Tariffs and Intranational Retail Price Dispersion: Evidence from Zambia

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Abstract

This paper investigates the relationship between tariff reforms and intranational retail price dispersion in Zambia. It draws on unique price and tariff dataset of 34 disaggregated products in 38 districts of Zambia over the period 2001 to 2010. This data are used to analyse the average and differential pass-through of reductions in import tariffs on South African imports, Zambia's largest trading partner, on domestic retail prices across districts. Specifically, the paper estimates how the trade costs and tradability of products affect the transmission of tariffs onto consumer prices. The results reveal an imperfect transmission of import tariff to domestic prices. Unlike other studies, does not find a negative association between the tariff pass-through and distance from the border. Rather, we find that distance from the major highway explains the differential effect of trade reforms across geographic areas. The paper also finds that the pass-through of tariffs to consumer prices is strongly and positively associated with the tradability of the product. These results indicate that tariff reform does not uniformly affect consumers across regions and products in emerging economies.

Keywords: Pass-through, retail prices, law of one price Zambia
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1.0. Introduction

Several empirical studies in international trade have examined the impact of external reforms on various economic outcomes within liberalising countries. Particularly, studies have uncovered the effect of tariff liberalisation on various dimensions of the economy such as economic growth, (Frankel & Romer, 1999), poverty and inequality (Topalova, 2007; Verhoogen, 2008) productivity and growth effects of manufacturing firms(M. J. Melitz & Ottaviano, 2008; M. J. Melitz, 2003). Most firm level studies have looked at the channels through which changes in tariffs affect productivity (Amiti & Konings, 2007; Fernandes, 2007) and the responsiveness of prices, mark-ups and marginal costs within firms (De Loecker, Goldberg, Khandelwal, & Pavcnik, 2012). Surprising though, the various impacts of trade reforms on domestic prices have been largely overlooked in empirical literature (Blonigen & Haynes, 2002). Yet, central to most of these outcomes of trade reforms is the effect of tariffs on prices of imported goods and domestic substitutes.

Until recently, much of the established theoretical and empirical literature has focused on the effect of trade policy shocks, particularly, the incompleteness of the tariff pass-through into import prices[2]. A bulk of this literature examine this relationship at aggregate level, implicitly treating a country as a single geographical unit with a common pass-through of tariffs to import prices (Feenstra, 1995; Feenstra, 1989; Pompelli & Pick, 1990).

However, the implicit assumption that treats a country as a single geographical unit has been questioned in recent theoretical and empirical literature. Particularly, recent theoretical literature in New *Economic Geography* demonstrates that countries differ substantially in terms of their internal geography (Behrens, Gaigne, Ottaviano, & Thisse, 2007; Coşar & Fajgelbaum, 2013; Crozet & Koenig-Soubeyran, 2004b; Fujita & Mori, 1996). The theory shows that large internal has so far been empirically established for among other countries such as Nigeria and Ethiopia by Atkin & Donaldson, (2014) and India by Ural Marchand, (2012).

[2] Though several theoretical papers examine how changes in tariffs may affect tariffs, few empirical studies have formally tested the relationship.

Empirically, price-based studies of product market integration within and cross countries have documented strikingly large deviations from the law of one price. Results of these find large price gaps within countries revealing the presence of large trade costs, which for some reasons get amplified when crossing national borders. This evidence holds in advanced economies (Ceglowski, 2003; Engel, Rogers, & Wang, 2003; Fan & Wei, 2006) but is more pronounced in emerging economies where trade frictions within countries lead to segmented markets (Atkin & Donaldson, 2014). In Africa, widespread evidence reveal large market fragmentation on account of large infrastructural and transport barriers that significantly impact on the structure and intensity of trade within and across countries (Brenton, Portugal-Perez, & Régolo, 2014; Limao & Venables, 2001).

With largely imperfectly competitive markets and weak production structures, the internal allocative and growth effects of tariff reforms is likely to be greater in emerging countries. However, the impact of tariffs is likely to differ across geographic regions within emerging economies due to large intra-national trade costs. Yet, there is relatively little, if any, systematic analysis of effects of external integration on internal price dispersion of liberalising economies, especially in Sub Saharan Africa. This scarcity of evidence can in part be explained by lack of requisite data to conduct such studies.

This paper bridges this gap using highly disaggregated product level price data collected from 38 districts of Zambia to analyse the differential pass-through of tariffs to domestic retail prices across geographical regions. The paper studies three key relationships. Firstly, average pass-through of tariffs to domestic prices in Zambia. Secondly, the differential pass-through of import tariffs to regions, and thirdly, the differential pass-through of tariffs across heterogeneous products. In doing so the study tests for the sensitivity of the tariff pass-through to different regions and products.

The paper contributes to the empirical literature on tariff pass-through in several ways. The data used has two unique features that allow us to empirically test the pass-through hypotheses. First, the dataset features a panel of district level prices of 34 narrowly defined products sold in markets across Zambia. In doing this, the analysis avoids differential pass-through that might be based on quality differences across products. This contrasts with other

studies Mallick & Marques, (2008) and Pompelli & Pick, (1990) that use industry level unit values as proxies for import prices. Second, the price data is collected from across a wider geographical coverage of 38 districts. This wide geographical coverage provide us with the requisite spatial variation to identify the differential pass-through across geographic areas within Zambia, a dimensions that previous contributions in this literature have missed out. Third, the richness of this dataset allows for the test of the differential pass-through of trade policy shocks across heterogeneous products.

In spirit with the literature on *border effect* this paper gives insights into how integrated regions are in the international environment. This contributes to our understanding of the product market integration and the failure of the law of one price to hold. The paper also speaks to the trade and poverty literature. With the high degree of poverty averaging at 68% in 2006, in Zambia, the pass-through estimates give insight in the role of external reforms in shaping the pattern of internal development and welfare through the price channel as in trade-poverty literature (Nicita, 2009; Porto, 2006).

1.1. Context and Motivation of study

The study is conducted in the context of Zambia's trade policy reforms with South Africa under the SADC trade protocol. There are reasons that make Zambia an excellent setting to study effect of trade shocks, particularly reductions in tariffs on internal price variation. First, the country is an import dependent and landlocked country with significant natural and infrastructural barriers to trade. In fact, remote and landlocked countries have higher transportation costs than countries with similar characteristics but not landlocked. For example, (Limao & Venables, 2001), estimate that a representative landlocked country has transport costs approximately 50% greater than does a representative coastal economy.

Zambia also exemplifies a classic African country that has undergone extensive economic reforms aimed at internal and external integration of the economy. However, the country remains internally segmented, with large and substantial price deviations across regions. Greater gains from external trade reforms are likely in this setting, motivating our approach of incorporating the heterogeneous effect of reductions in tariffs across geographical areas.

The results therefore will contribute to the understanding of the consequence of tariffs on domestic price and hence the extent to which tariff changes may drive economic responses within Zambia.

Testing the causal link between changes in tariffs and internal price integration requires a measure of traded goods prices, like world prices that would exist in an open market. As an extension to previous studies this paper uses a sample of matched products from South Africa which is ideal for several reasons. First, we test the differential effect of the trade policy shock on intranational price integration using a case study of preferential tariff reductions by Zambia from the SADC trade protocol with South Africa. This tariff reform was exogenously dictated by the SADC trade protocol that aimed at attaining a free trade area. The fact that the final tariff was pre-determined to be zero across products by 2010 reduces concerns about endogeneity in the tariff reform process.

A second benefit is that South Africa is Zambia's largest trading partner and is a major source of consumer products. Further, South African supermarket chains are dominant players in the retail market. South Africa also serves as the main transit route for Zambian imports. Consequently, price shocks in South Africa and changes in tariff rates on SA imports are likely to have a substantive effect on Zambian prices.

The empirical results can be summarised as follows. First product market in Zambia are not perfectly integrated in regional markets. Supportive evidence of this view is provided by the imperfect pass-through of tariffs and foreign prices at the national level. Secondly, the tariff pass-through differs across regions in interesting ways. Particularly, the pass-through differs across regions based on distance from main transit route, pointing to the value of the quality of transportation infrastructure. Finally, the pass-through of tariffs to product prices is strongly influenced by the tradability of the product. The greater the share of imports in consumption, the higher the pass-through.

The remainder of the paper is structure as follows. Section 2 derives the theoretical model that informs our empirical analysis. The section that follows reviews the empirical literature,

while section 4 presents the empirical framework. The data are discussed in Section 5 and section 6 presents the estimation results. Section 7 concludes the paper.

2.0. Theoretical Framework of Tariff Pass-through

This section presents a simple theoretical model that informs the estimation of the intranational pass-through of tariffs into retail prices. The theoretical model is derived from Crucini et al, (2005b)'s retail pricing model. The model assume that trade occurs in intermediate inputs and retailers combine local with traded inputs for sale in local markets.

2.1. The retailer's Technology

The production of good k requires two inputs; a traded and a nontraded inputs that are combined to produce the product of interest. The Cobb-Douglas retail production function takes the form:

$$Y_{kj} = (N_{kj})^{\alpha_k} (T_{kj})^{(1-\alpha_k)} \qquad (1)$$

Y is the output level of product k which is produced using a combination of a nontraded local input (N) and tradable input (T) that is either produced locally or imported into region j. α is the share of non-tradable intermediate input and is product specific.

In the model, the cost function is the solution to the following minimisation problem at each date:

$$\min_{\{N_{kj}, T_{kj}\}} C_{kj} = P_j^N N_{kj} + P_{kj}^T T_{kj} + f_x \qquad (2)$$

$$\text{s.t. } (N_{kj})^{\alpha_k} (T_{kj})^{(1-\alpha_k)} \geq Y_{kj} \qquad (3)$$

where C_{kj} is the cost of producing good k in location indexed j, P^T is the price of the traded intermediate input into the production of the retail good k in location j and P^N is the price of nontraded input common to all goods but differs across regions.

2.2. Retail price determination

Solving the minimisation problem produces a cost function that takes the form: $Y_{kj}C(\overline{P}_{kj})$ where $C(\overline{P}_{kj})$ is the unit cost of the good and retail price (P_{kj}) of good k. The standard calculation of the price or cost per unit reveals that:

$$P_{jk} = (P_j^N)^{\alpha_k}(P_{kj}^T)^{(1-\alpha_k)} \qquad (4)$$

Retail prices are thus a function of traded input prices P^T and non-traded input prices P^N. The sample comprise products mostly imported from South Africa. Therefore, P^T represents the South African price, in line with the production-destination model. The price of the tradable input T_{kt} depends on the free on board price P_{cik}^* and a two part trade cost that comprise an ad valorem tariff rate (τ_{kt}) charged by domestic authorities and the internal per unit transportation cost (d_k) of moving the good from the border to the final destination j. The price of the tradable input P_{kt}^T is then defined as:

$$P_{kj}^T = P_k^B(1+\tau_k) + d_{kj} \qquad (5)$$

where P_k^B is the imported price valued in domestic currency ($P_k^B = eP_k^*$ where e is the exchange rate and P_k^* is the foreign currency denominated price). Substituting (5) in (4) yields the retail price equation:

$$P_{kj} = (P_j^N)^{\alpha_k}[P_k^B(1+\tau_k) + d_{kj}]^{(1-\alpha)} \qquad (6)$$

Taking logarithms of both sides of equation 6 gives us:

$$\ln P_{kjt} = \alpha_k \ln(P_{jt}^N) + (1-\alpha_k)\ln[P_{kt}^B(1+\tau_{kt}) + d_{kj}] \qquad (7)$$

Equation (7) demonstrates that that the retailer's price setting behaviour depends on five factors that consist of: the fluctuations in the foreign price of the good in local currency, the ad valorem tariff rates charged at the border, the internal trade costs, the tradability of the

product and the location specific input costs. To understand how the extent to which tariff rates are passed through into retail prices, we differentiate equation 7 respect to $(1+\tau_{kt})$ to obtain the following:

$$\frac{\ln P_{kjt}}{\partial(1+\tau_{kt})} = V(\tau_{kt}) = (1-\alpha_k)\left(\frac{P_{kt}^B}{[P_{kt}^B(1+\tau_{kt})+d_{kj}]}\right) < 1 \qquad (8)$$

The main insight from equation 8 is that the pass-through of import tariffs to consumer prices is less than 1. An *incomplete pass-through* obtains if a 1% fall in trade costs reduces the price of the imported good by less than 1%. The sign of the right hand side of Equation 8 is positive, but less than 1.

The incomplete pass-through is driven by two features of the retail price. The pass-through rate depends on the transportation costs of moving the good from the border to local markets. To illustrate this relationship, we differentiate it (equation 8) with respect to distance to obtain[3]:

$$\frac{\partial V(\tau_{kt})}{\partial d_{kj}} = -\frac{(1-\alpha_k)P_{kt}^B}{[P_{kt}^B(1+\tau_{kt})+d_{kj}]^2} < 0 \qquad (9)$$

Equation (9) provides a second hypothesis regarding the pass-through rate. The pass-through of tariffs into consumer prices decreases with an increase in transportation costs. The implication is that regions more distant from the source of imports experience lower reductions in consumer prices in response to tariff liberalisation. The pass-through is likely to much lower for emerging countries with weak infrastructure and natural barriers to trade.

The share of traded intermediate input costs in the supply of good k (tradability) is a second factor that affects the pass-through of ad valorem tariff rates onto retail prices. Differentiating equation 8 with respect to the share of nontraded input costs yields :

[3]Equation 14 can be expressed as $v(\tau_{kt}) = (1-\alpha_k)P_{kt}^B[P_{kt}^B(1+\tau_{kt})+d_{kj}]^{-1}$

$$\frac{\partial V(\tau_{kt})}{\partial(1-\alpha)} = \frac{P_{kt}^{B}}{[P_{kt}^{B}(1+\tau_{kt}) + d_{kj}]^{2}} < 0 \qquad (10)$$

The sign of the relationship in equation 10 is negative. The share of traded intermediate input in the retail price the greater the pass-through of tariffs into the product's retail price. The implication is that the pass-through of tariffs to consumer prices differs across products. Products such as fresh vegetables where non-traded inputs constitute a high share of the retail price, experience a lower pass-through of tariffs than product such as refrigerators where traded inputs make up a high share of the retail price. This yields a third hypothesis that will be investigated in this paper, namely that the more tradable a product the higher pass-through of tariffs onto retail prices. The hypothesis points to the existence of heterogeneity in the pass-through of tariffs across products.

3.0. Findings in Empirical Literature

This section presents an overview of previous empirical literature on tariff pass-through studies. In general there is very little research on retail price behavior and even fewer studies focus on the heterogeneous effect of tariff cuts across products and regions. This review focuses on two strands of literature that informs our empirical and theoretical literature. These comprise the tariff pass-through literature and the poverty and new economic geography literature. Typically, both strands document incomplete pass-through rates. These are discussed in turn.

3.1. Tariff pass-through literature

There are a number of studies on the pass-through of trade protection instruments, particularly changes in tariffs to consumer prices. The important exceptions are (Feenstra, 1989; Mallick & Marques, 2008; Pompelli & Pick, 1990; Rezitis & Brown, 1999). In a typical way, these studies evaluate the hypothesis that changes in ad valorem tariffs lead to identical changes in import prices. The general finding of this literature is that changes in trade policy are not perfectly reflected in consumer prices.

In his study, Feenstra (1989) developed a classic theoretical model of how tariff pass-through is determined. His Bertrand duopoly model, in which a foreign exporter competes with domestic producer of an imperfect substitute shows that import prices are also determined by foreign producer costs, domestic demand and fluctuations in exchange rates. Feenstra (1989) uses this model to estimate tariff pass-through of prices of Japanese trucks into US import prices. He estimates a tariff coefficient of 0.6 for trucks indicating that reductions in tariffs are not perfectly passed into domestic prices.

Using Feenstra's classical model, Pompelli and Pick (1990) and Rezitis and Brown (1999) estimate the tariff pass-through US imports of Tobacco from Brazil and Greece respectively. Pompelli and Pick (1990) find the Brazil-US tariff pass-through elasticity of 0.549. Rezitis and Brown (1999) report qualitatively similar results of tariff pass-through rates of unmanufactured Greek oriental tobacco into the US prices. However, like Feenstra (1989), these studies do not analyse the spatial effects of tariff cuts within a country and focus on a narrow range of products the car and tobacco industries.

Mallick and Marques (2007) study the effects of Indian tariff reforms on import prices of a variety of products. Particularly, they use 38 sectors of products obtained at two-digit SITC-level to test the tariff pass-through model for Indian imports. They found incomplete and varying tariff rate pass-through for 36 of the 38 sectors although only six sectors were statistically significant. The pass-through of tariffs in the significant sectors varied between 12% and 40% across sectors. Only one of the six sectors had perfect pass-through. Further, Mallick and Marques (2007) identifies the import penetration rate, share in total imports, nontariff barriers and the effective rate of protection. They showed that while the tariff pass-through decrease with import shares, the import penetration rate did not influence the pass-through.

In another study, Mallick and Marques (2012) investigate the tariff and exchange rate pass-through of Indian exports onto the US, Japanese and EU (G3 markets and onto South Africa, Brazilian and Chinese markets (BRICS). They found the pass-through of Indian export unit prices to range from a perfect of 100% in Japan and EU markets to a low of 80% in China.

Their average results find not only imperfect across the G3 and BRICS but also insignificant in the BRICS countries.

Ludema & Yu, (2011) use an extended version of the (Melitz & Ottaviano, 2008) model to investigate the tariff pass-through at firm level and how it depends on firm heterogeneity in terms of productivity and product quality. They find that firms absorb the changes in tariffs by adjusting both the mark-ups and product quality leading to incomplete pass-through. In general evidence suggest incomplete pass-through of tariffs and exchange rates to import prices.

3.2. Tariffs and poverty literature

The second strand of literature uses household survey data to explore the effect of trade reforms on household welfare via the price mechanism following (Winters, 2002; Winters, McCulloch, & McKay, 2004) and (Porto, 2006). This literature's theoretical prediction is that trade policy reforms affect different households differently and could be influenced by geographical characteristics of localities (Nicita, 2009; Ural Marchand, 2012). Its approach identifies two causal links through which these outcomes are realised– one connecting trade policies to prices and another connecting prices to household welfare via wages and employment. In this literature the price-tariff link is used to analyse the differential effect of trade policy changes at regional or household levels. This subject remains sparsely researched in the earlier literature.

Recently, Porto (2006), Nicita (2009) Marchand (20012) and Han (2014) investigate the effect of trade reforms on households using demographic data focusing on Argentina, Mexico, India and China respectively. This literature emphasise the role of trade costs and market functionality in terms of household location and market competitiveness as sources of variation in the effect of tariffs across regions and households. For example, Nicita (2009) extends the standard model tariff pass-through model to capture heterogeneity across geographic regions. He uses the heterogeneity of trade costs from the nearest border between the US-Mexico borders to estimates the distributive effects of tariff liberalization across 63 geographic areas of Mexico. He finds the tariff pass-through average of 33% for agricultural

products and 27% for the manufactured good. Accounting for regional differences, he found the elasticity pass-through of 70% in border regions for manufactured products. The pass-through declined to 40% at 1000km and 20% at 2000 km from the border. However, there was no variations in tariff pass-through across various regions for agricultural products.

Marchand (2012) uses a model showing that consumer prices are determined by foreign prices, the exchange rates and tariffs. She uses this model to estimate the tariff pass-through elasticities across urban and rural regions of India. She estimated the tariff pass-through range of 33 % to 49 percent in rural areas and 64 to 68 % in urban regions of India, the results indicating that trade shocks affect urban areas more than rural regions.

Finally, Han, Liu et al, (2014)'s study on China assesses the effect of the market structure proxed by the size of the private sector tariff pass-through using unit prices of tradable products across 56 cities. They find that on average a 10% increase in the private sector increases the pass-through of 2.5%. They estimated the pass-through variation ranging from 20% to 39 % across cities.

In sum, evidence suggest incomplete pass-through of tariffs to import prices. However, most of the evidence has a number of limitation. First, they are based on unit prices that do not correct for quality change in products. Second, these studies also tend to assess the pass-through of tariffs using broad trade reforms such as the WTO reforms and control for world prices using American prices. Also missing from this literature are studies focused on Sub-Sahara Africa, a region that has undertaken several economic and trade reforms yet faces several trading frictions that could inhibit the success of such reforms. We extend the literature by using a sample of goods that are identified by brand and units in the context of SSA, which remains understudied. The study also evaluates a clear tariff reform program between Zambia and South Africa that is associated with strong trade linkage. This source-destination relation minimises the potential underestimation of the pass-through that could arise from matching non-trading pairs in standard models. To our knowledge, this study is among the first of its kind in the SSA region and global literature

4.0. Empirical Framework

This section presents the empirical framework used to quantify the extent of tariff pass-through to retail prices in Zambia. It is split into two parts, one focusing on pass-through rates at the national level and the other focusing on the regional pass-through effects of tariff reform

4.1. Average Tariff pass-through

First, we explore the average pass-through of import tariffs to retail prices. Following our theory the baseline empirical framework guiding our pass-through analysis is given by the following equation:

$$\ln P_{kjt} = \beta_0 + \beta_1 \ln P_{kjt}^N + \beta_2 \ln P_{kt}^B + \beta_3 \ln(1+\tau_{kt}) + \lambda_t + \lambda_j + \xi_{kjt} \qquad (11)$$

where P_{kjt} is the domestic retail price of good kin location j, P_{kjt}^N is the price of nontraded input price in location j, P_{kt}^B is the pre-tariff border price of traded goods in the domestic currency, τ_{kt} is the ad valorem tariff, λ represents the fixed effects for products, time and district, and finally ξ_{kjt} is an i.i.d. error term.

In this setup, the coefficient β_2 measures the average pass-through of tariff into retail prices across all regions of the country. As shown in 5.8, the pass-through is expected to be positive, but less than one ($dP_{ikt}/d\ln(1+\tau_{kt}) = \beta_3 < 1$) indicating a partial or incomplete pass-through.

4.2. Regional Heterogeneity

This paper extends the standard pass-through framework by estimating the differential pass-through of tariff reforms across regions. This is captured by including an interaction term between the ad valorem tariff rates and distance from the border or hub district. This gives us the following equation:

$$\ln P_{jkt} = \beta_0 + \beta_1 \ln P_{jt}^{N} + \beta_2 \ln P_{kt}^{B} + \beta_3 \ln(1+\tau_{kt}) + \beta_4 \ln(1+\tau_{kt}) \times \ln dist_j + \lambda_k + \lambda_j + \lambda_t + \xi_{jkt} \quad (12)$$

where $dist_j$ is the distance between the local market j and the border or hub city. The estimated pass-through elasticity is:

$$\frac{\partial \ln P_{ik}}{\partial \ln(1+\tau_{kt})} = \beta_3 + \beta_4 dist_j \quad (13)$$

where β_4 is gives the summary measure of the spatial influence of changes in trade policy on internal price behaviour. In the case that trade costs have identical effect across regions, then $\beta_4 = 0$. However, if consumer prices vary based on distanced, then $\beta_4 \neq 0$. It is expected to be negative ($\beta_4 < 0$) if the pass-through of tariffs implies that the pass-through of tariffs into consumer prices decrease with an increase in transportation costs. The further a product destination is from the border, the lower the pass-through of tariffs into retail prices.

Further there might be variations in the effect of tariff liberalisation on products based on their characteristics,-in particular tradability. To investigate this heterogeneity, we introduce interactions between tariffs rates and Product tradability

$$\ln P_{jkt} = \beta_0 + \beta_1 \ln P_{jt}^{N} + \beta_2 \ln P_{kt}^{B} + \beta_3 \ln(1+\tau_{kt}) + \beta_4 \ln(1+\tau_{kt}) \times trad_k \lambda_k + \lambda_j + \lambda_t + \xi_{jkt} \quad (14)$$

where $trad_k$ is the measure of product tradability index. This test our hypothesis that the more tradable a product the higher pass-through of tariffs onto retail prices

5.0. Data and description

In is section, we describe our unique micro-price data that allows us to test the effect of trade liberalisation on internal price distributions. The price data comprise 35 products obtained from two sources: the first sample dataset constitute retail prices of individual goods underlying the construction of the consumer price index obtained from the Central Statistical

Agency of Zambia. This data is available at a monthly frequency at product level in 38 districts for the period December 2001- 2010.

The second, for world prices, the foreign micro price data obtained from the South African Statistical agency is used in the analysis. This dataset, underlay the construction South African CPI is available at city and monthly frequency for the period December 2001 to December 2010 inclusive[4]. This data is advantageous for the following reasons. First, products are narrowly defined and closely match with the Zambian products. This precision minimises the potential bias associated with unit values. Second, we use the simple average retail price for the Gauteng region is used in the analysis for one simple reason.

Although South Africa is the major source of the consumer products, the Gauteng region is the major production and commercial hub from which Zambian imports are sourced. This enables us to estimate a spatially informed model, in which the production and consumption centres are linked with actual trade flow- hence the pass-through is likely to be accurately estimated as in price integration studies (Anderson, Schaefer, & Smith, 2013; Atkin & Donaldson, 2014; Inanc & Zachariadis, 2012). This minimises the potential underestimation of the tariff pass-through associated with studies using world prices of non-trading partners. The South African prices are converted into Zambian kwacha using the monthly exchange rate obtained from the Bank of Zambia.

Figure 1 plots the monthly average price series of four selected products – spaghetti, cooking oil, ladies dress and a refrigerator for South Africa and Zambia. A few observations about the prices in the two countries can be made from the figure. First, the figure shows the existence of log price differences between the two countries with higher prices in some products in Zambia compared to South Africa and vice versa. This price segmentation is essential for imperfect pass-through of trade shocks into domestic prices.

[4] Note: the South African CPI product were revised in 2006/7. This could introduce some variations in brands and quality across years that this study does not control for

Figure 1: Trend in the monthly Average retail price of selected products

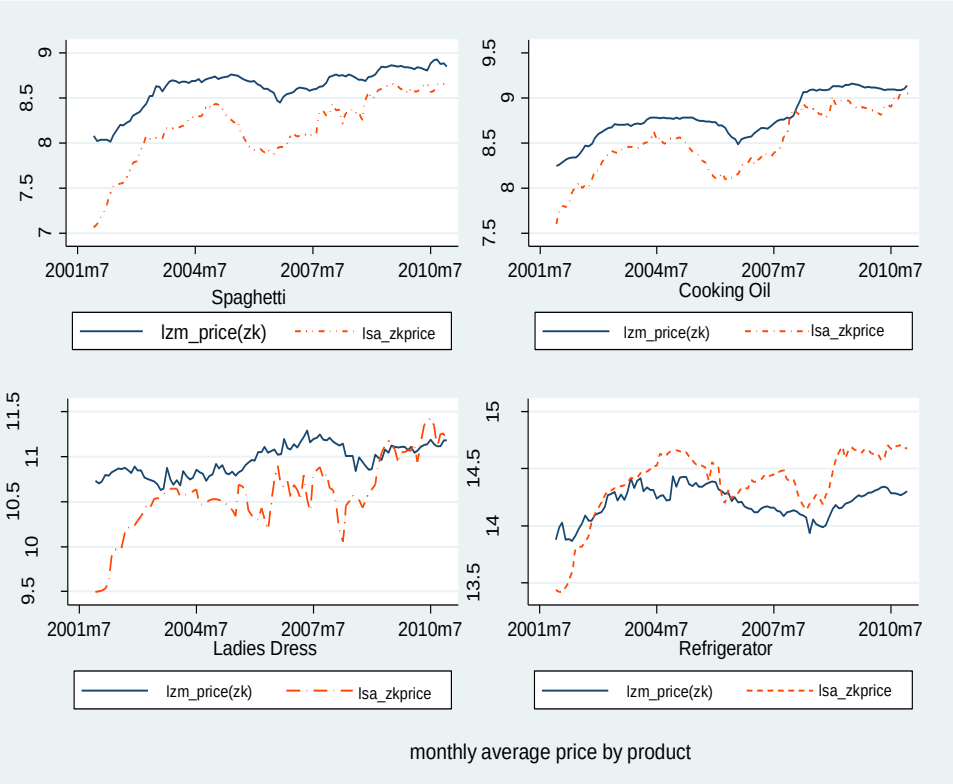

Table 1 presents the Zambian and South African average and log price differences of the sample products for June 2002 and 2010 in columns (i)-(ii) and columns (iii)-(iv). The average Zambian log prices are generated at district level and then aggregated to the national average. The average price for the Gauteng province is used to proxy the South African prices. The table exhibit considerable amount of variation of the log prices across products and across the two countries. First, the table confirms the trends in figure 1.

Table 1 also shows that the price levels across the two countries in some goods seem to move together quite closely with greater convergence during the later years of the reforms. This is also evident in columns (v) – (vi) that report the approximations of the percentage differences of the log prices between the two countries at product level. In these columns, the positive number implies that the Zambian good has a higher average price than the corresponding South African product. Clearly, price deviations from the LOP varies across products with the absolute percentage price differences ranging from 0.01 for a kilogram of sugar to 1.74 for brassiere in December 2010. However, it is worth noting that not all products in our

subsample are imported from South Africa as some have locally produced substitutes and imports from other countries such as China in textiles and clothing and Kenya in oils and fats.

Looking at table 1, it can be seen that the average log prices of some goods in Zambia are in some periods even lower than the log prices of the same products in South Africa. However, prices of homogenous goods like tinned baked beans, tinned Pilchards fish, spaghetti and toothpaste are slightly higher in Zambia than South Africa compared to heterogeneous products like boys' shirt, carrots and fresh oranges. In sum, the log prices exhibit significant variation across products and the two countries. These properties are essential not only to test the tariff pass-through hypothesis but also treat product heterogeneity differently. Finally, the price differentials appear to be sensitive to the monthly movements in the kwacha rand exchange rate. This is evident from the pattern of price movements and Kwacha-Rand exchange rates displayed in figures 1 and Figure A4.1.

The second database constitutes a panel of Zambia's preferential import tariff rates offered to South Africa. We obtained this data from Zambia's tariff phase-down programme offered to South Africa as obtained from the Customs database. The original schedule is adjusted for changes in tariffs gazetted by government as part of the annual budgetary process.

The product-level tariff rates were weighted by the 2010 import values from South Africa. Individual products prices were hand matched to corresponding tariff line at HS six digit level. In most cases, several tariff lines were matched with a single price. For example, the price of sugar was matched with the tariff line on sugar and cane sugar. The average South African import weighted tariff rate was used in this study.

During the tariff phasedown period, tariffs were drastically reduced across products with the strongest cuts having been made between 2005 and 2010. Although the phasedown across products was at the discretion of policy makers, the reform remained part of the broad external reform process that culminated into the SADC FTA. Table 2 shows the weighted and unweighted preferential average tariff rates across products between 2001 when the implementation of the reforms started and 2010 after the formation of the free trade area.

Table 1 The logarithmic December average price and percentage differences 2002 and 2010 (ZMK)

	Zambia		***South Africa***		**lnPz –lnPsa**	
	(i)	***(ii)***	***(iii)***	***(iv)***	***(v)***	***(vi)***
Products	**2002**	**2010**	**2002**	**2010**	**2002**	**2010**
Baked beans (420g)	8.08	8.94	7.37	8.28	0.7	0.66
Macaroni (500gm)	8.22	8.84	7.54	8.69	0.68	0.15
Spaghetti (500gm)	8.2	8.84	7.53	8.66	0.67	0.18
pilchards (155)	7.65	8.68	7.57	8.39	0.08	0.29
sugar (1kg)	7.93	8.69	7.64	8.7	0.29	-0.01
Peanut butter (400gm)	8.34	9.08	8	9.31	0.34	-0.23
Cooking oil (750ml)	8.42	9.13	7.98	9.04	0.44	0.09
Orange Squash(2lt)	8.29	9.53	8.33	9.48	-0.04	0.04
Instant coffee (250g)	8.9	9.86	8.44	9.68	0.46	0.18
Tea leaves (250g)	7.79	8.33	8.72	9.47	-0.93	-1.14
Vinegar (750ml)	7.87	8.32	7.28	8.44	0.59	-0.13
Salt (1kg)	7.1	8.32	6.93	9	0.17	-0.68
Toothpaste (100ml)	8.39	8.79	7.81	8.62	0.58	0.17
Carrots (1kg)	7.92	8.44	6.97	8.57	0.95	-0.13
Onion (1kg)	7.85	8.55	7.72	8.63	0.13	-0.08
Oranges (1kg)	7.08	8.4	7.34	8.6	-0.26	-0.2
Tomatoes (1kg)	7.22	8.16	7.89	8.89	-0.68	-0.73
Irish potatoes (1kg)	7.51	8.32	7.53	9.1	-0.02	-0.78
Bread	7.49	8.35	7.47	8.65	0.02	-0.3
Cheddar cheese (1kg)	10.43	11.04	9.8	10.21	0.63	0.83
Brandy (750)	10.08	10.47	9.88	10.94	0.19	-0.47
Cigarettes (packet 20)	8.36	9.14	8.35	9.78	0.01	-0.64
Shoe Polish (50ml)	7.73	8.36	7.39	8.6	0.34	-0.24
Paraffin (1 litre)	7.81	8.51	7.2	9.09	0.6	-0.58
Refrigerator	14.02	14.3	13.8	14.67	0.22	-0.37
Kettle (2.2lt)	11.27	11.32	11.04	11.67	0.23	-0.34
Electric Iron	11.42	11.78	10.77	11.89	0.64	-0.1
Ladies dress	10.86	11.2	9.96	11.19	0.89	0.01
Ladies shoes	10.53	11.36	10.49	11.77	0.04	-0.41
Brassiere	8.59	9.34	10.26	11.08	-1.68	-1.74
Boys shirt	9.6	10.15	9.45	10.97	0.15	-0.82
Body lotion(100ml)	7.86	8.58	8.79	9.13	-0.93	-0.55

Note: lnP_z represents the log Zambian price and lnP_{sa} standards for the log of South African price fora given good.

Each individual sample product from the CPI basket was matched to the six-digit harmonised system (1988/92) industry level tariff rates. In instances a single product was matched to more than one tariff line. In such cases, a simple trade weighted average tariff rate was used to in the analysis. For example, the cigarettes code is matched to cigars and other tobacco.

Table 2: Zambian Preferential import tariffs for South Africa

Year	Unweighted Tariff rate	Trade weighted (ln(1+t))	$\ln(1+t_2)-\ln(1+t_1)$
2001	23.94	20.68	-
2002	20.35	17.84	-2.8
2003	20.20	17.83	-0.01
2004	16.90	14.94	-2.89
2005	15.95	14.19	-0.75
2006	12.11	10.66	-3.53
2007	7.80	6.21	-4.45
2008	3.71	2.16	-4.05
2009	2.29	1.41	-0.75
2010	1.57	0.98	-0.43

Next, the pass-through of tariffs is likely to be influenced by product specific characteristics. In particular the trade costs of individual products is likely to affect the pass-through of tariffs into consumer prices. The paper uses heterogeneity in individual product tradability as an alternative measure of trade costs. The tradability index is computed as the ratio of the sum of imports and exports to total domestic output at industry level. The data for this purpose is obtained from the UNIDO (Compact Disk) database.

This differs from Crucini et al' (2005a) who use the shares of traded and nontraded intermediate inputs as measures of tradability. Finally, we use log average price of the national staple food, nshima and beef stew sold in restaurants to proxy the district level input prices that vary across districts and time. Unlike fixed effects that capture time invariant factors, this variable controls overtime variations as well as local drivers of price mark-ups. The distance variable is used as proxy for trade costs to capture regional heterogeneity in the robustness tests. We used the most practical driving distance from Lusaka to other districts. This data is obtained from the google maps.

6.0. Estimation Results

This section presents and discusses the main quantitative results regarding the effect of trade policy on internal prices. The section comprises three subsections. The first subsection

reports the average effect of trade policy on Zambian retail prices. The section also infers the extent to which domestic markets are integrated with international (South African) markets. The second part presents the estimates of the impact of tariffs on the internal distribution of retail prices. The last part looks at the effect of product heterogeneity as captured by tradability and import elasticity of demand on the pass-through of tariffs.

6.1. Homogenous (average) Pass-through Estimates

This section estimates the magnitude of the tariff pass-through on retail prices using the pooled data. The geographic dimension of price responses to tariff liberalisation are ignored. The pooled regression model is specified as:

$$\ln P_{ikt} = \alpha + \beta_1 \ln P_{kt}^{*} + \beta_2 \ln(1+\tau_{kt}) + \beta_5 \ln(pr\_ntd_{it}) + \lambda_t + \lambda_k + \xi_{ikt} \qquad (15)$$

where P and P^{*} are domestic and foreign retail price, respectively, valued in Zambian Kwachas. We include the product λ_k and time λ_t fixed effects to control for any time-invariant product specific effects and year specific shocks in consumer prices. The standard errors are clustered around the districts in this pooled regression equation.

We begin the analysis by documenting in a simple regression whether local prices are systematically related to foreign. The results give an insight of how integrated Zambian retail prices are integrated in the international environment. If the LOP holds, suggesting perfect domestic and foreign markets integration, then the local retail prices should vary with the market conditions in other markets. In this case, we have a one-to-one domestic-foreign price correlation so that the transmission elasticity $\beta_1 = 1$.

The first column of table 3 reports the estimate from the regression of retail prices on foreign (import) prices. The simple average price pass-through is positive and statistically significant at 1%. The estimated elasticity of 0.206 suggest that on average a 10% increase in foreign prices raise domestic retail prices by 2.1%. This coefficient is significantly less than one indicating that fluctuations in foreign prices are not fully passed through into consumer prices in Zambia, confirming the earlier hypothesis based on equation 15.

Table 3: Transmission of Tariffs and foreign prices into domestic retail prices

Regressor	**(1)**	**(2)**	**(3)**
ln(foreign price)	0.206***	0.189***	0.189***
	(0.0226)	(0.0212)	(0.0210)
ln(1+tariff)		0.815***	0.807***
		(0.206)	(0.202)
ln(nontraded input prices)			0.0739***
			(0.0201)
Constant	6.658***	6.625***	5.991***
	(0.176)	(0.176)	(0.274)
Observations	9,286	9,286	9,286
R-squared	0.944	0.944	0.944
Product FE	YES	YES	YES
Year FE	YES	YES	YES

Standard errors are clustered at district level
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Comparisons across countries are difficult given different units, products and time periods, but the results suggest a much lower pass-through of foreign prices to domestic prices than is found in the international literature. For example Marchand (2012) estimates the average price transmission of 0.39 for agricultural products and 0.50 for manufactured products based domestic prices computed from household consumption data for India. Using similar data for China, Han et al (2014) find an average transmission of 0.23.

The lower pass-through in our sample is consistent with barriers to integration and the high border effects estimated in similar price studies on Africa by (Aker et al, 2014a; Aker & Fafchamps, 2014b; Balchin et al, 2015; Brenton et al., 2014; Nchake, 2013; Versailles, 2012). This literature attribute the failure of the LOP to the incomplete pass-through of trade policy instruments such as tariffs, nontariff barriers and exchange rate variability.

The next key hypothesis that we test is that of imperfect pass-through of trade policy shocks proxied by tariffs onto consumer prices as captured by β_2. The summary measure of the tariff pass-through is presented in columns (2) – (3) of Table 3. The estimated tariff pass-through coefficient is positive and statistically significant at the 1% level. The estimate implies that a 10 percent reduction in the ad valorem tariffs (1+τ), the tariff inclusive border price of the import competing goods, leads to an 8.1 % reduction in the average consumer prices. This average tariff pass-through estimate is considerably different from zero but insignificantly

different from one (as per statistical test)[5]. In column (2) we control for nontraded prices, though the variable is significant and of correct sign -positive, it has no effect on the other coefficients.

The key insight from that results is that changes in trade policy is not perfectly transmitted to the consumer prices. This can be interpreted as rejecting the hypothesis of imperfect pass-through of trade policy shocks to consumer prices which is consistent with mixed evidence of the pass-through records in international literature. For example, using unit values Feenstra (1989) records an imperfect average pass-through of 0.6 for Japanese trucks onto US market. In contrast, he finds the elasticity of import prices to tariffs to be unit and above (0.946 to1.39) for motorcycles indicating perfect pass-through. Similarly Mallick and Margue (2012) find a perfect pass-through (100%) of Indian exports to the EU and Japanese markets.

The result on the near perfect tariff pass-through are somewhat surprising in the light of the weak infrastructure of the country. One possible explanation for this phenomenon may be that the reform period under study was accompanied by an influx of South African chain retailers into the domestic markets. The entry of supermarkets with powerful logistics mechanisms tend to collapse the fragmentation of markets by inducing competition (across firms and domestic product varieties) and pass long term trade policy shocks onto the average domestic prices (Reardon, et al, 2003)

However, these findings have two caveats relating to the potential masking of important compositional effects across products and destination markets. Our pooling of the products across districts imposes a common pass-through to regions and across products. This may hide differences in the tariff pass-through. These two dimensions are sequentially addressed in the next sections.

6.2. Regional Heterogeneity and Tariff Pass-through

[5]We test whether coefficient β_2 is not different from 1 (test _b[ltariff+1]=1). F(1,36) = 0.81 and Prob > F = 0.3733; Our estimate accepts the null

Another key purpose of this paper is to test whether changes in trade policy affect regions differently according to their characteristics. As shown in equation 12 spatial heterogeneity is isolated by an interaction term between tariffs and distance, which serves as a source of identification. The model is tested to using distances from various port and hub cities such as distance from Lusaka, the commercial hub-city, and main ports through which imports from SA pass through among others. The hypothesis being tested is that the pass-through of tariffs onto consumer prices decrease with an increase in transportation costs. Equation 12 is used using different identifications of sources of distance:

6.2.1. *Main port of import entry: Southern Border*

In this regard, we proxy internal trade costs as distance from the nearest border from the Southern province (Chirundu and Livingstone,) which are the main ports of entry for imported goods originating and transiting through South Africa to various destinations in Zambia.[6] The regression results of equation 16 are reported in table 4.

Column (1) reports the baseline results of regression retail prices on tariffs and its interaction with distance. It can be seen that the coefficient on the foreign price is statistically significant and positive as expected, but is not substantially different from the earlier regression results in table 3. In line with our earlier results, the coefficient on tariffs is also positive and statistically significant at 5%. However, this coefficient has fallen in size by about 37 percentage points from 0.81 to 0.51. This suggest that the price falls with reductions in tariffs, specifically, a 10 percentage reduction in tariffs reduces the consumer prices by an average of about 5.1%.

Of key interest to the study, however, is the significance and sign of the interaction term between tariffs and distance from the border. Surprisingly, the estimated coefficient is not only insignificant, but is also of the incorrect sign (i.e., positive instead of negative as

[6] It is important to note that Zambia does not have a direct border with South Africa per se but goods have to transit through either Zimbabwe, Botswana or Namibia. However, Chirundu via Zimbabwe is the busiest followed by two borders that have customs clearances within Livingstone –which is much more developed than Chirundu

hypothesized). This suggest that there are no regional differences in the impact of reductions in tariff rates.

Table 4: Internal Trade costs and tariff-pass-through (Nearest South Border)

Regressor	(1)	(2)	(3)
ln(foreign price)	0.187***	0.187***	0.193***
	(0.0182)	(0.0182)	(0.0204)
ln(1+tariff)	0.510**	0.512**	0.515**
	(0.226)	(0.227)	(0.227)
ln(1+tariff)×ln(south border_distance)	0.0447	0.0443	0.0436
	(0.0301)	(0.0302)	(0.0304)
ln(nontraded input prices)		0.0257	0.0255
		(0.0206)	(0.0206)
ln(foreign price)×ln(south border_distance)			-0.00102
			(0.00163)
Constant	6.718***	6.492***	6.498***
	(0.142)	(0.229)	(0.229)
Observations	9,286	9,286	9,286
R-squared	0.947	0.947	0.947
Product FE	YES	YES	YES
Year FE	YES	YES	YES
District FE	YES	YES	YES

Note: distance is measured from nearest southern border district (Chirundu and Livingstone)
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p

Columns (2) extends the estimation by controlling for the price of nontraded inputs but turns insignificant and has no effect no effect on other variables. Column (3) then introduces an interaction variable between foreign prices and distance to test the possibility that the pass-through of foreign prices also differs by geographical areas. In line with theoretical expectations, this estimate is negative indicating that regions closer to borders are more exposed to the changes in foreign prices than more distant regions, though in an insignificant way. This interaction variable does not affect the sign or significance of the coefficient on the tariff and distance interaction variable.

In summary, the estimates we present do not find evidence of the differential effect of tariff liberalisation across geographic region- suggesting that distance from the nearest southern border plays no role in the pass-through of tariffs to regions in Zambia. However, this does not necessarily rule out the possibility of the differential pass-through regions. In particular, estimates may suffer from the omitted variable bias which we deal with next.

6.2.2. Commercial Hub: Distance from Lusaka

One drawback with our measure of trade costs is that the southern border regions largely serve as transit centres because they do not have logistical infrastructure to directly provide wholesaling and or redistribution of imported products to the rest of the country. Rather, Lusaka, the centrally located commercial capital serves as a hub-and-spoke for product re-distribution across the local markets. As (Hillberry & Hummels, 2003) note, importers use large trucks to transport products to distribution or wholesale centres, but use smaller trucks when transporting to retailers- with the cost of some geographic frictions rising sharply. To address this possibility we re-estimating the basic specification of Table 4.using distance from Lusaka to the rest of the districts across the country as a measure of transportation costs.

Table 5 Tariff reform, distance and internal price dispersion –(distance from Lusaka)

Regressor	(1)	(2)	(3)
ln(foreign price)	0.187***	0.187***	0.190***
	(0.0182)	(0.0182)	(0.0209)
ln(1+tariff)	0.483**	0.467*	0.469*
	(0.244)	(0.244)	(0.245)
ln(1+tariff)×ln(lusaka_distance)	0.0501	0.0528*	0.0525
	(0.0320)	(0.0320)	(0.0323)
ln(nontraded input prices)		0.0286	0.0287
		(0.0206)	(0.0206)
ln(foreign price)× ln(lusaka_distance)			-0.000371
			(0.00188)
Constant	6.719***	6.467***	6.467***
	(0.142)	(0.228)	(0.228)
Observations	9,286	9,286	9,286
R-squared	0.947	0.947	0.947
Product FE	Yes	yes	Yes
Year FE	Yes	yes	Yes
District FE	Yes	yes	Yes

Note: distance is measured from Lusaka, the commercial hub
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p

The output of this regression are displayed in Table 5. Once again, the results show little evidence that distance from the main commercial and hub city affects the pass-through of tariffs. This is evident from the coefficient of interest on the distance-tariff interaction which is only weakly significant with an unexpectedly positive sign once we control for the price of

nontraded inputs in Column 2. The coefficients on foreign prices and tariffs remain statistically significant and qualitatively robust to the new measure of trade costs.

6.2.3. Net exposure: distance from Nearest Border

An alternative explanation for the counter-intuitive result obtained above may be the measure we use for distance .In particular, the distance from the hub or southern border may not be the appropriate indicator of exposure to external competition. As a landlocked economy, regions across the country are differently exposed to different borders. In this case, what may be more important for the effect of tariffs on consumer prices is proximity to closest border[7]. In this case, ignoring the alternative sources of external exposure introduces an omitted variable bias. To address this limitation we reconstruct the measure of trade costs, as the shortest distance to the nearest border.

Table 6 contains the results when we include the interaction of distance from the nearest border and tariffs in the regression. Once again, the coefficient on foreign prices is significant at 1% and positive but not substantially different from the earlier regression results. The estimate on tariffs is also correctly signed – positive, statistically significant at 1% and very similar in size to those in previous estimations shown in Tables (4)-(5).

The coefficient associated with the interaction between distance from the nearest border and tariffs is not significant, rejecting the hypothesis that the tariff pass-through decrease the further you are from the border regions. This result is robust to the inclusion of other control.

In contrast to previous results in table 5 the interaction of foreign price and distance turns out negative and statistically significant at 5 % level. This result indicates that compared to interior districts, the effect of external shocks in stronger on districts close to external borders. This finding is consistent with the hypothesis indicating that external shocks affect border regions more than interior regions. This results gives us two insights. First, that the net effect of tariff reforms under the regional trade arrangements have increased exposure of all

[7] For example, districts in the Northern region are exposed to inflow of goods from East African countries such as Tanzania and Kenya that have a free trade arrangement with Zambia.

border regions to external competition compared to interior regions. Secondly, the result, also points to the possibility that our earlier results suffer from an omitted variable bias. This warrants further investigation of the channels through which trade affects local prices.

Table 6: Internal Trade costs and tariff-pass-through (nearest border)

Regressor	(1)	(2)
ln(foreign price)	0.187***	0.200***
	(0.0182)	(0.0189)
ln(1+tariff)	0.640***	0.631***
	(0.195)	(0.196)
ln(ln(1+tariff))×ln(nearestborder_distance)	0.0263	0.0271
	(0.0217)	(0.0220)
ln(foreign price)×ln(nearestborder_distance)		-0.00245**
		(0.00120)
ln(nontraded input prices)		0.0279
		(0.0209)
Constant	6.719***	6.497***
	(0.142)	(0.232)
Observations	9,286	9,286
R-squared	0.947	0.947
Product FE	Yes	yes
Year FE	Yes	yes
District FE	Yes	yes

Note: distance is measured from the nearest border of countries that include border with Malawi, Tanzania, Zimbabwe/Botswana. Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6.2.4. Distance an Infrastructure quality

The results so far find no differential impact of tariff pass-through across geographic regions. A potential reason for this is that we are using a wrong indicator of trade costs or distance. In particular, distance ignores the importance of road quality in driving the transportation costs across regions. A good road network lowers the per unit costs transportation of products (Cavailhes, Gaigné, Tabuchi, & Thisse, 2007). This affects the pass-through of external shocks to local prices in two ways. Lower transport costs fosters competition and a reduction in the price level. (Coşar & Fajgelbaum, 2013) and (Du, Wei, & Xie, 2013) show that cities

linked to high quality road infrastructure within a country tend to face high competition among retailers and firms in general[8].

Another explanation for this possibility is that it ignores the effect of infrastructure quality to the concentration of retail services. For example, the liberalisation of tariffs in Zambia promoted the inflow of chain supermarkets in the retail sector investment from South Africa. For commercial reasons, supermarket chains initially setup in relatively large cities and districts especially (cities and municipalities) linked to highways. These regions also tend to have larger populations, making them attractive to retail sector investment, creating the *gate effect* relative to remote regions. We counter the potential effect of mismeasuring trade costs arising from ignoring the quality of transportation infrastructure by interacting tariffs with a highway indicator –which gives us the geographical effect based on the equation:

$$\ln P_{jkt} = \beta_0 + \beta_1 \ln P_{jt}^N + \beta_2 \ln P_{kt}^B + \beta_3 \ln(1+\tau_{kt}) + \beta_4 \ln(1+\tau_{kt}) \times highway_j \\ \beta_5 \ln P_{kt}^B \times highway_j + \lambda_k + \lambda_j + \lambda_t + \xi_{jkt} \qquad 17$$

where $highway_j$ is a binary variable taking 1 if the district (municipality or city) is on the tarred highway and zero otherwise. The coefficient on the interaction term between tariff rates and the road quality dummy β_4 is expected to be positive. The working hypothesis is that the pass-through of tariff liberalisation to domestic prices is higher in districts located along quality road infrastructure compared to largely smaller remote districts.

The ensuing estimation results are presented in table 7. All signs match our theoretical expectations and are with the exception of the price of nontraded input prices, statistically significant at significant at 1% level. Consumer prices increase with tariffs and the magnitudes of the estimated coefficients (of β_3 ranges from 0.60 to 0.64) are not substantially different from the preceding regressions. Similarly, the level of significance and size of the average coefficient (0.18) of the foreign price shocks is robust to our new innovation. Consistent with our earlier findings, the estimates on these two variables indicate significant but incomplete and partial pass-through of external trade shocks to average prices.

[8] We do not have data on Road quality by road segment. Therefore, we limit our road infrastructure quality measure to tarred highways.

The key variable of interest - the coefficient associated with the interaction between the tariff rate and the highway indicator is positive and statistically significant at 1% level. The coefficient on this interaction indicates that a 10 % reduction in tariffs reduces consumer prices by 2.2% in cities and municipalities cities linked by quality transportation infrastructure compared to off-highway districts. Column (2) controls for the prices of nontraded inputs but remains insignificant without any effect on other variables.

Table 7: Highways and tariff pass-through to retail prices

Regressor	(1)	(2)	(3)
ln(foreign price)	0.186***	0.186***	0.174***
	(0.0182)	(0.0182)	(0.0185)
ln(1+tariff)	0.640***	0.639***	0.603***
	(0.174)	(0.173)	(0.174)
ln(1+tariff)×*highway*	0.221***	0.221***	0.268***
	(0.0767)	(0.0767)	(0.0786)
ln(nontraded input prices)		0.0265	0.0263
		(0.0206)	(0.0205)
ln(foreign price)×*highway*			0.0225***
			(0.00540)
Constant	6.726***	6.493***	6.399***
	(0.142)	(0.228)	(0.227)
Observations	9,286	9,286	9,286
R-squared	0.947	0.947	0.947
Product FE	yes	Yes	yes
Year FE	yes	Yes	yes
District FE	yes	Yes	yes

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

Column (3) introduces the interaction between foreign prices and highway indicator to evaluate whether the pass-through of foreign prices differ by geographic areas. As expected, the result finds that pass-through of foreign prices is greater in areas linked to major highways.

Overall, comparisons across countries are difficult given different units, products and time periods. However, our results of the interaction variables are in line with the literature that find heterogeneous effect of trade policy shocks across geographic areas. Studies employing demographic survey data find qualitatively consistent results as ours despite using incomparable datasets. For example Han et al., (2014) find the spatial pass-through of 29 % in regions with higher private sector concentration across Chinese cities. In the case of

Mexico, Nictita (2009) found that the pass-through of tariffs declined from 70% at the border region to 40% at regions that were1000km away from the border. Similarly, Ural Marchand (2012) finds that 64 to 68 % of the tariff cuts are passed onto urban consumer in India compared to 33% to 50 rural towns. Our findings confirm the existing evidence of considerable variations in the tariff pass-through across geographic areas within a country.

In short, the important insight from this result is that spatial frictions matter, and greatly impact on the effectiveness of regional integration efforts to foster intra-country market integration. Particularly, internal trade costs captured by the quality of transportation infrastructure of countries engaged in product market integration scheme play an important role in determining the extent to which the country becomes internally integrated and improves welfare across regions. This result is consistent with other studies on the availability and quality of transportation infrastructure in driving internal economic outcomes, such as price integration and welfare distribution (Behrens et al., 2007; Coşar & Fajgelbaum, 2013; Teravaninthorn & Raballand, 2009)

6.3. *Product Heterogeneity and Tariff pass-through*

One key fear in the standard estimation of the average and spatial transmission of changes in tariffs to destination prices is that the estimation strategy pools all products together without accounting for differences in product characteristics. With the huge product heterogeneities, the key transmission mechanism of reductions in tariff rates may also depend on their individual characteristics. Therefore standard tariff pass-through estimates as above could be masking the important composition effects that impacts on the average pass-through rate. This section extends the tariff pass-through literature by investigating the effect of product heterogeneity on the pass-through of tariff shocks to local prices. In particular we consider the role played by product tradability, as an alternative to trade costs in driving the pass-through of tariffs onto retail prices.

6.3.1. *Product tradability*

Theoretical and empirical evidence from the price integration literature show that the degree of market integration differs according to the tradability of individual products. The extent to which a good is traded depends of whether the cost of arbitrage make trade profitable of not. At a micro level, the tradedness of a product is an endogenous response to explicit trade costs that vary heterogeneously across goods- with low cost products likely to more traded than the high trade cost products.

Since import penetration is inversely related to trade costs, we use trade as a share of output as alternative product specific indicator of tradability. In theory, we expect product with high trade-output ratio to be more exposed to external shocks and experience larger tariff pass-through compared to less traded products. To assess the role tradability as an alternative indicator of trade costs across heterogeneous products, we introduce interactions between import-tariff changes and the tradability index that varies across products. We also control for the effect of fluctuations in foreign price on tradability by including the interaction of the two variables extends the empirical framework to:

$$\begin{aligned}\ln P_{ikt} = {} & \alpha + \beta_1 \ln P_{kt}^{B} + \beta_2 \ln(1+\tau_{kt}) + \beta_3 trad_k \times \ln(1+\tau_{kt}) + \beta_4 trad_k \times \ln P_{kt}^{B} \\ & + \beta_5 \ln(pr\_ntd_{it}) + \lambda_i + \lambda_k + \xi_{ikt}\end{aligned} \qquad (16)$$

The effect of tradability on the tariff pass-through is measured by the coefficient β_3 . Since tradability which varies by product only is multiplied by tariffs, this coefficient measures the tariff pass-through that varies by across products. The estimate on the tariff rate β_2 capture the tariff pass-through unrelated to product characteristics. If product tradability systematically increases the pass-through rates the coefficient β_3 should positive. The total pass-through for product k is thus given as $\beta_3 trad + \beta_2$. Since tradability only varies over products and not overtime with product fixed effects, its level estimate drops out of the regression.

The estimation results of the estimated coefficient of interest for equation 14 are presented in Table 4. The coefficient on the tariff-tradability interaction is positive and significant at 1% level across the three regressions. The result suggest that suggest that a product whose

tradability is 1 has a pass-through of 0.85, which is statistically not different from 1 whereas a product with a tradability of zero has a pass-through of 20% and is insignificantly different from zero. This result confirm our hypothesis of greater pass-through of tariffs onto more traded products than less traded goods markets.

Table 8: Product tradability and tariff pass-through

Regressor	(1)	(2)	(3)
ln(foreign price)	0.159***	0.203***	0.204***
	(0.0214)	(0.0269)	(0.0272)
ln(1+tariff)	0.208	0.304	0.319
	(0.215)	(0.217)	(0.215)
ln(1+tariff)× tradability	0.845***	0.641***	0.611***
	(0.103)	(0.115)	(0.119)
ln(foreign price)×tradability		-0.0839***	-0.0840***
		(0.0229)	(0.0236)
ln(nontraded input prices)			0.0710***
			(0.0200)
Constant	6.905***	6.892***	6.273***
	(0.177)	(0.181)	(0.281)
Observations	9,286	9,286	9,286
R-squared	0.945	0.945	0.945
Product FE	yes	Yes	Yes
Year FE	yes	Yes	Yes

Standard errors are clustered at district level
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0

Next, we compute the average estimated effects of tariffs and tradability across the three columns in Table 2 and construct the net pass-through elasticity ($\beta_3 trad + \beta_2$) for the most traded and least traded products in our sample. The computed net pass-through elasticity shows imperfect pass-through of tariffs across the selected products. With the exception of electronic products like Fridges, the net pass-through is smaller than 1 ranging from 0.23 for cigarettes to 0.95 for such products as insecticides and body lotion. However, the constructed net pass-through of tariffs for household electronics stood at 1.72, which is substantially greater than 100 percent pass-through.

In columns (2)-(3), we test the sensitivity of our results to fluctuation in foreign prices by adding an interaction between tradability and foreign prices in columns (2) – (3). The coefficient of interest, β_4 is statistically significant and negatively signed rather than positive

as expected. Although the magnitude of the tariff-tradability coefficient declines, the inclusion of additional controls does not affect its sign and level of significance. One explanation of this result is the possibility that large retailers are absorb the temporal reductions in foreign prices than permanent import liberalisation.

In table 9, we test whether the pass-through of tariffs decline in the geographic areas that are more remote from highways regions. We introduce a variable interacting among tariffs, highway and measure of tradability. To evaluate whether more remote regions have lower tariff pass-through than regions along highways. The sign of the coefficient on this interaction is positive and statistically significant as expected –indicating that more tradable products and regions along highway are more exposed to international trade shocks than geographic areas further from the highways.

Table 9: Trade route, tradability and Tariff pass-through

Regressor	(1)	(2)
ln(foreign price)	0.170***	0.164***
	(0.0183)	(0.0185)
ln(1+tariff)	0.399**	0.453***
	(0.171)	(0.175)
ln(1+tariff)× *tradability*× *highway*	0.708***	0.745***
	(0.0643)	(0.0747)
ln(1+tariff)×*highwa*y		-0.132
		(0.0902)
ln(foreign price)×*highway*		0.0121**
		(0.00558)
ln(nontraded input prices)		0.0237
		(0.0203)
Constant	6.881***	6.627***
	(0.143)	(0.227)
Observations	9,286	9,286
R-squared	0.948	0.948
Product FE	YES	YES
Year FE	YES	YES
District FE	YES	YES

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

In column (2), we include other controls and our variable of key interest is significant and robust to the inclusion of the controls. However, the interaction between the highway and tariffs surprisingly becomes insignificant but also of the incorrect sign (negative). Overall, the results find that the pass-through of tariffs on differs across individual products and is

greater across regions along the highways and more tradable products. In general, more tradable products are more likely to be influenced exposed to trade policy changes while markets for less traded products respond slowly to trade reforms.

7.0. Conclusion

This paper uses highly disaggregated product level retail price data in 38 regions of Zambia to analyse the differential pass-through of tariffs to domestic retail prices across local markets. This differential analysis of tariffs is preceded by the evaluation of how integrated these regions are to the international environment. The last part tests the sensitivity of tariff pass-through to product heterogeneity as measured by tradability. The conclusions of the study are summarised as follows:

The firstly, that Zambian retail markets are not perfectly integrated in the international environment. This is in line with international literature suggesting that the LOP does not hold across countries; Secondly, tariffs play an important role in driving price differences across destination market within countries. In particular, the results reveal that regions that are more exposed to external shocks such as border regions and districts linked to quality transportation infrastructure experience greater effects of trade policy changes than interior districts. Finally, product heterogeneity in form of tradability has implications for the degree of tariff pass-through across products and across destination markets. In particular, the results find that more traded goods experience higher pass-through of tariffs compared to less traded products.

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APPENDIX TABLES
Not Fully Discussed in Main Body

Table 10: Product Characteristics and Tariff Pass-through

Product	Total Pass-through	Tradability Index
Baked beans (420g)	0.36	0.19
Body lotion(100ml)	0.95	1.03
Boys shirt	0.54	0.45
Brandy (750)	0.35	0.17
Brassiere	0.54	0.45
Bread	0.36	0.19
Carrots	0.58	0.51
Cheddar cheese (1kg)	0.36	0.19
Cigarettes (pct. 20)	0.23	0.008
Cooking oil (750ml)	0.36	0.19
Electric Iron	1.72	2.14
Instant coffee (250g)	0.36	0.19
Irish potatoes	0.36	0.19
Kettle (2.2lt)	1.72	2.14
Ladies dress	0.54	0.45
Ladies shoes	0.54	0.45
Macaroni (500gm)	0.36	0.19
Onion	0.58	0.51
Orange Squash(2lt)	0.36	0.19
Oranges	0.58	0.51
Paraffin	0.78	0.79
Peanut butter (400gm)	0.36	0.19
Refrigerator	1.72	2.14
Salt (1kg)	0.36	0.19
Shoe Polish (50ml)	0.95	1.03
Spaghetti (500gm)	0.36	0.19
Target	0.95	1.03
Tea leaves (250g)	0.36	0.19
Tomatoes	0.58	0.51
Toothpaste (100ml)	0.95	1.03
Vinegar (750ml)	0.36	0.19
Pilchards	0.28	0.07
Sugar (1kg)	0.36	0.19
Average of all products	**0.61**	**0.55**

Robustness Tests

	Highways cities		**Off highway Towns**	
Regressor	(1)	(2)	(3)	(4)
ln(foreign price)	0.223***	0.240***	0.144***	0.161***
	(0.0256)	(0.0371)	(0.0306)	(0.0373)
ln(1+tariff)	1.013***	0.397	0.469	0.231
	(0.242)	(0.259)	(0.317)	(0.343)
ln(nontraded input prices)	0.0875***	0.0847***	0.0582	0.0559
	(0.0205)	(0.0202)	(0.0381)	(0.0379)
ln(1+tariff)× tradability		0.651***		0.404**
		(0.148)		(0.175)
ln(foreign price)×tradability		-0.0957**		-0.0660**
		(0.0335)		(0.0245)
Constant	5.691***	6.062***	6.391***	6.524***
	(0.269)	(0.296)	(0.479)	(0.480)
Observations	4,797	4,797	4,489	4,489
R-squared	0.960	0.961	0.925	0.925
Product FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes