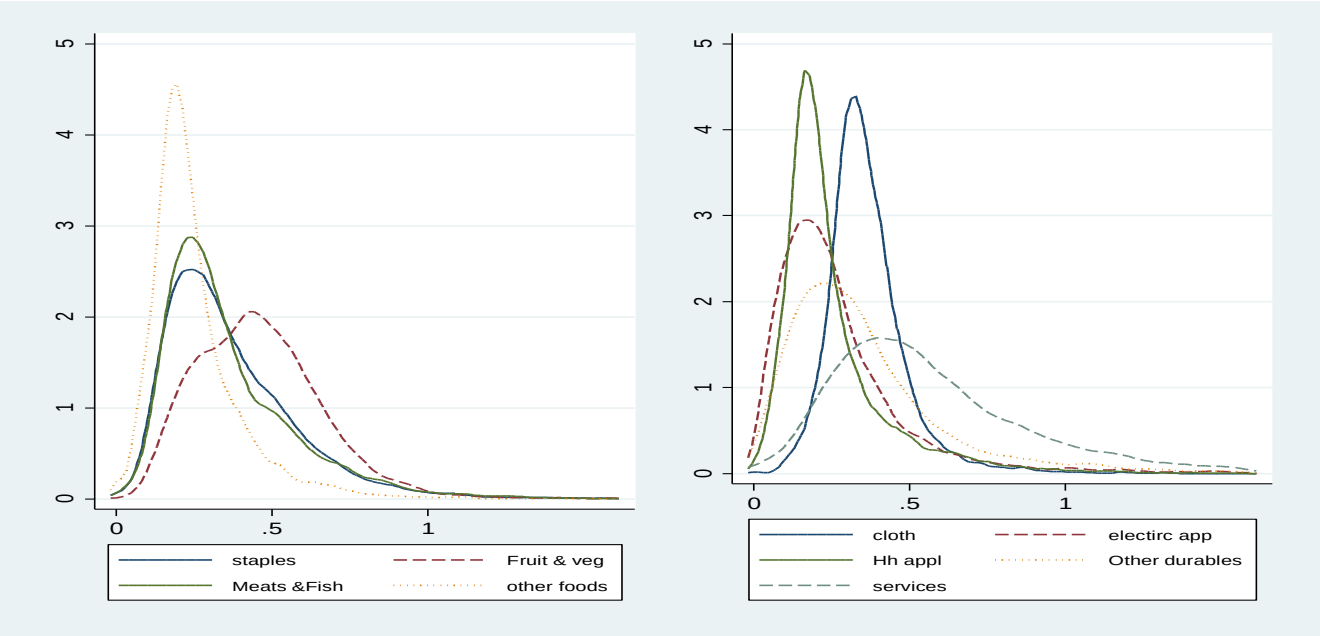
5.1. Measuring Price Dispersion

Based on the above products classification, figure 3 provides the summary of the empirical distributions from the LOP of q_{ijkt} defined in equation 1.4. The curves in the figure represent the kernel estimates of price variability at product group level for the period under analysis. If the LOP held always and everywhere, all the distributions would be degenerate at zero, in line with the null hypothesis that the markets are fully integrated. The kernel estimates and

associated statistics in table 1 reject the hypothesis that the domestic market is integrated, implying that the product markets in Zambia are fragmented.

The descriptive statistics in table 1 and the kernel estimates also show variations in inter-city price disparities across product groups. The general pattern of the distributions show that the densities of less traded goods located more on the right while those of mostly traded are centered more on the left suggesting that tradability matters. The services, which are non-traded, are almost twice more dispersed with a mean of the absolute deviation of 0.65 compared to the period average of 0.29 for all traded goods.

Figure 3: Empirical distributions of the LOP deviations by product group



The pattern of the good-by-good price distributions based on durability as expected reveals some heterogeneity among tradable categories. The kernel density estimates plots in figure 3 represent the mean absolute relative price variability for each product group. It reveals that each product has substantially different amounts and patterns of price dispersion partially explained by tradability. For instance the mean of the standard deviation of the least traded category consisting of perishable foodstuffs such as vegetables and fruits stood at 0.50 compared to the mostly traded and storable household supplies that have an overall mean absolute price dispersion of 0.21. The high price variability and dispersion for perishables is expected because by their nature, they are subject seasonality effect and tend to be localized

their marketing, further segmenting the markets. In addition, they tend to be difficult to store and transport and hence prices are relatively more dispersed {{111 Allington, Nigel FB 2005; 122 Gluschenko, Konstantin 2010; 140 Engel, Charles 2001}}. Dispersion in Zambia is further exacerbated by the weak intranational transport and storage infrastructure.

Table 1: Summary statistics of the variability of price differentials and absolute price dispersion: 1993-2000

		Mean absolute price differential		Variability of price Differentials		
	Overall mean	**1993-1995**	**1996-1999**	**1993-1995**	**1995-1999**	**Overall Std Deviation**
Staples foods	0.36	0.33	0.37	0.32	0.37	0.35
Fruits and Vegetables	0.51	0.50	0.50	0.38	0.39	0.39
Meat and fish products	0.31	0.31	0.32	0.23	0.25	0.24
Other foods	0.24	0.24	0.24	0.25	0.25	0.25
Clothing	0.36	0.36	0.37	0.32	0.34	0.33
Electrical and household appliances	0.30	0.28	0.31	0.29	0.34	0.32
Household supplies	0.20	0.21	0.20	0.19	0.22	0.20
Other Durables	0.36	0.35	0.38	0.33	0.44	0.39
Overall traded	***0.29***	**0.29**	**0.30**	**0.29**	**0.31**	***0.30***
Services	***0.65***	**0.66**	**0.64**	**0.60**	**0.56**	***0.58***

Note: The mean absolute price differential is defined as the mean absolute differentials of log prices between locations mathematically calculated as mean of q_{ijkt} and the variability is measured as $sd(q_{ijkt})$ from equation 1.4.

In summary, the kernel density estimates and associated descriptive statistics in this section have shown that a very high variation in the mean and standard deviation of the absolute price dispersion in Zambia. As expected the standard deviations reduces with tradability. Less tradable goods such as services and perishable foods have larger than those of traded goods such as household supplies and other foodstuffs comprising of processed food items. Although products are classed differently from (C. Simon Fan & Wei, 2006; D. C. Parsley & Wei, 1996)criteria, the domestic average price dispersion in Zambia a far much larger than those obtaining in both America and China. For instance, the mean absolute price differential obtained by Parsley and Wei ranged from 0.125 for non-perishables to 0.156 for services in America. Fan and Wei found the same to be 0.0898 for raw materials and 0.372 for services in China. These are relatively smaller compared to 0.20 for household supplies and 0.65 for services in the case of Zambia.

To the extent that price differentials reflect product market fragmentation, we reject the null hypothesis that the domestic prices are integrated in Zambia. Moreover, the estimates confirm

the suggestion that product markets are more fragmented in developing countries compared to developed and emerging countries (as compared to the American and Chinese statistics. The next section explores the sources of fragmentation.

5.2. Factors influencing of intra-national price dispersion

The empirical evidence in the preceding section indicates that the product markets in Zambia are fragmented. Using the framework laid out in section 4, this section quantifies the potential effect of the possible determinants of the observed price disparities across city-pairs by estimating equations 1.3 and 1.4 under two subsections. The first subsection analyses the role of distance, internal borders for adjacent districts and being a port of entry for the imports or external border city" in price variability. The second subsection estimates the role of tariff rates on price dispersion. In all these estimations, we pool all tradable products in the sample without dividing them into tradability to test the prediction of the LOOP. Although by pooling the data across individual tradable products, one may overlook the prevalent heterogeneity within specific tradable categories, it enables us to generalise our results. This is because although the estimations at disaggregated levels reduce the low power problems introduced by measurement errors, the results cannot easily be generalised {{140 Engel, Charles 2001}}. All the estimated coefficients are based on heteroskedasticity consistent standard errors.

5.2.1. The role of distance

We first assess the role of distance on inter-city price differentials based on the benchmark model of the LOP. In the benchmark model represented by equations 1.5, we condition price dispersion on the logarithm distance for both traded and non-traded goods and the log distance squared is included in the next results. In equation 1.6, the natural log of absolute inter-city price deviation at product level of traded goods is related to the natural logarithm of distance and associated controls to test the sources of price dispersion. The time, district and product fixed effects are included in all specifications to control for inherent heterogeneity. The time specific effects capture the economy wide fluctuation that affect price dispersion during a given period while city specific effect account for time-invariant district level

determinants of price variations. The fixed effects ensure that the remaining price dispersion only captures the intensity of relative price movements by region and product.

The results of the benchmark model in table 2 confirm that price differentials for both traded and non-traded goods substantially rise in response to increases in bilateral distance. The distance coefficients for both traded and nontraded products are positive and significant at 1% level. In case of the tradable goods, this result confirms the theoretical prediction that distance is a proxy for transport costs. Whereas, a 10 percentage increase in distance increases price dispersion by 2.3% for traded goods, the increase for nontradables is 3.3%.

Table 2: The role of distance in price differentials of traded and nontraded goods

	Nontraded	**Nontraded**	**Traded**	**Traded**
log(distance)	0.0328***	0.160***	0.0226***	0.0376***
	(0.00327)	(0.0391)	(0.000410)	(0.00515)
log(distance squared)		-0.0114***		-0.00137***
		(0.00349)		(0.000471)
Constant	0.503***	0.163	0.202***	0.162***
	(0.0368)	(0.110)	(0.00449)	(0.0140)
λ_t	*Yes*	*Yes*	*Yes*	*Yes*
λ_c	*Yes*	*Yes*	*Yes*	*Yes*
λ_k	*Yes*	*Yes*	*yes*	*Yes*
Observations	53,972	53,972	775,894	775,894
R-squared	0.269	0.269	0.271	0.271

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

Since services by definition cannot be arbitraged, their inter-city price dispersion can vary substantially across locations. These variations may not have any systematic relationship across distant places observed. The above finding raises the possibility of the concavity of distance. For this reason, the distance squared in logs is included in the specification of the baseline equation. The results also confirm the concavity of distance, suggesting the existence of a limit to which distance affect price dispersion across cities[9].

5.2.2. The role of district adjacency and International borders

[9] The distance sensitivity analysis of this result is presented in the in section XXX where we limit the distance to 500km

Next, we investigate the effect of adjacency or city-pair borders and city location in terms of external border city against no external borders. Table 3 displays the regression results of equation 1.3, which takes these variables into account. The estimated parameters show strong evidence for both adjacent city border and proximity to external borders after controlling for district, year and product specific effects. The inclusion of these variables marginally reduce the magnitude and hence the role of distance on price dispersion but not the level of significance.

The *adjacent* by design takes the value of 1 for adjacent the cities so that the coefficient on *adjacent* measures the extent to which relative prices for geographically close districts are integrated relative to non-bordering districts. As can be seen from columns 2 and 3 its inclusion has reduced the point estimate on the logarithm of distance coefficient suggesting that adjacency of districts partially explains the part of the distance effect. In addition, the estimated parameter for *adjacent* variable is statistically significant at 1% level and as hypothesised has a negative sign suggesting that price disparities are greater for cities far apart compared to neighbouring cities.

This result can partially be explained by the *adjacent effect* that posits more trade and arbitraging activities for nearby cities compared to far off ones. These results also support evidence from existing literature such as (Aker et al., 2010)who observe for Niger and Nigeria, that *adjacen*t effects driven by factors comprising linguistic and ethnicity similarities foster trade because of tighter trading networks embedded in the historical and cultural ties compared characterising sub-regions compared to national trading networks.

Table 3: Assessing the Role of distance, external and district borders on price differentials	(1)	(2)	(3)
Log(distance)	0.0289***	0.0389***	0.0278***
	(0.00528)	(0.00515)	(0.0052 8)
Log(distance squared)	-0.000967**	-0.00140***	-0.00087 8*
	(0.00047	(0.00047	(0.0004

	3)	1)	73)
adjacent	-0.0103***		-0.0131***
	(0.00157)		(0.00157)
R		-0.0268***	-0.0280***
		(0.00137)	(0.00138)
Constant	0.205***	0.155***	0.210***
	(0.0154)	(0.0140)	(0.0154)
λ_t	*Yes*	*Yes*	*Yes*
λ_c	*Yes*	*Yes*	*Yes*
λ_k	*Yes*	*Yes*	*Yes*
Observations	775,894	775,894	775,894
R-squared	0.271	0.271	0.272

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

The regression output for specification 3 show the relationship between price disparities that also take into account the location of cities in terms of being a border district or not. This variable (R) account for the effect of all city pairs with both cities hosting an international entry or exit point. Our working hypothesis posits that the forces of arbitrage will be stronger for these city pairs compared to non-border towns, suggesting lower price disparities with a negative estimate. The regression result confirm this expectation which shows that price dispersion is lower among border compared to non border cities[10]. One caveat to this finding is that Lusaka and Ndola, some of the cities with international gateways are also commercial cities. Thus, this result could also be influenced by spatial clustering of production.

In table in the appendix, we test the sensitivity of this result using a counterhypothesis to both cities being border towns and posit that at least one district is a border town (EB =1) if only one district is a border town. The point estimate turns out to have a statistically significant at 1% level and positive suggesting that price dispersion increases with distance from an international border.

Finally, the above regression also provides a simple method to implicitly test for price convergence during the period under review by observing the time fixed effects taking 1993

[10] This result should be interpreted with caution as the some of the border towns such as Lusaka and Ndola are also key production centers.

as a base year. We specifically test if the fixed effects follow a declining trend in both signs and magnitude of the associated coefficients. All the fixed effects coefficients are statistically significant and take on a negative sign for 5 out of 6 coefficients relative to 1993. The magnitudes in absolute terms also progressively declined for all the years except 1998 that registered a positive and higher price dispersion compared to 1993. On average, the trend shows increased price convergence of less than 1% a year between 1993 and 1999.

5.2.3. Tariffs and Price Disparities

This subsection extends the above analysis by exploring the extent to which the observed price disparities may be due to tariffs whose adjustments may not completely be passed through into retail prices due to pricing to the market. Their effect in intercity price disparities is explored by regression the mean absolute price dispersion against the natural log of the trade weighted and price inclusive tariff rate and other controls. Since the main objective is to measure the effect of tariff liberalization on intranational price dispersion, the specification includes an interaction term between the tariffs and external border term (R) and between tariffs and the *adjacent* city dummy as specified in equation 1.7. The specifications are estimated with the product, time and city fixed effects and employ the robust variance estimator.

Table 4 displays the regression outputs of four specifications. In each specification, a new control variable is included. The first specification estimates the role of tariffs without including the trade costs and associated interaction terms. The subsequent models include the tariff interacted adjacent cities and external border dummies respectively. In all model specifications, the results confirm the hypothesis that tariffs exert significant and negative effect on price dispersion in the pooled regression.

The result suggests that tariffs have a much stronger effect on price dispersion compared to distance such that a 10% decrease in tariffs reduces price dispersion by up to 1.9% compared to 0.2% for a 10 percentage decrease in distance across all specifications.

Table 4: Assessing the role of tariffs and internal borders in price variability

	(1)	(2)	(3)	(4)
log(distance)	0.0386***	0.0398***	0.0398***	0.0291***
	(0.00517)	(0.00517)	(0.00517)	(0.00532)
log(distance squared)	-0.00145***	-0.00147***	-0.00147***	-0.000981**
	(0.000473)	(0.000473)	(0.000473)	(0.000476)
$(1+tariff_{kt})$	0.190***	0.190***	0.193***	0.191***
	(0.0252)	(0.0252)	(0.0253)	(0.0255)
R		-0.0264***	-0.0182***	-0.0199***
		(0.00138)	(0.00450)	(0.00452)
$(1+tariff_{kt})$*R			-0.0379*	-0.0353*
			(0.0197)	(0.0198)
adjacent				-0.0157***
				(0.00306)
$1+tariff_{kt})$*adjacent				0.0136
				(0.0136)
Constant	0.109***	0.102***	0.101***	0.155***
	(0.0157)	(0.0157)	(0.0157)	(0.0169)
λ_K	*Yes*	*Yes*	Yes	Yes
λ_C	*Yes*	*Yes*	Yes	Yes
λ_t	*Yes*	*Yes*	Yes	Yes
Observations	769,313	769,313	769,313	769,313
R-squared	0.273	0.274	0.274	0.274

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

Further, the empirical results of the model that includes the dummies for the adjacent city and the port of entry for imports and their interaction with tariffs marginally reduced magnitude of the log of distance estimate. The interaction variables do not substantially reduce the point estimate of the tariff rates and its theoretical prediction holds strong. It is also noticeable from the estimated coefficient for port of entry (R) and *adjacent* that the two are statistically different from zero and are associated with reduced price dispersion. This result closely supports the finding by (C. Simon Fan & Wei, 2006; Ceglowski, 2004)in Canada who found that price dispersion diminishes with adjacent provinces.

However, the tariff-port of entry interaction variable is only significant at 10% level and that of *adjacent* is not significant. This result suggests that tariff liberalisation is a major source of cross-price integration among border towns compared to all adjacent districts and non-border cities (see also Table A1 –A2 in the appendix). One caveat as to this finding is that two of the cities that have port of entry for Zambian imports are also major commercial cities. As observe, geography could exert an extra influence in price dispersion from the core or production centres if freight costs are included and are an increasing function of distance.

The examination of the time fixed effects from model 3 in the table above show that relative to 1993, the trend declined over the period 1994-1997 before rising from negative to positive coefficients in 1998-1999 suggesting a U-shaped price integration trend. The fixed effects point estimates are all significant at conventional levels. Nonetheless, the overall time fixed effects trend has declined over the period.

5.2.4. Robustness

Our estimation results above have shown that price differentials increase with distance at a declining rate. The alternative interpretation of this is that trade costs especially distance have a limit to which they affect price dispersion, making distance irrelevant beyond that level. To address this issues, we have in this section arbitrary limited distance to 500 kilometres and rerun all the above estimations. The assumption is that arbitrage activities are only relevant for retailers within 500km distance beyond which distance becomes irrelevant with other localised arbitrageurs exploiting any opportunities.

The outputs of the analysis are presented in appendix 2 tables A3 - A5. The estimation is subjected to all the year, product and city fixed effects to control for any heterogeneity. The result confirms that price dispersion is a positive function of bilateral distance between cities. Prices are more dispersed for town further apart than those closers to each other. However, with the introduction of log distance squared in the model to test for concavity, the role of distance becomes negative contradicting the theoretical expectations. This could suggest that price dispersion is affected by distances that are even beyond the 500km generating the observed bias. This could obtain our case considering the concentration of core production centres in fewer locations and the distances between ports of entry for imports and most locations in the country.

The results for all variables except for the concavity of distance from this regression are found to enter with the same signs with minor variations in the magnitude compared to our earlier estimations. Similarly the tariff rate inclusive regressions enter with the same sign and the role *of tariff-adjacent* interaction variable remain insignificant and with a wrong sign. From the foregoing, we can conclude that price variability in Zambia is influenced by geography and tariffs, with far apart locations being less integrated than closer ones. Further, the removal or inclusion of the *adjacen*t and port of entry variables does not

quantitatively affect the role of tariffs. However, the role of distance is significantly reduced as observed from the decline in the distance coefficient in the two specifications.

Limitations

The preceding sections have established the existence of intranational price dispersion partially driven by geographical and trade liberalisation measures. These results are born out of the pooled regression that aggregates products into a single regression. As {{111 Allington, Nigel FB 2005; 106 Lutz, Matthias 2004}} argues, the use of aggregated data has an advantage of generating a highly representative outcome. This provides a more general pattern as opposed to using single products or small products. Despite this advantage, the result should be interpreted with caution. By aggregating the data, valuable information is potentially lost. Single product regressions with opposite signs in a basket of products cancel each other out which introduces biases. These biases distort the result by either understating or overstating the actual effects of determinants and controls in price variability.

Our panel spans a period of 6 years and covers the period of high macroeconomic instability in the country. These potentially reduce the significance and precision of the regression analysis. Further, to the extent that inter-city price differential reflected changes in trade policies, particularly tariff liberalisation, the result confirms the reductions in tariffs have contributed to the observed trend towards product market integration in Zambia. The caveat with the use of tariffs here is that tariffs could have a lag effect on price dispersion. In this case, the point estimate of the tariffs may not be accurately measured if price adjustments occur with lags since our regression assumes a static relationship. In addition, the pooled regression used may mask the effects of tariffs on individual products that are traded under different market structures. Although the reductions in tariffs should intuitively result in reductions in price differentials across regions, the existence of retailers with market power in the trading system does not necessarily translate into lower consumer prices in imperfectly competitive market structure.

6.0. Conclusion

This paper set to explore the extent and the role of geography and tariffs on price convergence towards the law of one price during a period of major economic reforms aimed at liberalising and integrating the Zambian economy. Using monthly spot price data collected for 306 products by government agencies, this study has established that the product markets in Zambia remain fragmented although there has been a trend towards integration. Our results confirmed the hypothesis that price variability is an increasing function of trade costs as represented by inter-city distance.

The findings also provide strong evidence that tariffs exacerbate the price wedge between various cities even after controlling for distance and adjacency of cities and ports of entry. This suggests that tariff reforms play an important role in intranational price integration. The result also provides strong evidence that cities that have ports of entry have lower price dispersion compared to cities without external borders. Similarly, inter-city price differentials are lower for adjacent cities compared those that do not share a common border. Throughout the analysis the product, city and product fixed effects have been found to be significant in the observed trends.

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Appendix 1:

5Table A 1: Assessing the role of Distance, adjacency and border location on price disparities

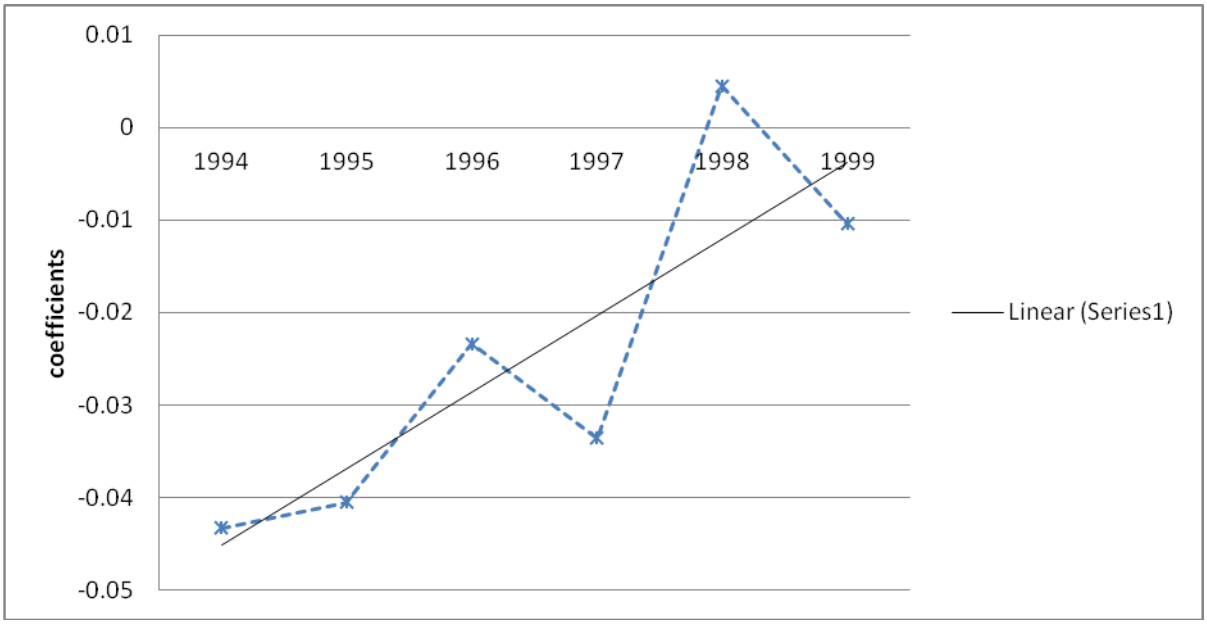
	(1)	(2)	(3)	(4)
Log(distance)	0.0289***	0.0389***	0.0278***	0.0132**
	(0.00528)	(0.00515)	(0.00528)	(0.00531)
Log(distance squared)	-0.000967**	-0.00140***	-0.000878*	0.000551
	(0.000473)	(0.000471)	(0.000473)	(0.000476)
adjacent	-0.0103***		-0.0131***	-0.0143***
	(0.00157)		(0.00157)	(0.00157)
R		-0.0268***	-0.0280***	-0.0269***
		(0.00137)	(0.00138)	(0.00138)
EB				0.0152***
				(0.000699)
Constant	0.205***	0.155***	0.210***	0.236***
	(0.0154)	(0.0140)	(0.0154)	(0.0154)

λ_K	*Yes*	*Yes*	Yes	Yes	
λ_C	*Yes*	*Yes*	Yes	Yes	
λ_t	*Yes*	*Yes*	Yes	Yes	
Observations	775,894	775,894	775,894	775,894	
R-squared	0.271	0.271	0.272	0.272	
Robust standard errors in parentheses			*** p<0.01, ** p<0.05, * p<0.1		

6Table A 2: Assessing the Role of Tariffs on price dispersion

	(1)	(2)	(3)	(4)	(7)	(9)
Log(distance)		0.0386***	0.0398***	0.0398***	0.0291***	0.0153***
		(0.00517)	(0.00517)	(0.00517)	(0.00532)	(0.00535)
Log(distance squared)		-0.00145***	-0.00147***	-0.00147***	-0.000981**	0.000359
		(0.000473)	(0.000473)	(0.000473)	(0.000476)	(0.000479)
$(1+tariff_{ik})$	0.195***	0.190***	0.190***	0.193***	0.191***	0.231***
	(0.0253)	(0.0252)	(0.0252)	(0.0253)	(0.0255)	(0.0258)
R			-0.0264***	-0.0182***	-0.0199***	-0.0109**
			(0.00138)	(0.00450)	(0.00452)	(0.00468)
$(1+tariff_{ik})$R				-0.0379*	-0.0353*	-0.0735***
				(0.0197)	(0.0198)	(0.0206)
adjacent					-0.0157***	-0.0172***
					(0.00306)	(0.00307)
$(1+tariff_{ik})$*adjacent					0.0136	0.0148
					(0.0136)	(0.0137)
EB						0.0306***
						(0.00220)
$(1+tariff_{ik})$*EB						-0.0750***
						(0.0101)
Constant	0.300***	0.109***	0.102***	0.101***	0.155***	0.172***
	(0.00766)	(0.0157)	(0.0157)	(0.0157)	(0.0169)	(0.0170)
Product fixed effects	*Yes*	*Yes*	Yes	Yes	Yes	Yes
Year fixed effects	*Yes*	*Yes*	Yes	Yes	Yes	Yes
City fixted	*Yes*	*Yes*	Yes	Yes	Yes	Yes
Observations	769,313	769,313	769,313	769,313	769,313	769,313
R-squared	0.270	0.273	0.274	0.274	0.274	0.274
Robust standard errors in parentheses			*** p<0.01, ** p<0.05, * p<0.1			

Figure 4: Trend (year fixed effects coefficient) in price convergence



7Table A 3: Price dispersion in a distance constrained to 500km model

VARIABLES	Nontraded	Nontraded	traded	traded
Log(distance)	0.0682***	0.0505	0.0254***	-0.0573***
	(0.00655)	(0.0980)	(0.000681)	(0.0106)
log(distance squared)		0.00173		0.00814***
		(0.00954)		(0.00104)
Constant	0.185***	0.228	0.154***	0.355***
	(0.0648)	(0.249)	(0.00938)	(0.0276)
λ_K	*Yes*	*Yes*	Yes	Yes
λ_C	*Yes*	*Yes*	Yes	Yes
λ_t	*Yes*	*Yes*	Yes	Yes
Observations	18,419	18,419	290,359	290,359
R-squared	0.320	0.320	0.235	0.235

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

8Table A 4: The role of city borders and ports of entry on Price dispersion (distance <=500km)

	(1)	(2)	(3)	(4)
log(distance)	0.0230***	0.0265***	0.0231***	0.0218***
	(0.00123)	(0.000687)	(0.00123)	(0.00124)
*Adjacen*t	-0.00469**		-0.00683***	-0.0115***
	(0.00197)		(0.00198)	(0.00207)
R		-0.0268***	-0.0278***	-0.0280***
		(0.00243)	(0.00245)	(0.00245)
EB				0.0112***
				(0.00133)
Constant	0.173***	0.147***	0.174***	0.187***
	(0.0124)	(0.00940)	(0.0124)	(0.0125)
λ_K	*yes*	*yes*	*Yes*	*yes*
λ_C	*yes*	*yes*	*Yes*	*yes*
λ_t	*yes*	*yes*	*Yes*	*yes*
Observations	290,359	290,359	290,359	290,359
R-squared	0.235	0.235	0.235	0.235

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

9Table A5: Role of Tariffs, adjacency and ports of entry in price dispersion (distance <=500km)

	(1)	(2)	(3)	(4)	(5)
log(distance)		0.0266***	0.0265***	0.0231***	0.0219***
		(0.000690)	(0.000690)	(0.00123)	(0.00124)
(1+tariff$_{kt}$)	0.133***	0.121***	0.128***	0.126***	0.144***
	(0.0408)	(0.0407)	(0.0409)	(0.0416)	(0.0421)
R		-0.0261***	-0.00521	-0.00699	-0.00363
		(0.00244)	(0.00733)	(0.00750)	(0.00767)
(1+tariff$_{kt}$)*R			-0.0980***	-0.0945***	-0.112***
			(0.0318)	(0.0325)	(0.0335)
Adjacent				-0.00782**	-0.0137***
				(0.00384)	(0.00396)
(1+ tariff$_{kt}$)**adjacent*				0.00480	0.0114
				(0.0167)	(0.0172)
EB					0.0200***
					(0.00378)
(1+tariff$_{kt}$)*EB					-0.0430**
					(0.0172)
Constant	0.277***	0.114***	0.113***	0.141***	0.151***
	(0.0139)	(0.0145)	(0.0146)	(0.0168)	(0.0170)
$\square_k$	*yes*	*yes*	Yes	yes	yes
$\square_c$	*yes*	*yes*	Yes	yes	yes
$\square_t$	*yes*	*yes*	Yes	yes	yes
Observations	287,913	287,913	287,913	287,913	287,913
R-squared	0.233	0.237	0.237	0.237	0.237

10Table A 6: List of Products in the CPI Basket

1. Staple food products

Plain flour
White breakfast
White Roller
Bread
Sweet potatoes
Irish potatoes
Yellow Breakfast
Yellow Maize
cassava
Rice (imported)
White maize
Yellow maize
Rice (local)

2. Vegetables and fruits

Cabbage
Onions
Carrots
Green Beans
Pumpkin
Tomatoes
Peas
Rape
Cucumber
Green Pepper
Spring onion
Dried beans
Oranges
Lemons
Bananas
Pawpaw
Pinapples
Water melon

3. Fresh Meat and fish products

Fillet steak
Rump Steak
Top side
Dressed chicken
Corned beef, canned
Sliced bacon
Ham, boiled and sliced
Kapenta, frozen
Bream, fresh/frozen
Kapenta, dried
Milk, fresh pasteurised
Kapenta, dried

4. Other food products

Pineapple chunks
Macaroni
Ginger Nut Biscuits
Kapenta, tinned chilli sauce
Cheddar cheese local
Powdered milk
Imported butter
Margarine
Cooking oil imported
Cooking oil local
Baked beans in tomato sauce
Salted peanuts
White sugar
Coffee, pure ground
Instant coffee, local
Instant coffee, imported
Tea leaves
Tea bags
Strawberry Jam
Marmalade
Golden syrup
Table salt local
Curry powder
White vinegar
Tomato ketchup
Custard powder
Peanut Butter (smooth)
Ice cream vanilla
Ginger ale
Whisky imported and local
Vodka local
Brandy
Cigarettes
Cigarettes
Pipe tobacco
Pain Killers
Pain Killers
Pain Killers
Cough mixture
Cough mixture
Anti-diarrhoea mixture
Anti-diarrhoea mixture
Laxatives
Laxatives
Vitamins
Anti-malaria prophylactic
Anti-Biotics
Anti-Biotics
Asthma cure
Throat lozenges
Plasters
Pilchards tinned hot chilli
Baked Beans in tomato sauce
Raisins
Milo
Lager beer imported
Fortified Wine imported

6. Electrical and Household appliances

Electrical Cooker, 2 plate
Refrigerator, single door
Heater, double bar
Electric Iron, dry
Electric Kettle Automatic
Vacuum cleaner
Ordinary Plate ceramic
Cup and saucer ceramic
Kettle non electric, aluminium
Cooking pot aluminium

Mince meat	Vita Orange juice	Table spoon
Mixed cut	Orange drink carbonated	Electric bulb
Sausages, beef	Coca-cola/Fanta/Sprite	Electric plug (3pin)
Ox liver and offal	Lager beer local	Spark plug
Pork chops and sausages	Opaque local beer	

List of products Continued

Electrical and Household cont'd	Household supplies cont'd	***9. Services***
Car battery 12 volt	Toilet tissue 2 ply	Private landlord rent
Television set B&W	Household soap	Water/sewerage charges
Television set colour	White polish	Water/sewerage charges
Colour film 100 ASA	Shoe polish	Electricity
Cassettes tape unrecorded	Pencil with rubber	Electricity
Radio cassette recorder	Picture postcard ordinary	Laundry pair of trousers
Ordinary plate metal	Ball pen Blue or Black	Dry clean 2 piece suit
	Ladies shampoo & set	1100kg Car licence
7. Other durables	Scouring powder	Airfare Lusaka/London
Portland cement	Detergent powder	Airfare Lusaka/Ndola
Building sand	Detergent paste	Train fare Lusaka/Ndola
Concrete hollow block	Bleach	Train fare Kapiri/Dar
Corrugated asbestos roofing	Petrol premium	Minibus fare
Corrugated iron roofing sheet	Oil	Giraffe Luxury
Clear glass 3mm	Tennis balls	Taxi fare
Window frame steel	Basket ball	Postage local letter
Floor tiles vinyl	Football	Airmail foreign Zone A
Roofing nails(10cm)	Toilet soap	Telegram local
Wooden Panel door	Toilet soap	Phone call local Lusaka
Mortise Lock (2 Lever)	Tooth paste	School fees Private Secondary
Water paint PVA local	Razor blades	Men's dry haircut
Putty	Shampoo	Ladies full perm
Fencing (diamond mesh) wire	Shampoo	Bed & Continental breakfast
3 Piece lounge suite	Disinfectant	Bed & Continental Breakfast
3 Piece Lounge Suite	Disinfectant	Nshima with beef relish
Wooden bed frame double	Sanitary tampons	Nshima with beef relish
Mattress cotton, single	Sanitary towels	Nshima with beef relish
Foam Mattress, double	Petroleum jelly	Take away chicken and chips
Green Hosepipe 1.5 inch	Petroleum jelly	Hammer milling charge
Hoe blade	Hair tonic	Boarding fees
Carpenters claw hammer	Hair cream	School fees Private Primary
Gents bicycle local	Skin cream	Developing & Printing colour
Bicycle tyre local	Skin cream	Cinema charges
Bicycle tube local	Baby powder	Video hire highest charge
Tyre radial	Baby Shampoo	Doctors consultation Fees
Toyota Hilux	Baby lotion	Hospital registration fee
Toyota Corolla	Lipstick	Dental fees

Nissan Sunny	Lipice	Hospital consultation fees
	School exercise book	Dental fees
8. Household supplies	Magazine	Council house rent
Matches local	Magazine	High cost private rent
Charcoal	Newspaper	Medical Scheme
Candles and paraffin	Newspaper	Chest X-Ray
Paraffin		