Import Tariff Pass through Effect and the Spatial Distribution of Domestic Consumer Goods Prices: Zimbabwe (2009-2014)

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PhD Thesis for Degree of Doctor of Philosophy in Economics in the

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Abstract

The study of import tariffs pass through has been observed to be crucial for policy making, for instance this may inflate some goods' prices thus having a negative effect on individual welfare. However, extant literature on the import tariffs pass through effect has largely ignored the possibility of spatial dependence between domestic goods prices which may brew imprecise estimates. Hence, this study proposes an extension of the traditional empirical model for estimating the import tariff pass through effect by introducing controls for the domestic spatial dependence of prices. The estimates rely on a panel dataset of consumer goods for Zimbabwe, which has both the individual spatial effect and the time spatial effects. Spatial econometrics model used in this study all agree that there is positive spatial dependence of domestic goods' prices in Zimbabwe over the period 2009 to 2014. When compared to our modified model, the traditional import tariffs pass through model was found to highly overestimate the import tariffs pass through effect. The study found that a positive and significant portion of import tariffs is being passed on to domestic goods prices in Zimbabwe. Thus there is need for policy to be cautious of the import tariffs increase in relation to national inflation, and poverty targets.

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1.0 Introduction

The extent to which import tariffs interact with domestic goods prices hinges on the pass through effect. This ranges from an incomplete (import tariffs change has a small effect on domestic goods prices) to a complete (entire change in import tariffs is passed on to domestic goods prices) pass through effect. In turn, this may intricately affect real economic variables like inflation, industrialisation, economic growth and household welfare (Ahn and Park, 2014). Consequently, economic development imperatives have made this topic of interest to many scholars and policy analysts, especially in developed countries. Much enquiry has dwelt on establishing the magnitude and speed at which a change in import tariffs is passed on to other economic variables - for policy purposes (Feenstra, 1989; Ludema and Zhi, 2011; Malliek and Marques, 2007; Ural, 2012; Hayakawa and Ito, 2015; Han et al, 2013). This policy relevance highlights the importance of precise estimates of the import tariff pass through effect to domestic goods prices.

In assessing the import tariff pass through effect to domestic good prices, Ludema and Zhi, (2011) and Ural, (2012) used time series and macroeconomics data in a Vector Autoregression (VAR). Their findings range from complete[1], moderate, incomplete[2] to low and fairly slow pass through. Traditional studies on the import tariffs pass through fail to establish the effects of spatial price distribution on the import tariffs pass. The spatial distribution of domestic goods prices can be random or spatially depended. The influence can be positive or negative which can also be called positive or negative spatial dependence. Positive spatial correlation means that prices in one district positively affect prices in other districts. Increasing price in one district will affect other surrounding districts. When the spatial distribution of prices is random, then there is no price relation across districts. Increasing price in one district will likely result in zero effect on prices of the surrounding districts.

The spatial distribution of domestic prices affects the resulting effect of import tariffs pass through on domestic goods prices. The failure to control for the nature of domestic spatial price distribution when commenting on the import tariff pass through is of great concern. Chances

[1] A complete pass through implies that, for example a 10 percent increase in import tariffs will also result in a 10 percent increase in domestic prices. That is, all the changes in import tariffs are completely passed on to domestic goods prices.

[2] Incomplete import tariffs pass through means that a change in import tariff will result in a small effect on domestic goods prices.

are that researchers might think that it is the import tariff pass through which is high yet it might be the nature of the domestic spatial price distribution.

In cases where domestic prices are spatially randomly distributed, then a change in import tariffs is likely to affect districts price randomly without a second round effect due to the fact that prices in different districts are not spatially correlated (Beag and Singla, 2014). If the districts prices are spatially correlated then an import tariff change will have second and third round effects, (Sekhar, 2012).

What we learn is that the nature of spatial distribution of domestic prices is important when assessing import tariffs pass through effects. Not controlling for spatial price distribution when estimating the import tariffs pass through is likely omitting an important variable in a regression, doing such a fault will bias the estimates. Traditional studies on import tariffs pass through do not control for spatial price distribution, (Malliek and Marques, 2007; Ural, 2012; Hayakawa and Ito, 2015; Han et al, 2013). Thus there is gap in literature of import tariffs pass through.

The gap mentioned above is being widened by the growing literature which model space through spatial econometrics modelling, on one hand. On the other side there are also studies on the import tariff pass through to domestic goods price. There is limited literature which combines these two aspects together. The few intra-trade studies which combine spatial econometrics and pass through are more focused on agriculture products and they use granger causality and pairwise cointergration to determine spatial distribution of prices between different markets, (Jayasuriya et al, 2007; Beag and Singla, 2014;). Intra-trade studies on spatial econometrics by Deodhar et al, 2007; Ghosh, 2011, Salehyan and Gleditsch (2006) and Salehyam (2008) only determine the existence or non-existence of the spatial dependence. They did not focus on the connection between spatial distribution effects and pass through of import tariffs at different provinces or regions in a country.

Hayakawa and Ito, (2015); Han et al, (2013) among others, used macro level data to investigate the import tariffs pass through. They did not consider investigating the spatial effects of the import tariffs variations. A few studies on pass through which use micro-data fail to provide evidence for the spatial dependence before analysing the pass through effects, (Varela et al., 2012). This literature gap brings out the need for studies which incorporate spatial price dependence in estimating the pass through effect for a more precise analysis of the import tariffs pass through effect. In that respect this study seeks to combine these two methodologies as it contributes to the existing body of knowledge.

This study intends to use data from Zimbabwe to contribute to the literature gap mentioned above. A review of trade studies point to deficiency of import tariffs pass through studies focusing on Zimbabwe, (Hayakawa and Ito, 2015; Mugano et al., 2013). The recent hyperinflation, adoption of multiple currency and the use of a fiscal cash budget make it interesting to undertake an import tariff pass through study on Zimbabwe, (Zimbabwe Economic Policy and Research Unit, 2012; Reserve Bank of Zimbabwe, 2014; Confederation of Zimbabwe Industry, 2013). A country not using its own currency has limited power to influence its exchange rates. Such a country takes the exchange rate as given and thus has limited policy influence as it can only adjust the import tariff rates to affect the flow of trade. Literature shows a growing number of countries adopting other countries currency. These countries include Ecuador, Liberia, Zimbabwe and Guatemala (Minda, 2005). With the growing pressure towards currency unions such countries will soon be on the increase.

Mugano et al., (2013) focused on Zimbabwe but the study looked only at the impact of most favoured nation tariffs rate on Zimbabwe. The study did not include other import tariffs types hence exclude trade between Zimbabwe and the rest of the World. Zimbabwe does trade with the rest of the world thus trade policy in Zimbabwe should inculcate all countries.

In light of the above research problems, the studies main objective is to combine spatial econometric and the pass-through literature in analysing the spatial distribution of prices in different districts of Zimbabwe. Prices survey data from the Zimbabwe statistical agency, import tariff rates from Zimbabwe revenue authority and Zimbabwe shape files are going to be used in the analysis. This study aims at contributing to knowledge through building an import tariffs pass through model which controls for spatial distribution of prices. The study will also contribute to existing literature as it uses micro-data for Zimbabwe over the period 2009 to 2014. It is also important to state the unique economic system that Zimbabwe went through during the period under study.

1.2 Background of the Zimbabwean Economy

In 2009 the Zimbabwean government adopted the multiple currency economic system. This economic system allowed the use of multiple currencies as legal tender in Zimbabwe (Government of Zimbabwe, 2009). At such a time, the Zimbabwean currency was dysfunctional following its rejection by Zimbabweans after the hyperinflation period of 2000-2008. Such an economic system meant that the Reserve Bank of Zimbabwe was not printing money and had no opportunity to use the exchange rate to influence economic variables. It should also be noted that during the same period, the Zimbabwean government adopted the cash budgeting system in managing national income and expenditure (Government of Zimbabwe, 2009). A cash budget system meant that the country could not borrow either domestically or internationally to finance government expenditure. Thus, the government was depending on tax which included import tariffs to generate government revenue. During the same period household welfare was highly suppressed with about 62.6 percent of Zimbabwean residents living in poverty and 16.2 percent living in extreme poverty. The proportion was also higher for rural than urban households, 76 percent versus 38.2 percent, (Zimbabwe statistical agency, 2014). These unique economic characteristics make it interesting to research on how the issue of import tariff pass through affected the domestic prices.

Prior to the 2009- 2014 period, Zimbabwe had implemented multiple macroeconomic policies which had effects on the import tariffs and the domestic goods prices. After attaining independence in 1980, the Zimbabwean government implemented policies which were targeted towards empowering the poor and most vulnerable groups of the population, (Tereke, 2001). In doing that they promoted industrialisation through import substitution which meant rising import tariffs with the objective of protecting and promoting domestic industries. In the period 1994-1996 the Zimbabwean government embarked on the Economic Structural Adjustment Programs (ESAP) which was highly towards liberalisation of the economy, (Chitiga, 2004). ESAP meant that import tariffs and other trade restrictive measure were to be reduced as the country focused on export oriented growth strategies.

After abandoning ESAP, the country reversed the liberalisation strategies which included rising import tariffs as it went back to protect the domestic industries (Tekere, 2001). With the growing bilateral and multilateral trade agreements such as SADC, COMESA, the countries import tariffs had to be reduced as the country was aimed at facilitating trade with its regional counterparts. However, there was a problem of reducing import tariffs to promote regional trade at the expense of exposing domestic industries to external competition. The research is more interesting given the unique characteristics of the Zimbabwean economy during the period under study. Due to the multiple currency and the cash budgeting, the government needed to generate revenue through taxes like import tariffs. The findings of the study will therefore show the effects of import tariffs changes on the domestic prices and household welfare.

1.3 Spatial differences in Zimbabwe

There are generally four reasons why prices in Zimbabwe are highly likely to be interdependent. Firstly, Zimbabwe is relatively small in size thus districts are close to each other which means what happens in one district is quickly communicated to another district. Secondly, the Zimbabwean economy is highly central with most markets being highly centralised as well. Some good examples are the markets for grain-maize, fresh vegetables, cotton and tobacco. Tobacco and cotton produced from different districts will find its way to Harare, the capital city where the central market and auctions of tobacco and cotton are located. This would mean a strong cotton price dependence between Harare and the major cotton producing district namely, Gokwe South, Mbire, Chiredzi, Kadoma and Mwenezi district, (Cotton Company of Zimbabwe Limited, 2018, Agriculture Marketing Authority, 2017). The price dependence would be much stronger among the districts which are closer to each other and would be expected to fade away as the distance between the districts grows. The same goes with fresh vegetables from different districts which also find their way to Harare-Mbare where the biggest vegetable market is located.

Thirdly, during the period 2009-2014 the local industrial capacity was low thus most goods which were being consumed in Zimbabwe were being imported. Over the same period South Africa was the biggest trading partner of Zimbabwe. This means that most of the goods in Zimbabwe were coming from the same source, thus price of these goods in different districts in Zimbabwe are bound to be equally influence by the economic condition in South Africa. The price of same imported products would be depended in different districts factoring in the distribution costs like transport, packaging and regulation factors.

Fourthly, the hyperinflationary period of 2006-2008 created a strong interconnection of markets in Zimbabwe. Prices of goods would change more rapidly and retailers had to keep up with price changes as they fear failure to restock their shops. This interconnectedness can best be explained with the black market of forex. The black markets of forex in different cities were all connected to what was happening in the capital City-Harare. A change of the exchange rate in Harare would be timely communicated to other cities as they tried to keep-up. This market chain arguably had some time lags but it shows the strong connectedness of markets in Zimbabwe.

Before determining the spatial distribution of prices and the spatial effects of import tariffs, it should be noted that the historical spatial settlement, rainfall patterns and agriculture regions already gives an indication of price difference across regions. Prior to the 1980 independence, the European White settlers relocated the black Zimbabweans to less fertile and semi-arid regions. Zimbabwe is generally divided into 5 Natural Farming Regions (NFR) as shown in Table 1 below.

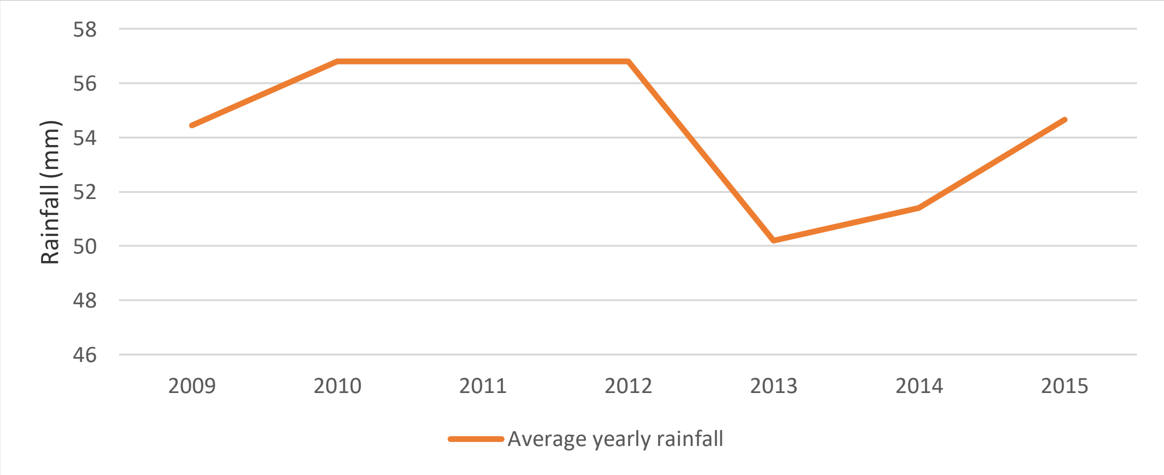
Table 1: Natural Farming Regions in Zimbabwe

Natural Farming Region	Province covered	Characteristics
1	Manicaland	1050mm or more rainfall per annum, relatively low temperature
2	Mashonaland East, Harare, Mashonaland Central	700-1050 mm rainfall per annum
3	Mashonaland West, Midland	500-700mm rainfall per annum, relatively high temperatures, subjective seasonal droughts
4	Matebeleland North, Matabeleland South	450-600mm rainfall per annum and subject to frequent seasonal droughts
5	Masvingo	less than 500mm rainfall per annum poorer soil

Source: Dube (2008)

White settlers forced the black Zimbabweans to move from NFR 1 and 2 into NFR 3, 4 and 5 which have high temperatures and receive lower rainfall (Dube, 2008). Provinces in NFR 1 and 2 also happened to have better roads and railway infrastructure and most agriculture industries are located in these provinces, (Dube et al., 2013). Though the 1980 independence tried to address this disparity, the effects are still being felt. This means that prices of agriculture products are expected to be higher in NFR 3, 4 and 5. However, this is subject to receiving of good rainfall and good national economic performance. Recently the country has not been receiving enough rainfall as shown in Figure 1 below. Over the period under study, the country received a yearly average maximum rainfall of 56.7 millimetres between 2010 and 2012, and a minimum yearly average rainfall of 50 millimetres in 2013. The economic performance of the country has also been subdued. This has resulted in the economy depending more on imported product. Thus, benefiting more, regions which are located closer to the country’s major trading partners like South Africa, Botswana and Namibia. This situation would mean that prices are expected to be lower in Matebeleland North, Matebeleland South and Masvingo provinces.

Figure 1: Average Yearly Rainfall

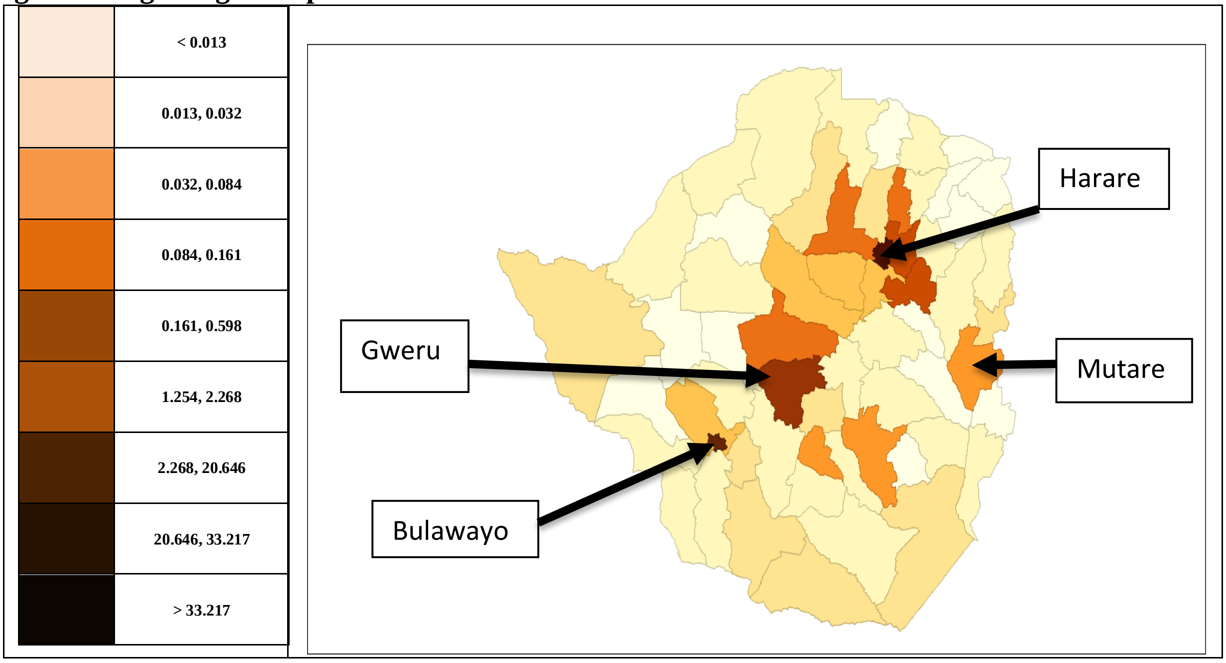


Source: World Bank Climate Data Portal (2018)

Another indicator which can also show the a-priori spatial difference of prices in Zimbabwe is the level of economic activities across different districts. Night light has been used as a proxy of measuring economic growth or the level of economic activities, (Ebener et al., 2005; Doll et al., 2009 and Xi et al., 2010). In Figure 2 below we present the spatial map of night light in Zimbabwe for the year 2012. The data used in the map was taken from QGIS Rasta files.

What we can observe from Figure 2 below is that levels of economic activities highly vary across different districts in Zimbabwe. On the map below the darker the colour the more the night light intensity, which implies higher economic activity. We can notice that Harare and Bulawayo have the highest levels of economic activities followed by other districts like Mutare, Gweru, Zvishavane and Marondera among other districts. The distribution of the night light intensity highly represents economic activity as we also have industrial hubs or mining activities in the districts with high night light intensity. A district located closer to an industrial hub in highly likely to enjoy lower price of the goods produced with the industries close to that district. Following the price gravity model, price varies with distance (Goldberg and Campa 2010). Therefore, districts far away from the industrial hub are bound to have higher prices. Thus the map provides a-priory information of how prices in Zimbabwe are likely to be distributed.

Figure 2: Night Light Map of Zimbabwe for the Year 2012



Source: https://www.arcgis.com/home/item.html?id=6e30256ec1da4f8a9d13a110db4508ec

This section provides the motivation of the study. As discussed above, it is clear that there is a literature gap. The gap is on establishing the import tariff pass through to domestic goods prices for a country using a cash budget and a multiple currency economic system. In light of the above problems, the study seeks to investigate the spatial distribution of the domestic prices and then establish the import tariff pass through to domestic price across the districts and the products. In addressing the problems, the study will use data for Zimbabwe from 2009 to 2014. The rest of the study will be structured as follows; section 2 will elude on the theoretical and empirical literature review. Methodology and data description will be shown in section 3 and the findings of the study will then be presented and analysed in section 4.

2.1 Theory of import tariffs pass through to domestic goods prices

The theoretical model of import tariffs pass through to domestic goods prices highly borrows from the law of one price (LOOP) which encompasses the works of Engel and Roger (1996); Ceglowski (2004) and Goldberg (1996) among others. The LOOP states that in a well-functioning economy, the price of similar goods should be the same in different places or regions, subject to transport cost. If at one point the price of say bread is $1 in region A and $2 in region B then, traders would arbitrage by buying bread from region A and selling it in region B. Over time prices in both markets will change in response to the forces of supply and demand such that the disparities will disappear as prices conform to the LOOP (Rogoff et al., 2001).

Evidence has shown some inconsistencies in prices meeting the law of one price. Some studies have pointed to the movement towards the LOOP being currently slower compared to the situation in the fourteenth and thirteenth centuries (Maurice and Rogoff, 2000; Alan, 2000). The main drivers of the failure of prices to conform to the LOOP have been cited as growing domestic nominal price rigidities, high nominal exchange rates volatilities, market segmentation, capital controls, coordinated financial regulation and coordination in trade policies (Rogoff et al 2001).

Other evidence for the failure of the LOOP is that goods have different attributes even when they are similar and also that consumers have imperfect information about prices in different places (Ceglowski, 2003). This study acknowledges the growing evidence of the failure of the LOOP and accepts that prices are different across regions even after accounting for transport cost and exchange rate variation. Against this backdrop, we assume that the consumer basket comprises of imported and domestically produced goods. Betts and Devereux (2000) noted that imported goods prices are temporarily rigid if markets block the transmission of import tariffs to domestic goods prices. Obstfeld and Rogoff (2001) also pointed out that import tariffs pass through to domestic goods prices is influenced by whether prices are set in producer or local currency. Prices are relatively sticky downwards in the producer’s currency. Thus the production and distribution channels affect the pass through mostly if intermediate inputs are imported. These models consider all the economic agents in an optimisation behaviour to explain the effects of the import tariffs on the domestic goods prices. This study focusses on the price function and acknowledges that the price setting dynamics affect the import tariffs pass through, and also that the average unit price of goods is a function of domestic and imported goods prices.

2.2 Incorporating domestic price dependence into import tariff pass through analysis

The theoretical framework follows closely the work for Engel and Rogers, (1996). We also assume a mark-up over marginal cost and a Cobb-Douglas production function. Thus, the average unit price of good 1 in location/district j, P_{1j} can be represented in the form:

$$P_{1j} = \mu_{1j}(P^D)^{\gamma}\left(P_{1j}^I\right)^{1-\gamma} \text{.......3.1}$$

μ_{1j} is the mark-up over marginal cost of product *1* in district j, P^D captures domestically sourced intermediate input, P^I captures imported intermediate input and $\gamma < 1$ is the substitution effect between imported and domestically sourced inputs. If $\gamma = 1$ then the P_{1j} will be produced only using domestic sourced inputs. When $\gamma = 0$ then P_{1j} will only be produces using imported inputs. The cases of $\gamma = 1$ and $\gamma = 0$ are extreme cases. Lets assume the price P_{1j} to be made up of a share of domestic and imported inputs. Furthermore we assume that the price of imported goods P_{1j}^I is made up of import tariffs and other distribution constraints variables *X* which include distance of district *j* from the border , money supply, exchange rate, distance from the industrial hubs among other factors that may affect the price imported inputs P_{1j}^I. The idea is that the faraway is district *j* from the border will increase the cost of distributing the imported input thus adding on the final price of the imported inputs. Assuming the quantity theory of money thus increase in the money supply will affect P_{1j}^I also after factoring the marginal propensity to import. Importing a good involve the exchange rate, thus the appreciation or depreciation of the exchange rate will definitely alter the price of imports. Then P_{1j}^I will be expressed as:

$$P_{1j}^I = P_1^B(1 + t_1) + X \text{.......3.2}$$

Where P_1^B depicts prices of imported inputs at the border before import tariffs are added, *t* is the ad valorem import tariffs rate of product P_{1j}^I at a given time *X* is a vector of control variables mentioned above (distance of district *j* from the border , money supply, exchange rate, distance from the industrial hubs among other). Due to possible spatial correlation of goods prices we add another component ρP_{1k}^I to equation 3.2. Where ρ represents the correlation between prices P_{1j}^I of imported good 1 in district *j* and price P_{1k}^I of imported good 1 in district *k*. Thus 3.2 can be re-written as:

$$P^{I}_{1j} = P^{B}_{1}(1 + t_1) + \rho P^{I}_{1k} + X \ldots\ldots\ldots 3.3$$

When there is spatial price randomness, meaning prices in one district are not correlated with prices in another district then $\rho = 0$ and we revert to equation 3.2. If there is price spatial dependence then $\rho \neq 0$ which means prices in one district are a factor of prices from other surrounding districts. What should be noted from 3.3 is that price P^{I}_{ik} is also affected by import tariffs *t* and it is also affected by prices from other districts such that P^{I}_{ik} can be expressed as;

$$P^{I}_{1k} = P^{B}_{1}(1 + t_1) + X + \rho P^{I}_{1l} \ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.4$$

If we substitute 3.4 into 3.3 we get

$$P^{I}_{ij} = P^{B}_{1}(1 + t) + X + \rho P^{B}_{1}(1 + t) + \rho X + \rho^2 P^{I}_{1l} \ldots\ldots 3.5$$

It should also be noted that P^{I}_{1l} is also affected by import tariffs *t* and also affected by prices from other districts. Without loss of generality we can assume that we only have three districts which are districts *j*, *k* and *l*. However, in reality these districts can go even up to 100. Transforming 3.1 into logarithms, substituting 3.5 and differentiating with respect to import tariffs *t* we get;

$$\frac{\partial log P_{1j}}{\partial t} = \frac{(1-\gamma)P^{B}_{1}(1+\rho)}{P^{B}_{1}(1+t)(1+\rho)+X(1+\rho)+\rho^2 P^{I}_{1l}} \frac{\partial P^{I}_{1l}}{\partial t} \ldots\ldots\ldots 3.6$$ [3]

Given that $\gamma < 1$, then $\frac{\partial log P_{1j}}{\partial t} > 0$ ……3.7

which means, there is a positive relationship which is less than 1 between unit price of product *1* and import tariffs at location *j*. This scenario is called partial import tariff pass through. For example, this implies that a 10 percentage increase in import tariffs will result in less than 10 percent increase in prices of domestic goods (Mudende, 2013). The extreme cases are when 100 percent or 0 percent of changes in import tariffs are passed-through to goods prices. The

[3] $log P_{1j} = log \mu_{ij} + \gamma log P^{D} + (1-\gamma) log P^{I}_{1j}$…….3.1.1

Substituting 3.5 into 3.1.1

$log P_{1j} = log \mu_{ij} + \gamma log P^{D} + (1-\gamma) \log[P^{B}_{1}(1+t) + X + \rho P^{B}_{1}(1+t) + \rho X + \rho^2 P^{I}_{1l}]$… 3.5.1

Differentiation 3.5.1 with respect to import tariff *t*

$\frac{\partial log P_{1j}}{\partial t} = \frac{(1-\gamma)P^{B}_{1}(1+\rho)}{P^{B}_{1}(1+t)(1+\rho)+X(1+\rho)+\rho^2 P^{I}_{1l}} \frac{\partial P^{I}_{1l}}{\partial t}$…….3.6

degree of the pass-through determines the power of import tariffs in influencing the substitution between domestic and imported goods.

When $\rho = 0$ that is spatial price randomness, then

$$\frac{\partial logP_{1j}}{\partial t} = \frac{(1-\gamma)P_1^B}{P_1^B(1+t)+X+P_{1l}^I}\frac{\partial P_{1l}^I}{\partial t}\text{...........}3.8$$

When $\rho \neq 0$ that is spatial price dependence then we will revert to equation 3.6. Equations 3.6 (positive spatial dependence), 3.8 (spatial randomness) show that the effect of import tariffs changes highly depends on the nature of the spatial price distribution. Positive spatial dependence also means that when price is decreasing in one district that price decrease will also be propagated to surrounding district depending on how close the districts are to each other. The aspect of spatial weights matrix will be introduced in the next section as it focuses on the closeness of the districts to each other. This finding has implications on the import tariff pass-through effects. What we can conclude is that the effect of an import pass-through highly depends on the nature of the spatial distribution of domestic goods prices. In later sections this argument will be tested using empirical regression estimations.

It should be noted also that it is not always the case that the effect of import tariffs on product *1* is the same across all the districts, such that;

$$\frac{\partial logP_{1J}}{\partial t_1} \neq \frac{\partial logP_{1k}}{\partial t_1}\text{.........}3.9$$

where $j \neq k$. Regions which depend highly on imported goods should be seen reacting relatively more sensitive to import tariffs rate changes compared to other regions (Moodley and Gordon, 2000). The same goes for regions close to industries which highly depend on imported materials. This shows the importance of including location in analysing regional price differences. Another issue that should also be noted is that the speed and magnitude of import tariffs effects on goods prices in different districts are bound to be non-uniform. Thus, showing the need of adding space in analysing import tariffs pass-through to domestic goods prices.

Using equation 3.6 we also observe ceteris paribus that if ρ and X increase independently the $\frac{\partial logP_{1j}}{\partial t}$ which is the import tariffs pass-through will decrease. Thus increase in the magnitude of the spatial dependence and the increase of distribution constraints is associated with a decreasing import tariffs pass-through. In the same token we notice that as the imported and domestic input substitution effect γ decrease the import tariffs pass-through increase. Which means it become difficult to pass-through a larger share of import tariffs when a greater portion of imported input are used to produce domestic goods.

2.3 Empirical literature review

This section reviews the empirical literature on import tariffs pass through to domestic goods prices. The idea is to show a gap in literature of limited studies on import tariffs pass through which controls for space. Import tariffs pass through effect measures the magnitude and the speed of how an import tariffs change is passed on to domestic goods price.

There are some previous studies which specifically look at how import tariffs are passed through to domestic goods prices (Ludena and Zhi, 2011; Malliek and Marques, 2007; Ural, 2012 and Hayakawa and Ito, 2015). Ludena and Zhi (2011) used the Melitz and Ottavian (2008) model to explore import tariff pass-through at the firm level. Their study showed that import tariff pass-through effect depends on firm heterogeneity, product differentiation and productivity. The incomplete tariffs-pass through was observed to originate from the fact that firms absorb import tariffs changes as they adjust mark-ups and product quality. The study also found the pooled regression model to over-estimate the import tariffs pass-through relative to the Melitz and Ottaviano (2008) model. The paper used U.S transaction-level export data and plant level manufacturing dataset. A similar study by Malliek and Marques (2007), investigated a combination of exchange rate and import tariffs for India over the period 1990-2001. The research found that import tariffs pass-through is complete in 6 industries which includes pharmaceuticals, specialised machinery, rubber, transport among others, but incomplete in 36 out of the 42 industries. The study observed that exchange rate pass-through is more dominant relative to import tariff pass-through. Import tariffs pass-through was observed to decrease with industries share of imports.

In a similar study Ural (2012) estimated the effects of market structure, size of the private sector on the transmission of import tariffs from the border to consumers in urban China. The paper postulates that imperfect market structures are likely to result in less price decrease following a reduction in import tariffs as profit margins and mark-ups absorb the tariff change for the case of China. About 35 percent of the import tariffs were estimated to be passed through to domestic prices for the incident of average size private sector. Feenstra, (1988) observed an identical long-run pass-through of import tariffs and exchange rate. Import tariffs pass-through was shown to be perfect for Japanese motor cycle import to U.S, and only 60 percent of import tariffs were pass-through to domestic goods prices in the case of importation of trucks. Thus import tariffs pass-through is postulated to vary with products. Hayakawa and Ito (2015) went beyond country specific import pass-through and looked on the global average import tariffs pass-through. The study used data from 174 exporting countries over the period 2007-2011. The traditional non-spatial econometric model was adopted which controlled for exchange rate and the size of the countries using their Gross Domestic Products. The study found that a 10 percent reduction of applied tariffs rate raises import price by 2-3 percent margin.

Table 2 below gives a summary of studies on import tariffs pass through to domestic prices. Although there are some studies which combine exchange rate and import tariffs pass through, there is need to separate these two effects for policy analysis purpose. The need to separate the effects of exchange rates and import tariffs on the domestic goods price becomes important mostly for those countries which are not using their own currency. Over the years we have seen a growing number of countries that have abandon their own currencies and adopted currencies of other countries.

Table 2: Summary Table of Pass through Studies

Authors	Model	Findings
Ludema and Zhi (2011)	Extended Melitz and Ottaviano (2008) model using US firm level data	Import tariff pass through at firm level
Feenstra (1989)	Non- spatial, symmetry exchange rate tariffs model	Incomplete tariffs pass through with about 60 percent pass through rate
Kreinin (1977)	Non- spatial import tariffs pass through model	Import tariff pass through rate of 60 percent in US following the Geneva round of negotiations
Malliek and Marques (2007)	Non-spatial pass through in a using panel dataset	60 percent import tariff pass through following trade liberalisation in India
Ural (2013)	Non-spatial econometric model controlling for market structure	Imperfect market structure and partial isolation is associated with imperfect tariff pass through
Hayakawa and Ito (2015)	Global non-spatial pass through model controlling for country specific characteristics	High import tariffs pass through when regional tariffs is reduce relative to when unilateral tariffs are reduced
Cadot et al (2005)	Traditional import tariffs pass through model	Incomplete multilateral, unilateral trade liberalisation
Han et al (2013)	Urban housing survey data controlling for city level and economy level	Changes in trade policy are not perfectly transmitted to consumers. China's market

	shocks in a traditional pass through model.	imperfection isolate households from trade policy changes

Source: own computation.

These countries include Guatemala, Ecuador, Liberia, and Zimbabwe among others as shown in the Table 3 below. Such countries do not have policy power to influence exchange rates as they take exchange rate as given. These countries highly depend on import tariffs rates or trade policy to influence the flow of trade. With growing movement towards currency unions, countries of such nature will soon be on the increase. Thus, there is need to separate import tariffs and the exchange rate pass through to the domestic goods prices.

Table 3: Selected Countries which Dollarized their Economies

Country	Currency used	Year
Guatemala	Quetzal and the American dollar	Since 2001
Ecuador	US dollar	Since 2000
Liberia	Liberian dollar and American dollar	Since 1945
Monaco	Euro and French franc	Euro since 2002, French franc since 1865
Micronesia	US dollar	Since 1944
Andorra	French Franc, Euro and Spanish peseta	Euro since 2002, French franc and Spanish peseta since 1278

Source: (Minda, 2005)

Focusing on the few studies which explicitly looked at import tariffs pass through to domestic prices shown in Table 2, we see that most of the studies used macro level data. One problem of using macro level data is that it does not show the dynamics of the import tariffs pass through to domestic goods prices at lower level like provincial or district level. These studies assume that different provinces/districts within a country are affected identically by the changes in import tariffs. This assumption is highly debatable due to the growing literature which shows the failure of the law of one price (Alan, 2000).

The law of one price state that in a well-functioning economy when price of identical goods across locations, economic agents will arbitrage based on the price difference across locations. Overtime the arbitraging will affect the forces of supply and demand which will result in the goods having the same price in different locations. Maurice and Rogoff (2000) pointed to the growing evidence of the failure of the law of one price. The major drivers leading to the growing literature on the failure of the law of one price include; rising nominal price rigidity, high volatility of exchange rates and product differentiation among others. Provinces closer to the borders are highly expected to respond differently to changes in import tariffs. Provinces located in industrial hubs of industries which highly depend on imported inputs should not be expected to react the same way to import tariffs changes when compared to other provinces of different characteristics. This gives an indication that different provinces within one country can be affected differently by the variations in the import tariffs rates. Thus, there is need to expand the literature of import tariffs pass through by including disaggregated level data at both location and product level.

If we consider disaggregation at product level, countries have multiple import tariff product lines which are different from each other. Import tariffs on food products are different from import tariffs on vehicles and machines. Due to this difference, countries may choose to increase import tariffs of a certain group of products while reducing import tariffs of the other group of products according to their domestic protection policy. In that same respect, prices of different goods can also vary differently overtime. The price of certain products might increase relative to another group of products. Given all these possible product variations it is important to disaggregate the analysis at product level. Studies in Table 2 can also be criticized based on their failure to separate economic shocks and variable shocks.

Given the fact that this study focuses on interregional trade, there is a need to also review studies on trade which use spatial econometrics modelling. The first point to be noted is that there are limited studies under trade which acknowledge space (Krishna and Mitra, 1998; Ceglowski, 2004; Parsley and Wei, 2007; Aker, 2010; Topolova, 2010). When investigating the distribution of prices across regions, these studies take location in absolute terms. Most of these studies use the gravity model to determine the price distribution across regions. In most of their modelling, the above studies incorporate regional differences through the use of dummies in a classical linear regression model, but fail to acknowledge the spatial dependence and the spatial heterogeneity (Adam, 1995; Rogolf, 1996; Greenway et al., 1997; Moodley and Grdon, 2000; Asplund and Friberg, 2001; Nicita, 2009; Foad, 2010).

A small group of studies under trade largely focus on space in spatial econometric modelling (Oosterhaven and Hewing, 1993; Sen and Smith, 1995; Hewing and Okuyahama, 2001; LeSaga and pace, 2005) among others. These studies emphasise on spatial dependence and spatial heterogeneity across regions. Their main argument is that everything is related to everything else but closer things are more related than distant things. This means in as much as a variable is explained by another variable, it should also be noted that variable y in location i is also influenced by variable y in location j. In that respect traditional literature which does not incorporate space when using variables with a location component, are highly affected by the problems of spatial dependence and spatial heterogeneity. Not accounting for the above problems when they are present will thus bias the estimations.

In this section we reviewed the literature on spatial econometrics and pass through effects. The section showed the literature gaps which need to be addressed. In the spatial econometrics literature, we found out that there are limited studies on trade which use spatial modelling in the pass through literature, we also found limited studies which use micro data at disaggregated level of both location and product. Most importantly we have limited studies which combine spatial economics and import tariffs pass-through effects. The literature showed limited studies which use data from a country using a multiple currency and the cash budgeting fiscal system.

3.0 Methodology

As highlighted in previous sections, this study is utilising two methodologies. The first are spatial econometrics models to determine whether there is price dependence in Zimbabwe. The second are import tariff pass through models, incorporating the spatial distribution of prices. This section discusses these respective methodologies. These are also based on the fact that the study employs a panel dataset of about 10 broad categories of goods' prices collected over 6 years (2009-2014) across 82 districts in Zimbabwe.

3.1 Determining the spatial distribution of prices.

The first objective is to determine the spatial distribution of domestic prices for selected goods in Zimbabwe. In section 2.3 we discussed that the distribution of prices may influence the import tariffs pass through to domestic prices. To determine the distribution of prices, the study intends to use spatial maps, Moran's I (Moran I948), Geary's c (Geary, 1954) and spatial dependence regression estimations[4]. The Moran's I test statistic use the z-score and it tests the null-hypothesis of no spatial autocorrelation against the alternative of spatial autocorrelation.

The Moran's statistic is defined

[4] More focus will be placed on spatial dependence regression estimation given that the Morans'I and maps are often censured in determining spatial dependence

$$I = \frac{R}{\sum_{i\cdot}\sum_{j} w_{ij}} \frac{\sum_{i\cdot}\sum_{j} w_{ij}(x_i-\bar{x})(x_j-\bar{x})}{\sum_{i}(x_i-\bar{x})^2} \ldots\ldots 3.10$$

Where $\bar{x}$ is the mean of x and w is the spatial weight matrix. Moran's I also use the expectation and a complicated variance. If the values of I is larger (smaller) than its expected value, then we conclude that x has a positive (negative) spatial dependence. This means that values of x in surrounding districts tends to be similar. The Moran's I measure global autocorrelation thus is can be influence by the distance between the locations/district. According to the Moran's I test statistic, a district which is 50 kilometers away and another one which is 500 kilometers away are all treated the same as if they are in the neighborhood. This concept slightly contradicts the Tobler (1970) first law of geography which says that, everything is related to everything else but closer things are more related than distant things.

To circumvent the limitation of the Moran's I statistic the study will also use the Geary's C statistic (Geary, 1954). The Geary's C statistic measures dependence at a local level. Geary's C statistic is defined as:

$$C = \frac{R-1}{\sum_{i\cdot}\sum_{j} w_{ij}} \frac{\sum_{i\cdot}\sum_{j} w_{ij})(x-\bar{x})^2}{\sum_{i}(x_i-\bar{x})^2} \ldots .3.11$$

The difference between 3.11 and 3.10 is found in the numerator and that is the reason why Geary C is classified as a measure of local autocorrelation. Under the null hypothesis of no global spatial autocorrelation, the expected value of c equals 1. If c is larger (smaller) than 1 then the x has a negative (positive) spatial dependence (Pisati, 2012).

The Getis and Ord G statistic can also be used to check the robustness of the spatial dependence measures mentioned above. The G statistic under this measure will be define as

$$G = \frac{\sum_{i\neq j} w_{ij}(x_i-\bar{x})(x_j-\bar{x})}{\sum_{i\neq j}(x_i-\bar{x})(x_j-\bar{x})} \ldots 3.12$$

If G is larger (smaller) than its expected value, then the overall distribution of x can be seen positive spatial dependence with a prevalence of high (low)-valued clusters (Getis and Ord 1992). When Geary's C statistic and Getis & Ord G statistic are used in conjunction with Moran's I, doing so will deepen the knowledge of the processes that give rise to spatial association, as the statistic measures enable us to detect local "pockets" of dependence that may not show up when using global statistics.

Under spatial maps of price distribution in Zimbabwe, the study employs shape files from ArcGIS and the GeoDa software program to draw the maps. The shape files have 82 districts and 10 provinces. The latitudes and longitudes of all the 82 districts are provided. District pricing data will be merged with the latitudes and longitudes coordinates in GeoDa. The Zimbabwean Statistical Agency provided the study with district monthly average prices of food products, alcohol and non-alcohol beverages, clothes, shoes, furniture, household textiles, vehicle fluids and fuels. A visual depiction of the maps serves as basis to assess the nature of price distribution across Zimbabwean districts over the period of study.

In addition to the descriptive techniques (spatial maps, Moran's I and Geary's c), the study does a more rigorous analysis of characterising price distribution in Zimbabwe through running spatial regression models that are described below. It is reiterated that the study utilises panel data of goods prices over 6 years and covering 82 districts. This dataset introduces two dimensions of spatial autocorrelation. The first is between districts, where the districts' prices might be positively or negatively spatially dependent or randomly distributed. The second dimension of spatial dependence is across time, where prices in one year might be spatially dependent with prices in the next year. Spatial regression models that are suitable for the analysis are those that account for the time difference, individual deference and the random effects in the relation. To capture this, the study runs several spatial regression models using the maximum likelihood estimation and some post-estimation tests to identify the most appropriate model given our dataset. The models to be estimated are:

1. Spatial Autoregressive Model (SAR) with lagged dependent variable which can be specified as;

$$P_t = \alpha_{lN} + \rho W P_t + X_t \beta + \mu_t \text{............} 3.13$$

For a panel data in which n units (districts) are observed for exactly T periods. The variable P_t specified as an $n \times 1$ column vector of prices and ι_n is an n×1 vector of ones associated with the constant term parameter α. Given that we have panel data were we have time and individual effects thus we depend on the model testing to show us if the appropriate model will be a fixed effect or random effect which control for individual effect, time effect or both. We denote W as an $n \times n$ matrix of spatial weights. Each element (j, k) of W denoted by $w_{j,k}$ shows the degree of spatial proximity of district j and k. It captures the network and interactions of pricing agents in districts j and k (Anselin, 2002; Pisati 2012). Notably, the diagonals of W are equal to zero as they quantify the distance between a district and itself, the rows of W are standardised such that they sum up to 1 (Kelejian and Prucha, 1998). Thus, W controls for the nature of spatial price distribution in our data. X_t is an $n \times k$ matrix of regressors with the associated parameters β contained in a k×1 vector and $\mu_t = (\mu_i, \dots, \mu_n)^T$ is a vector of disturbance terms, where ε_i are independently and identically distributed error terms for all i with zero mean and variance σ^2.

ρ is the spatial autoregressive parameter. If ρ is positive (negative) and statistically significant it implies that there is positive (negative) spatial dependence in prices an insignificant ρ implies random price distribution. Given the data for Zimbabwe there are great chances that ρ will be statistically significant. This is due to the small size of the country thus display a great closeness among districts. The centralised nature of the Zimbabwean economy is highly likely to attraction the results toward price dependence.

There is a possibility that some of the regressors in X_t are also spatially dependence. Variables like temperature rainfall are highly likely to show some signs of spatial dependence. In Zimbabwe districts which receive high (low) rainfall are mostly close to each other, the same also goes for temperature. This reasoning will lead us to our next model the Spatial Durbin model (SDM) which model such dynamics.

2. Spatial Durbin model (SDM) is a generalised SAR model which includes spatially weighted independent variables as explanatory variables. The model is specified as;

$$P_t = \alpha_{ln} + \rho W P_t + x_t \beta + \emptyset \gamma \eta_t + \mu_t \; \dots\dots \qquad 3.14$$

where (η_t), is an $n \times 1$ matrix of regressors which depict spatial dependence, γ represent is the $n \times n$ spatial matrix for these spatially lagged regressors, the other variables are as explained in equation 3.13.

3. Spatial Autoregressive model with spatially autocorrelated errors (SAC). This model combines the SAR with a spatial autoregressive error. This is specified as:

$$P_t = \alpha_{ln} + \rho W P_t + x_t \beta + V_t \dots\dots\dots \qquad 3.15$$

where $V_t = \lambda E V_t + \mu_t$. E is the $n \times n$ spatial matrix for idiosyncratic error terms.

4. Spatial Error Model (SEM). This model can be treated as a special case of both the SA and SDM. It focuses on spatial autocorrelation in the error term, thus it treats spatial dependence as a nuisance (Pisati, 2001). The model is specified as:

$$P_t = \alpha_{ln} + x_t\beta + \mu_t \ldots\ldots \qquad 3.16$$

Where $\mu_t = \lambda E v_t + \varepsilon_t \ldots\ldots$ 3.17

5. Generalised Spatial random-effect model (GSRE), which is represented as;

$$P_{1kt} = \alpha_{ln} + x_t\beta + \mu_t \ldots\ldots \qquad 3.18$$

Where $\mu_t = \lambda E v_t + \varepsilon_t \ldots$ 3.19

and $\alpha = \theta W\alpha + \eta \ldots\ldots$ 3.20

The generalised spatial model assume panel effects α are spatially correlated, α and ε_t are assumed to be independently normally distributed errors so that the model is necessarily a random effects model. We expect all the models to show a positive spatial price distribution in line with discussion in section 1.3.

The Likelihood Ratio test (LR test), Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) test values will be used to choose the most appropriate model for the dataset at use. All the three tests[5] for price distribution are expected to be consistent. The study will employ STATA version 15 estimation package to run the above regression model.

Notable, there are two approaches of constructing the spatial weights matrix; contiguity and based on distance. The contiguity approach creates the matrices based on spatial units which share common borders. Under this approach there are the Rook criterion which uses common borders, Bishop criterion which uses common vertex and the Queen criterion which uses either common borders or common vertex. For weights matrices based on distance there are the Euclidean matrix, Manhattan matrix and the Minkowski matrix (Anselin, 1988). This study intends to focus on one weight matrix but it will use other types of weights matrix for robustness checks of the regression outcomes. Appendix Table A1 provides a description and

[5] Moran's I test, spatial maps and spatial regression

measurements of the variables to be used in the models including the apriori expected relationships..

3.2 Incorporating price distribution into import tariffs pass through

The second objective of our estimation strategy entails incorporating findings of the spatial distribution analysis of prices into the import tariff pass through models. The ultimate strategy is to compare the findings of the traditional import tariff pass through model and those of this 'new' model which controls for spatial distribution of prices. The traditional specification used in the literature to investigate the import tariff pass through is presented in equation 3.21 (Liu and Tsang, 2008; Marazzi et al., 2005; Mumtaz et al., 2006; and Zubair et al., 2013).

$$\Delta logP_t = \beta_0 + \beta_1 \Delta logtar_t + \beta_2 logmon_t + \beta_3 \Delta logexc_t + \beta_4 \Delta x_t + \beta_5 y_t + \epsilon_t .. 3.21$$

Where $\Delta logP_t$ is change in the log of domestic goods prices of good *1* at time *t*, β_0 is a constant, $\Delta logtar_{1t}$ is change in log of import tariffs of good *1* at time *t* (policy consistent factor), mon_t is money supply at time *t* (policy consistent factor), exc_t is exchange rate of US dollars to South African rand at time *t*. Though Zimbabwe had no exchange rate during the period 2009-2014 most economic variables like inflation rate, poverty datum line were highly correlated with the US dollar and South Africa rand exchange rates (Zimbabwe Economic Policy Analysis and Research Unit, 2012). *X* are other region specific explanatory variables at time *t*, it also includes district temperature and rainfall. *Y* includes regional specific indicator variables for rural/urban location, year and month among others. The key variable is $\Delta logtar_t$ with its coefficient β_1. β_1 gives the percentage magnitude of how changes in import tariffs are passed on to domestic goods prices across different goods, regions and time. Appendix Table A1 describes each variable and its measurement.

In spatial dependency regression estimation, the study will adopt an appropriate spatial regression model which will be determine by the outcome of section 3. This study intends to incorporate spatial price distribution into import pass through effect analysis. In this regard a spatial weights matrix will be added to equation 3.20. Such modification will produce equation 3.22. Equation 3.22 include the spatial weights matrix following the model (Long et al., 2016; Chen et al., 2017; Tsutsumia and Tamesuea, 2011 and Wheeler et al., 2013)

$$\Delta logP_t = \beta_0 + \beta_1 \Delta logtar_t + \beta_2 logmon_t + \beta_3 \Delta logexc_t + \beta_4 \Delta x_t + \beta_5 y_t + \beta_4 W \Delta logP_t + \epsilon_t .3.22$$

The difference between 3.21 and 3.22 is the addition of the spatial component $\beta_4 W \Delta log P_t$ in equation 3.22. This component controls for the spatial distribution of prices as highlighted in section 2.3. Equation 3.22 is a spatial lagged model, the specific model to be used will depend on the most appropriate spatial model following the analysis in section 3.1 above. Similarly, the estimation technic of fixed, random or ols will also be determined from section 3.1 since the appropriate model will indicate controlling for individual effect, time effect, fixed effect among others.

3.3 Data Source and Descriptive Statistics

The analysis utilises a national representation dataset from the monthly consumer goods prices surveys produced by the Zimbabwe National Statistics Agency (ZIMSTAT), covering 60[6] districts over the period 2009-2014. The survey covers tradable goods which can be group into, Non-Alcohol Beverage, Alcohol Beverage, Cloth, Footwear, Fuel, Textiles, Vehicle Fluids and Furniture. As shown in the table 4 below[7].

Table 4: Product Groups

Product Groups	**Number of Products**
Food	18
Non-Alcohol beverage	7
Alcohol beverages	9
Clothes	50
Footwear	6
Fuels	9
Household textiles	7
Vehicle fluids	3
Furniture	8
others	2

Source: own computation.

Appendix Table A1 presents definitions and measurements of all variables used in the analysis. Pertaining our dependent variables, summary statistics of the consumer goods prices in United States of American Dollars (US$) at district level are shown in Table 5. Table 5 shows the overall, between the districts and within the years' statistics for the products prices. The overall average yearly price of all the goods is US$4.26 and we can observe some variation given by

[6] We originally had 82 districts from the shape file but only 60 could be matched from the shape files to the price surveys. The price survey had 60 district as some districts boundaries were changed thus we could not match all the 82 districts

[7] Less emphasis will be place on analysis product group "other" it has only 2 products.

the different standard deviation, minimum and maximum values when we look between the 60 districts covered and also within the 6 years. Table 5 shows different overall mean values across the products for example we have an overall mean of 2.24 for non- alcohol beverage, 5.75 for cloth, 6.97 for footwear, 17.40 for fuel among others. These mean difference greatly show the price variation across different products. The standard deviation, minimum and maximum columns also show the variation of the product prices between the 60 districts and within the 6 years. We have a standard deviation between the 60 districts of 0,78 for non-alcohol beverage, 0,42 for alcohol beverage, 1,95 for cloth among others, thus confirming the price variation between the 60 districts.

Table 5: Summary Statistics of the products prices (2009-2014)

Variable		Mean	Std. Dev.	Min	Max	Observations
All Food	overall	4.26	1.06	3.09	7.51	N = 360
	between		0.87	3.43	6.31	n = 60
	within		0.62	1.75	6.84	T = 6
Non-Alcohol Beverage	overall	2.24	1.05	0.86	5.19	N = 360
	between		0.78	1.08	3.65	n = 60
	within		0.71	0.39	3.89	T = 6
Alcohol Beverage	overall	2.57	0.54	1.76	3.86	N = 360
	between		0.42	1.92	3.31	n = 60
	within		0.34	1.76	3.44	T = 6
Cloth	overall	5.75	2.39	2.14	12.15	N = 360
	between		1.95	2.60	8.96	n = 60
	within		1.40	2.56	9.75	T = 6
Footwear	overall	6.97	3.51	1.45	14.99	N = 360
	between		3.09	2.01	10.97	n = 60
	within		1.69	2.00	11.86	T = 6
Fuel	overall	17.40	12.65	1.25	46.24	N = 360
	between		12.06	1.69	31.29	n = 60
	within		4.06	2.63	33.05	T = 6
Textiles	overall	6.61	2.66	2.39	13.23	N = 360
	between		1.96	3.16	9.80	n = 60
	within		1.81	2.53	11.29	T = 6
Vehicle Fluids	overall	6.27	3.09	1.75	13.80	N = 360
	between		2.79	2.24	9.60	n = 60

	within		1.37	3.03	12.20	T = 6
Furniture	overall	338.89	50.45	132.57	457.45	N = 360
	between		28.73	276.62	383.03	n = 60
	within		41.61	176.08	499.06	T = 6

Source: Stata output, using price surveys from Zimbabwe National Statistics Agency (ZIMSTAT 2009-2014).

Before discussing the spatial distribution of prices, the study first looks at the price differences across the 60 districts. Table 6 below unbundles the average all price variable (All goods) and show the mean price of the 8 groups of goods for the random 8 districts. Similar to table 5, Table 6 also show some price variations across the districts. A good example is an average food price of US$146.5 in Bulawayo and US$201.6 in Harare; an average non-alcohol beverage of US$159.8 in Bulawayo and an average price of US$300.8 in Mutare. This high price variation across district contradicting the LOOP.

Table 6: Average price for the random 8 districts (US$) 2009-2014

	Bulawayo	Harare	Chimanimani	Chipinge	Makoni	Mutare	Mutasa	Nyanga
Food	146.5	201.6	194.3	182.3	187.2	164.6	187.3	194.3
Non-Alcohol Beverage	159.8	292.6	281.8	298.5	300.6	300.8	291.1	279.3
Alcohol Beverage	125.8	155.8	164.8	185.2	178.3	173.2	167.8	157.5
Cloth	122.1	219.8	221.6	233.3	224.8	222.8	221.1	209.2
Footwear	159.6	249.3	250.5	269.5	264.3	261.6	256.1	240.8
Fuel	146.1	146.5	146.2	153.8	151.1	151.6	146.6	141.6
Textiles	129.3	212.6	219.3	227.8	219.3	218.1	214.6	204.3
Vehicle Fluids	97.2	209.5	214.5	163.3	158.8	157.5	208.3	254.6
Furniture	115.3	93.8	99.2	111.5	105.6	99.8	99.6	89.3

Source: Own compilation using price surveys from Zimbabwe National Statistics Agency (ZIMSTAT 2009-2014).

Moving on to the covariates used in our regressions, Table 7 presents the non-price variables' descriptive statistics. Similar variation can also be observed for example we have an overall standard deviation of 7.25 and a within standard deviation of 6.32 for import tariffs[8]. We do not have within variation for import tariffs, money supply and exchange rate as they are national level variables. Using the standard deviation for temperature and rainfall we observe variation of overall (14.24; 134.92), between (13.49; 122.02) and within (48.16; 59.34). Other variable

Table 7: Descriptive statistics for covariates

Variables		Mean	Standard Deviation	Minimum	Maximum	Observations
Imports Tariffs	overall	18.37	7.25	6.89	37.56	N = 360
	within		6.32	5.97	33.29	T = 6
Exchange rates	overall	8.58	1.38	6.72	11.46	N = 360
	within		1.36	6.63	11.11	T = 6
Money supply	overall	2867.61	1236.82	297.63	4457.26	N = 360
	within		1222.45	571.67	4354.17	T = 6
Temperature	overall	29.47	14.24	0.005	54.25	N = 360
	between		13.49	69.58	50.77	n = 60
	within		48.16	16.80	53.17	T = 6
Rainfall	overall	344.86	134.92	0.007	563.63	N = 360
	between		122.02	107.27	548.48	n = 60
	within		59.34	157.45	559.39	T = 6

Source: Own compilation using price surveys from Zimbabwe National Statistics Agency (ZIMSTAT 2009-2014).

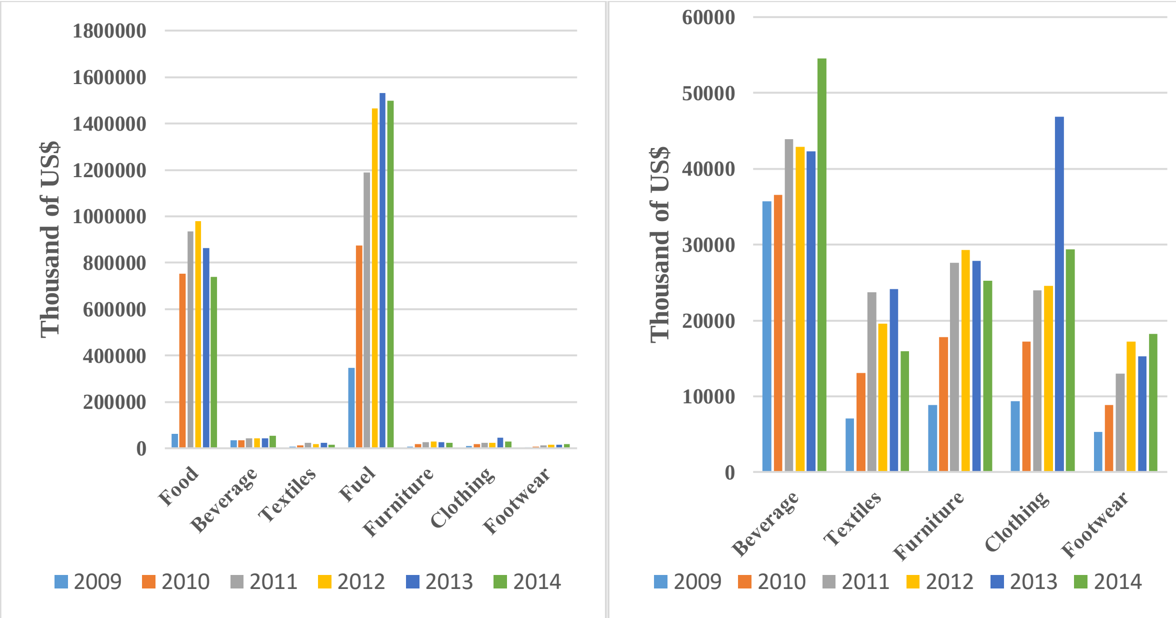
3.4 Tradable goods

The distinction between tradable and non-tradable goods is very important mostly when product prices are collected. Non-tradable goods are products which cannot be traded internationally or across country. Such goods include services where the producers and consumers of the product in question are all located in the same country. Some examples of non-tradable goods are electricity, water supply, public service, local transport, hotel accommodation among others (Jenkins et al., 2011). A tradable good can end-up being a non-tradable due to extreme levels of domestic protection. An extreme level of protection can officially prohibit importation of a certain product such that the producers and consumers of that product will only be found within the country. The prices surveys provided by Zimstat

[8] All import tariffs were converted to ad valorem since we originally had ad valorem, specific import and mixed (partly ad valorem and partly specific) import tariff rates types.

which are used in the study have a problem that they exclude non-tradable goods like services (Table 6). Thus we cannot distinguish tradable from non-tradable, the study thus makes an assumption that all the goods are tradable hence we are likely to overstate imports.

Figure 3: Volume of Imports by Products



Source: Own computation using (WITS database)

Futher analysis of the imports by Zimbabwe proves that the products we have are tradable goods. Figure 3 above shows Zimbabwe's imports by product groups. The figure to the left (3A) includes food and fuels while the one to the right (3B) excludes the two product groups. Food and fuel have high values thus they overshadows other import as show in 3A hence 3B removes food and fuel. Over the period under study Zimbabwe was significantly importing all the products. However, we see food (36 percent) and fuels (57.7 percent) occupying the highest share of Zimbabwe's imports. This is highly attributed to poor harvest and increased demand of fuel during the period under study as a result of the influx of cars dominated by the impotation of second hand car Japanese cars (Confederation of Zimbabwe Industry, 2013).

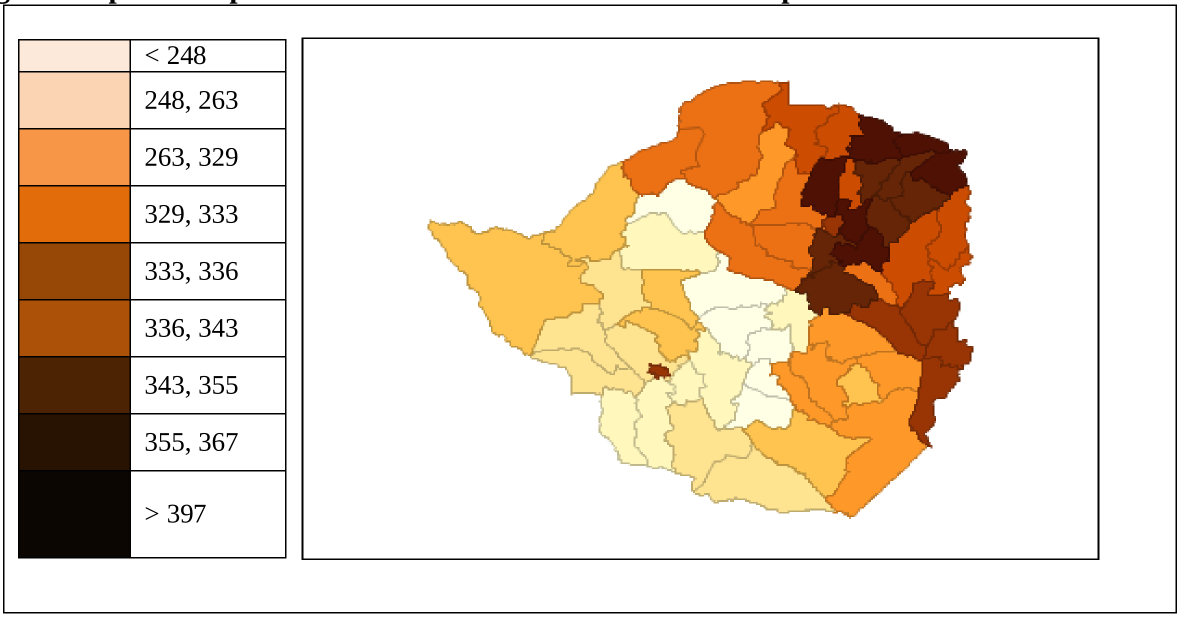
Section 4: Presentation of results

4.0 Spatial distribution of prices.

This section discusses results for the study. In light of the study's objective, the results are discussed in two subsections. Here we discuss results on the spatial distribution of prices in Zimbabwe , in the following section we will discuss findings for the import tariffs pass through.

Using data described in section 3 and averaging the prices for the 6 years in GeoDa software the study constructed spatial map for the 60 districts. The spatial map is presented in Figure 4.

Figure 4: Spatial Map of Price Distribution in Zimbabwe for the period 2009-2014



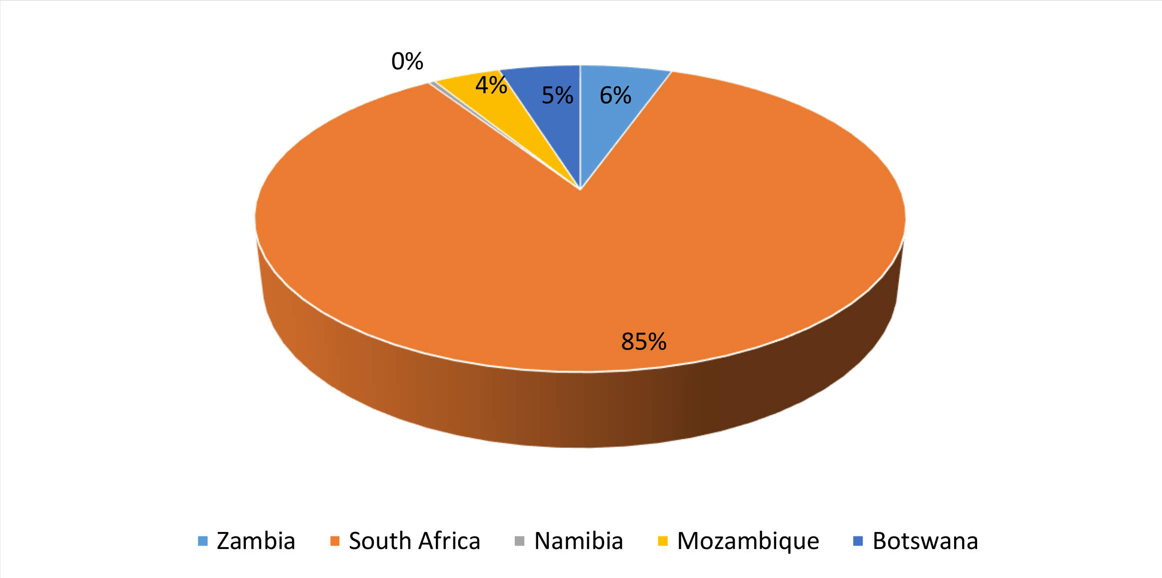
Source: GeoDa spatial map

Source: GeoDa spatial map

In the spatial map, the darker the colour the higher is the average goods prices, the maps key shows the district average prices before they converted into logarithm. The map shows that prices are relatively lower in districts to the western and south western sides of Zimbabwe. Prices are relatively high in districts to the northern east parts of Zimbabwe. To the eastern side of the country there is Mashonaland central, Mashonaland east and Manicaland provinces. The cities in these provinces are Harare, Bindura, Marondera, and Mutare. These cities are closer to the Mozambican border but they are far away from the Beitbridge border and it seems as if they are not benefiting much from that. The eastern side of the country is rich in agriculture and the region is also an industrial hub with industries located in Harare and Mutare, (CZI, 2014). However, these characteristics seem not helping in keeping prices lower.

In the western and southern west parts of Zimbabwe there is Matebeleland North, Matebeleland South and Masvingo provinces. The cities in these provinces are Beitbridge, Masvingo and Victoria Falls. These provinces do not receive good rainfall, (Dube, 2008). They have dry and less fertile land for agriculture but people there are enjoying relatively lower prices. Most industries in the western and southern western parts of Zimbabwe relocated to the capital city (Harare) following the economic crisis between 2000 and 2008 (Dube et al., 2013). These provinces are also relatively closer to the major country borders which are Beitbridge border post, Plumtree border post, Pandamatenga border post, Kazungula and Chirundu border post. These borders are between Zimbabwe and South Africa as well as Botswana. Figure 5 below shows the share of goods imported from the five countries surrounding Zimbabwe which are Botswana, Mozambique, Namibia, South Africa and Zambia for the period 2009 to 2014. The pie chart shows that Zimbabwe imported much from South Africa (85 percent) and Botswana (6 percent). This helps to explain why these provinces located to the western and southern western parts of Zimbabwe have relatively lower prices.

Figure 5: Share of Imports among 5 Countries surrounding Zimbabwe

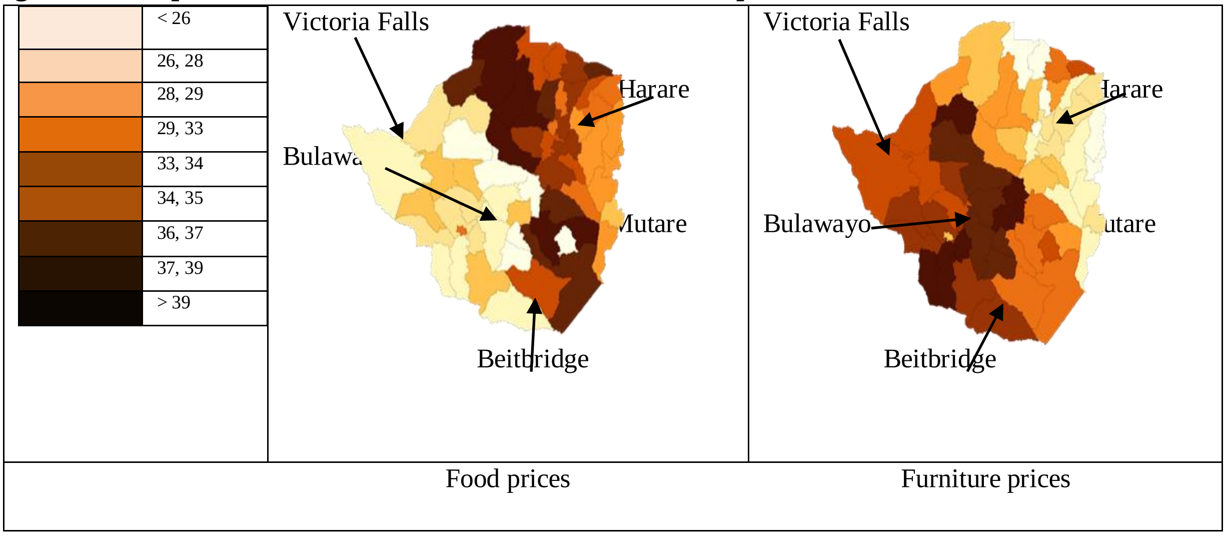


Source: own computation. Using data from WITS: https://wits.worldbank.org

Looking at the same map but at product level, one can see some variations in the distribution of prices (Figure 6).

Figure 6 below shows the spatial distribution of food and furniture prices, used as an example of spatial price differences across commodities. The maps key shows the district average prices before the prices are converted into logarithms. The spatial distribution of food prices is similar to that for the overall price as shown in Figure 4, while that for furniture prices is evidently different from that for food. This shows some extent of variation in cross commodity price distribution across regions. The spatial distribution of furniture prices seems to be highly influenced by strong furniture industries in the eastern side of Zimbabwe.

Figure 6: Comparison of Food and Furniture Prices for the period 2009-2014



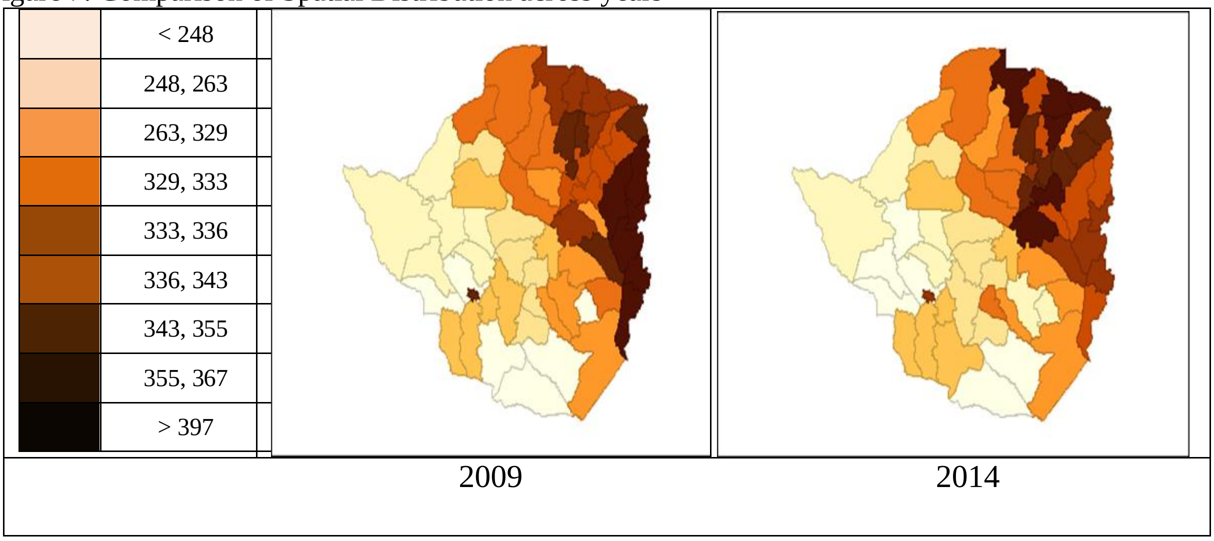
Source: GeoDa spatial map

The eastern highlands of Zimbabwe are characterised by multiple tree plantations and furniture industries which makes it the furniture industrial hub (Dube et al., 2013). Further analysis also shows that Manicaland province was the least affected by the 2000-2003 land reform as it had a low land take up rate of 42 percent compared to the national average of 66 percent (Utete, 2003). Given the long life cycle of tree plantation compared to maize and other small grains, at a time when the average rainfall pattern was erratic, it makes sense for the furniture industry to continue striving while other agriculture food products were repeatedly being imported from neighbouring countries. These are some of the reasons to why furniture prices were lower in the eastern parts of Zimbabwe. More maps at product level are shown in the Appendix Table A2. However, the major lesson from these maps is that the spatial distribution of prices is different across products though some products show some similarities.

A closer analysis of the yearly maps also shows that the spatial distribution of the products prices varies across years. Figure 7 shows the spatial price distribution maps of 2009 and 2014. Though there are some similarities, we can also observe some distributional differences. A good example is that of Manicaland province which experienced higher prices in 2009 compared to 2014. This change in distribution is partly attributed to the influx of second hand clothes being imported from Mozambique, among other factors which might be of social economic or political nature (Confederation of Zimbabwe Industry, 2013). This is the case given that the Nyamapanda border post and Manica border post between Zimbabwe and Mozambique are all located in Manicaland province. However, districts to the western parts of the country continued to experience relatively low prices in both 2009 and 2014. This might be driven by continued importation of products from South Africa and Botswana over the period under study, (African Development Bank, 2013).

Considering our objective of determining whether there is spatial dependence or spatial randomness, what one can conclude from the maps is that districts with low (high) prices are surrounded also by districts with low (high) prices. This gives an indication of the existence of spatial prices dependence across districts in Zimbabwe. Cressie and Chan (1981) highlighted that maps can be misleading in determining the spatial dependence or randomness. We can continue the analysis through estimating the Moran's I test. The Moran's I test statistically and significantly determines the presence or absence of spatial dependence in the given data set. The Moran's I test statistic, test the null hypothesis that the variables are randomly distributed against the alternative hypothesis in which the variables are dependent on each other (Viton, 2010).

Figure 7: Comparison of Spatial Distribution across years



Source: GeoDa spatial map

Using the same data, the Moran's I test statistic is presented in Table 8 below. We observe that the I values are all greater than the expectations values for all the products in Table 8. An example is the case for all goods where the I-statistic value of 0.207 is greater than the expectation value of (-0.003), for households we also observe an I-statistic value of 0.379 being greater than the expectation value of (-0.003), this pattern is consistent for all the variables. The p-values are significant for all the products at the 5 percent significant value. According to the discussion in section 3.1 we thus conclude that we have positive price spatial dependence for all the products. Appendix Table A3 in the appendix shows the Geary' C and the Getis &

Ord's G. Panel A shows that the C-statistics are greater than 1 while panel B display that the G-statistics are all less than the expectations values. We thus conclude that there is a consistent positive price spatial dependence among the prices of all the product groups.

Table 4: Moran's I Statistic Test

Variables	I	E(I)	sd(I)	z	p-value*
All goods	0.207	-0.003	0.015	14.171	0.000
Furniture	0.090	-0.003	0.015	6.291	0.000
Vehicle fluids	0.628	-0.003	0.015	42.417	0.000
Household textiles	0.379	-0.003	0.015	25.661	0.000
Fuels	0.616	-0.003	0.015	41.589	0.000
Footwear	0.456	-0.003	0.015	30.904	0.000
Cloth	0.534	-0.003	0.015	36.134	0.000
Alcohol beverages	0.391	-0.003	0.015	26.493	0.000
Non-Alcohol beverage	0.250	-0.003	0.015	17.047	0.000
Food	0.489	-0.003	0.015	33.190	0.000

Source: Stata output Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

This means that districts in Zimbabwe with high (low) prices are also surrounded by district with high (low) prices. In other words, changing prices in one district will affect prices in all the surrounding districts. This means that prices of good y in district i depend on the price of good y in the surrounding districts.

Before comparing the traditional pass-through regression to the spatial pass-through model, we need to allow the data to tell us which spatial model is more appropriate from the 5 models specified in section 3.1. Table 9 shows the three most appropriate spatial models according to our dataset, the rest of the table is in Appendix Table A4. The lower the values of the AIC and BIC, the better is the model. The greater the LM value, the better is the model. The SDM, SAR and the SEM models which control for both the individual and the time effect are highly preferred against the other models. According to the three chosen models, rho (0.556, 0.609) and lambda (0.643) values show the presence of positive spatial dependence of price. All model shows a consistent positive spatial price dependence give the positive and significant rho and lambda values (Appendix tables A4-A7). This result is consistent with the outcome of Table 9. Panel A of Table 9 shows the regression estimates using the Queen spatial weights matrix while panel B use the Euclidean matrix. These are the two most different types of weights matrix given that the Queen matrix uses district boundaries while the Euclidean matrix uses distance between the districts. Appendix tables A5-A7 re-run the estimation using K-nearest neighbour weights matrix, Rook weights matrix, and the Arc distance matrix correspondingly. The SDM, SAR and the SEM models which control for both the individual and the time effect is favoured with all varying models. However, the model which use the Rook weights and K-nearest neighbour also favour the GSPRE weights matrix. We observe some small variations depending on the spatial weights matrix used however the overall decision is skewed towards the SDM, SAR and SEM being the most appropriate models.

Table 5: Appropriate spatial model[9]

Variables	SDM both	SAR both	SEM both
Panel A : Using the Queen spatial weighted matrix			
rho-spatial dep	0.556***	0.609***	
LM	4.805***	5.630***	5.557***
lambda-spatial dep			0.643***
AIC	1708,49	1725,74	1725,89
BIC	1895,02	1822,89	1822,95
Observations	360	360	360
R-squared	0.465	0.532	0.424
Panel B : Using the Euclidean matric spatial weighted matrix			
rho-spatial dep	0.433***	0.759***	
LM	3.631***	4.544***	3.854***
lambda-spatial dep			0.453***
AIC	1698,49	1842,74	1826,89
BIC	1795,02	1877,89	1878,95
Observations	360	360	360
R-squared	0.365	0.432	0.524

Source: Own computation using STATA, the dependent variable is average consumer goods price

Following the analysis in section 3.1 we observed that there are several spatial weights matrices that can be used in the estimation models. The study will continue the analysis using the Queen spatial weights matrix given the consistency being shown when alternative weights matrixes are used as shown in Table 9 and in Appendix A4-A7. Appendix Table A8 tabulates the details of the Queen weights matrix used, we thus have 2 districts which share 2 borders and only 1 district which shares borders with 9 other districts.

4.1 Comparison between the traditional and spatial import tariffs models

Following the results in Table 9, the study proceeded to estimate and compare equation 3.21 and 3.22. Table 10 shows the regression results of the traditional import tariffs pass through

[9] The regressions Control for import tariffs, location (rural and urban), exchange rate, money supply, industrial hubs, distance to the borders, provincial dummies, rainfall), (*** p<0.01, ** p<0.05, * p<0.1) All the dummy variables being drop in the fixed effects model.

model compared to SAR model which controls for the spatial distribution of price. The first four columns we show the regression estimations using the fixed effects estimation model; this drops all the static variables. The last 6 columns use the ordinary least (OLS) regression in which the static variables are added iteratively. In all regressions the dependent variable is the average price of all goods. The most important variable is the coefficient of import tariffs. The coefficient shows the magnitude of import tariff changes which are being passed on to domestic goods prices. The coefficient for import tariffs is positive and statistical significant in all the models.

The magnitude of the coefficient (0.289) of import tariffs in the traditional model is greater compared to that of the SAR (0.085), which means 28.9 percent and 8.5 percent of import tariffs will be passed on to domestic price following a 1 percent increase in import tariff rate. The relationship is consistent in all the 10 regression models shown in Table 10. This finding confirms the discussion in section 2.3, consequently the spatial distribution of domestic prices affect the import tariffs pass through. Thus not controlling for spatial distribution highly bias the import tariffs pass through effect. Rho values for the spatial models all agree on the presence of a positive spatial price dependence in Zimbabwe over the period 2009-2014.

In columns 4 and 5 we add money supply in both models, money supply captures the monetary policy effect on prices. We have similar results between the two models, money supply variable is positive and statistically significant in both model the coefficients of 0.002 and 0.013 for the traditional and SAR models respectively. The monetary policy effect appears to have a small effect on price, this might largely due to the multiple currency economic system during the period 2009-2014. Over this period the monetary policy was arguably ineffective as it had limited power on controlling money supply levels (Confederation of Zimbabwe Industry, 2014). Table 11 also have regression results for the Ordinary least square model in column 6-11.

Column 6 and 7 import tariffs is the only independent variable the traditional model depict that 33.9 percent and 1.7 percent of import tariffs is being passed through to domestic goods prices following a 1 percent increase in import tariffs. Again we observe that the traditional model coefficient for import tariff pass though is greater than new model which control for spatial distribution. In column 8 and 9 we add the variable for money supply, we obtain a low coefficient of 0.001 and 0.003 for the traditional and SAR model respectively. Zubair et al

(2013) obtained a money supply coefficient of 0.066, the low monetary policy effect on price is again attributed to the multiple-currency economic system.

Column 10 and 11 add the variable location which capture rural and urban area price difference. The variable for location is positive and statistically significant in both models which a coefficient of 1.482 and 3.056 for the traditional model and SAR model correspondingly. The coefficient means that prices are 14.82 percent and 30.56 percent higher in the rural area relative to urban areas. This outcome is likely to be driven by poor rainfall over the period 2009-2014, (World Bank Climate Data Portal 2018). Most rural households highly depend on agriculture activities, thus lack of enough rainfall will affect their livelihoods causing shortages and rising of prices. Poorer transport infrastructure in the rural areas could also be contributing to relatively higher prices in the rural areas.

Table 6: Comparison between the traditional and spatial import tariffs models[10]

	Fixed Effects models				OLS regression models					
Variables	Traditional	SAR	Traditional	SAR	Traditional	SAR	Traditional	SAR	Traditional	SAR
Import tariffs	0.289**	0.085**	0.205**	0.051**	0.338**	0.017**	0.2606***	0.040***	0.256***	0.049***
Money supply			0.002***	0.013**			0.001*	0.003*	0.022*	0.072*
location									1.482**	3.056**
rho		4.533***		4.765***		5.562***		4.754***		5.651***
R-squared	0.565	0.553	0.568	0.564	0.498	0.479	0.497	0.584	0.393	0.598

Source: Own computation using STATA, the depend variable is average consumer goods (significant level *** p<0.01, ** p<0.05, * p<0.1)

Table 12 below continues the analysis through focusing on the OLS regression model and adding more controls to the traditional and the SAR models. In column 1-2 we add rainfall to both the traditional model and the SAR, there is a negative relationship between rainfall and domestic prices with the traditional model producing a rainfall coefficient of (-0.075) while the SAR has a coefficient of (-0.009). Thus a 1 percent increase in rainfall is associated with a 2.75 percent and 0.9 percent decrease in domestic goods price under the traditional and SAR models respectively. The introduction of the rainfall variable is also affecting the location variable as it become smaller and less significant. Thus agriculture activities are of paramount important in explain the rural and urban price variations.

[10] The model also controlled for location, provincial dummies, year dummies, and distance to merger borders, distance to industrial hubs. These variables we dropped given that we are using fixed effect model. The model use the Queen spatial weights matrix.

Column 4-5 introduce the nightlight variable which capture the level of economic activities or industrial hubs in respective districts. The coefficient for nightlight is negative and statistically significant at the 5 percent significant level in all the columns 4-15. This means that districts which are nearer to high economic activities are benefiting from reduced prices. The effect of economic activities is higher in the SAR (-0.091) model compared to the traditional model (-0.004).

Table 12: Comparison between the traditional and spatial import tariffs models

Variables	Traditional	SAR	Traditional	SAR	Traditional	SAR	Traditional	SAR	Traditional	SAR	Traditional	SAR	Traditional	SAR
Import tariffs	0.260***	0.040***	0.256***	0.049***	0.256***	0.049***	0.316***	0.059***	0.339***	0.062***	0.205**	0.071**	0.329**	0.084**
rho		4.805***		6.431***		5.458***		5.873***		5.643***		5.557***		5.668***
Exchange rates	0.056	-0.778	0.082	-0.978	0.008	-0.0948	0.017	-0.059	0.038	-0.093	0.098	-0.112	0.193	-0.142
Money supply	0.001*	0.002*	0.022*	0.072*	0.042*	0.067*	0.091*	0.092*	0.036*	0.074*	0.064	0.103	0.037	0.453
location	1.112*	2.956*	1.082*	2.056*	1.094**	2.068*	1.303**	1.602	1.205**	2.106**	1.250*	1.146	1.320**	1.146**
Rainfall	-0,075**	-0.009***	-0,035**	-0.014***	-0.002**	-0.023*	-0.0053**	-0.069**	-0.0047**	-0.058**	-0.002***	-0.013**	-0.012***	-0.024**
Nightlight			-0.004***	-0.091***	-0.006***	-0.101***	-0.011***	-0.081***	-0.014***	-0.171***	-0.041***	-0.171***	-0.004***	-0.091***
Distance to Harare					0.028	0.048**	0.038	0.068**	0.028	0.048**	0.014	0.019***	0.028	0.048**
Distance to Bulawayo							-0.015**	-0.006	-0.053**	-0.056	-0.053**	-0.082*	-0.015**	-0.006
Distance to Beitbridge									0.073***	0.064*	0.029*	0.023***	0.073***	0.054*
Distance to Mutare											0.015	0.010	0.015	0.010
Bulawayo prov dum													0.529	3.078
R-squared	0.424	0.532	0.365	0.584	0.265	0.558	0.424	0.465	0.365	0.465	0.373	0.507	0.436	0.545

Source: Own computation using STATA, the depend variable is average consumer goods (significant level *** p<0.01, ** p<0.05, * p<0.1)

Table 12 also shows the introduction of other controls namely distance from Harare (column 6-7), Distance to Bulawayo (column 8-9), Distance to Beitbridge (column 10-11) and introduction of provincial dummies starting with the Bulawayo province dummy (column 14-15). The regression results show that the far away a district is from Harare and Beitbridge the greater are the prices of the province. Distance from Harare capture the effects of the capital city and the relevance of industrial hubs. Following the economic crisis of 2008 most industries closed their branches in other cities like Bulawayo and only left there Harare branches open (Dube, et al, 2013 and Confederation of Zimbabwe Industry, 2013). Distance from Beitbridge capture the border effect. During the period 2009-2014 the industrial capacity for Zimbabwe was low, thus most of the goods were being imported and 85 percent of the imports were coming from South Africa (Figure 5). Factoring in the transport cost and other distribution coast district closer to Beitbridge benefited from relatively low prices. In all the regression model the effect of Beitbridge is greater than the effect of Harare as given a lower coefficient of the Harare variable. A good example is in column 11 were the coefficient for the distance from Harare variable is 0.048 while the coefficient from the distance from Beitbridge is 0.064, this pattern is observed in all the regression coefficient from column 11-15.

Appendix A9 shows the complete regression estimations of Table 12. The last two columns control for provincial difference using the provincial dummies. We also observe varying results across provinces depending on the model being used. Price are relatively higher in Manicaland, Mashonaland East and Mashonaland West relative to prices in Matabeleland North. Prices in Masvingo, Midlands and Matabeland South were observed to be relatively lower compared to prices in Matabeleland North. Appendix A10 re-run the regression estimations in table 12 but using SDM and SEM. We thus observe that the coefficients of import tariffs remain positive and significant in all the models and also that import tariffs coefficient in the traditional model will remain greater than in the other spatial models.

In Table 11 and 12 the y-variable was the average prices of all the goods. We can continue the analysis repeating the regressions in Table 11 but breaking the prices according to different products as shown in Table 13. The aim is to observe if the coefficients of import tariffs will remain positive and significant in all the models and also to notice if the import tariffs coefficient in the traditional model will remain greater than in the other spatial models (SDM, SAR and SEM). Notably, Table 13 only presents results for few products, results for all product groupings are presented in Appendix A11. This follows as the results are qualitatively similar across products.

Table 13: Robustness checking[11] (Selected products)

	Panel A: Food Prices			
Variables	Traditional	SDM	SAR	SEM
Import tariffs	0.171**	0.063***	0.048**	0.011*
rho		0.484***	0.501***	
LM		0.224***	0.257***	0.250***
lambda				0.552***
R-squared	0.602	0.593	0.420	0.405
	Panel B: Cloth prices			
Import tariffs	0.162**	0.056***	0.057**	0.025**
rho		0.526***	0.561***	
LM		0.789***	0.847***	0.843***
lambda				0.574***
R-squared	0.726	0.464	0.429	0.561
	Panel C : Beverage prices			
Import tariffs	0.143**	0.0428**	0.022**	0.011***
rho		0.373***	0.429***	
LM		0.047***	0.051***	0.053***
lambda				0.440***
R-squared	0.647	0.443	0.514	0.501

Source: Own computation using STATA, (the regressions Control for import tariffs, location (rural and urban), exchange rate, money supply, industrial hubs, distance to the borders, provincial dummies, rainfall), (significant level *** p<0.01, ** p<0.05, * p<0.1)

Table 13 show positive and significant import tariffs coefficient in all the panels (Panel A-C). The coefficient of import tariffs in the traditional model remains greater than in the spatial model, though the level of statistical significance varies across the models. The results in Table 13 are thus consistent to the outcome displayed in Table 11 and 12.

4.2 Explanation of the import tariffs pass through bias

The driver of the wedge between the traditional pass through model and the model proposed in this study, the one which controls for spatial distribution of price, hinges on the inclusion or non-inclusion of the spatial lagged variables. Under the problem of the omission of an important variable, such a problem will bias the regression estimations. For the problem to be

[11] Appendix A6 shows the full regression table of the regression estimates

valid the omitted variable should be strongly correlated with both the dependent and some or one of the independent variable.

Table 14: Correlation matrix

	Prices	Tariffs	Money supply	Spatial weighted price	Rainfall	Distance to Beitbridge	Location
Prices	1.0000						
Tariffs	0.4438	1.0000					
Money supply	0.4013	0.8857	1.0000				
Spatial weighted price	0.8173	0.4912	0.4672	1.0000			
Rainfall	-0.1935	0.0018	0.0041	-0.3858	1.0000		
Distance to Beitbridge	0.2366	-0.0006	-0.0040	0.4563	-0.4430	1.0000	
Location	0.0325	0.0007	0.0041	0.0470	-0.2201	0.0475	1.0000

Source: Own computation using STATA

Table 14 shows a strong correlation between the spatial weighted price with price and other independent variables, for example a correlation coefficient of 0.49 with import tariffs. There is thus spatial dependence in the prices as identified in sections 4.1. The spatial interdependence of prices across districts is the driver of a small import tariffs pass through in SDM, SAR and SEM models. The spatial weighted matrix captures the shortest paths relation between 60 districts paring. The matrix acknowledges that each district has an intrinsic degree of uniqueness due to its situation relative to the rest of the district spatial system.

What happens in one district will affect greatly closer districts relative to districts which are far away. If prices of goods are decreasing in one district, then the decrease will be propagated to the surrounding districts. Given that the spatial weighted matrix captures distances between the districts, it also means that the matrix controls for variations in the distributional cost, language, culture and information across the districts (Haynes and Fortheringham, 1984).

Distributional costs are the cost incurred in distributing the goods from one district to another. The costs include transport cost, information asymmetry, packaging cost, extent of competition, domestic taxes, regulatory cost just to name a few (Winters et al, 2004). Thus a decrease in the distribution cost will be propagated across the districts factoring in the distance component.

Districts prices of goods in Zimbabwe are highly interdependent as shown by the positive spatial dependence in section 4.1. The strong districts price dependence also means that district price strongly influences each other both positively and negative.

Tobler's first theory of geography strongly supports why the import tariffs pass through is smaller once we control for the spatial dependence of prices. The strong interdependence of price in Zimbabwe, the general low inflation rate over the period 2009-2014 and the adoption of a multiple currency, can generally explain the low import tariffs pass through in Zimbabwe. The period after 2009 was followed by general stable prices and low inflation rates. The general price level started to stabilise as inflation rate was dropping severely. The year on year inflation rate was recoded as -0.2 percent in 2014 (Zimbabwe Statistics Agency 2014). A negative inflation rate signifies a drop in prices. Such dropping prices were also timely communicated in all the market due to the strong market linkages. An increase in import tariffs in the present of decrease in general price would definitely absorb the effect of import tariffs on final domestic goods prices. The above market dynamics can be used to explain the subdued import tariffs pass through once the market connectedness is controlled for in the form of a spatial weighted matrix.

The growth of the black market in Zimbabwe introduced some market competition were basic goods like cooking oil, sugar among others, would be sold on the black market at a discounted price compared to the formal market. Such competition would also mute the final price effect of import tariffs.

In addition to the explanation in section 1.2 and supporting of the generally low import tariffs pass through, is the correction of the exchange rated distortion in Zimbabwe during the period 2009-2014 due to the adoption of the multiple currency economic system. The adoption of a multiple currency and the complete dysfunctional of the Zimbabwean dollar meant a complete removal of the Zimbabwe dollar exchange rate and the distortion which might have been previously created by the system. Prior to the adoption of the multiple currency system in February 2009, 1USD was trading for 300 trillion Zimbabwe dollar, the Zimbabwean dollar had also gone through a series of re-denomination. The first one in 2006 were 3 zeros were removed, the second one in 2008 were 13 zeros were removed and the last on in 2009 were 1 billion Zimbabwe dollars were re-denominated to 1 Zimbabwe dollar (Reserve bank of Zimbabwe 2009). In addition, the Zimbabwean dollar had been devalued several times, Government of Zimbabwe (2009). The above evolution of the Zimbabwe currency might highly have attracted some exchange rate distortions. Correction of the exchange rate distortions can offset the effects of rising import tariffs, (Krueger, 1992). Including exchange rate in equation 3.2 will produce $P_{1j}^{D} = P_{1}^{B} e(1 + t_1)$ where e is the exchange rate. A high and distorted exchange rate will inflate domestic prices while a correction of exchange rate distortion will absorb the rising import tariffs such that the final price will not capture the full price changes of import tariffs.

The significant drop of inflation cited above, might have also muted the distribution cost of imported products that include transport cost, and domestic tax which is likely to absorb the effects of increasing import tariffs thus muting the import tariffs pass through effect.

Apart from the exchange rate there also could be other factors that can slow down the import tariff pass through, McCulloch et al (2004) pointed to the extent of domestic competition, functioning of the market, infrastructure and domestic regulation. The policy of price control is popular in Zimbabwe, where the government controls the rising of prices through enforcing strong regulation against price increase. The other possible explanation of low import tariffs pass through is the changes in the world or border prices. Using equation 3.2 a drop in the border prices can greatly offset the effect of rising import tariffs, (Lutz and Singer, 1994).

4.3 Findings

1. There was a positive spatial correlation of domestic goods prices across Zimbabwean districts over the period 2009- 2014.
2. A significant portion of import tariffs was being passed on to domestic goods prices over the given period.
3. The traditional import tariffs pass through model overestimates the import tariffs pass through to domestic goods prices when compared to the spatial import tariffs pass through model estimations.

4.4 Conclusion

The study was set out to achieve two key objectives: first to investigate the nature of spatial price distribution across Zimbabwean districts over the period 2009-2014. Second to investigate whether failure to control for the nature of spatial price distribution when estimating the import tariffs pass through effect biases the estimates.

The study found a positive spatial price dependence of domestic goods' prices among districts in Zimbabwe over the period 2009-2014. This finding has been reached after employing several spatial econometrics techniques (Spatial maps, the Moran's I, Spatial Durbin model, Spatial

AutoRegressive model, Spatial Error model, Spatial Autoregressive with Spatially Autocorrelated Errors model and the Generalised Spatial Random effects model),

The study also found evidence of an incomplete tariff pass through in Zimbabwe; a positive and significant portion of import a tariffs is being passed on to domestic goods prices. The finding of this study are consistent with the outcomes of Ural (2013), Hayakawa and Ito (2015), Malliek and Marques (2007) and Cadot et al (2005). These studies observed an incomplete import tariffs pass through to domestic goods for the case of developed and developing countries. However, the import tariffs pass through found in this study are so low at a maximum of 33.9 percent for the traditional model (Table 12) and a maximum of 8 percent for the model which control for spatial distribution (Table 11). Feenstra (1989), Kreinin (1977) and Malliek & Marques (2007) found an import tariff pass through of around 60 percent. The explanation given in section 4.2 and the high distribution cost as highlighted in section 2.1 justify the large disparities. Thus policy should be cautious of the import tariffs increase in relation to household welfare and poverty reduction targets. Since an increase in import tariffs translates into a non-trivial increase in domestic goods prices.

More importantly, the study found that the traditional import tariffs pass models which do not account for spatial correlation of domestic goods prices tend to overestimate the import tariffs pass through effect. The findings greatly highlight the need to control for the spatial distribution of domestic goods prices before estimation the import tariffs pass through effect. Thus the domestic spatial distribution of prices highly affects the import tariffs pass through effect. Studies on import tariffs pass-through should control for spatial price distribution else they will obtain biased regression estimations.

The major weakness of the study is the failure to separate tradable and non-tradable products. The dataset used in this study include products which were produced domestically and those which were imported. Thus all the products are assumed to have been imported. Future studies are thus recommended to separate the above two types of products. The idea is that the two types of products might be affected differently with import tariffs changes.

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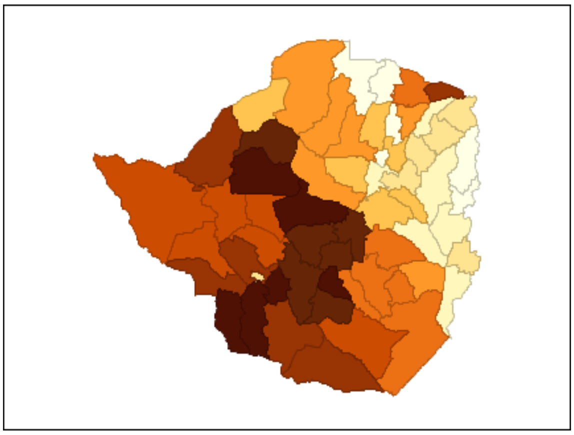
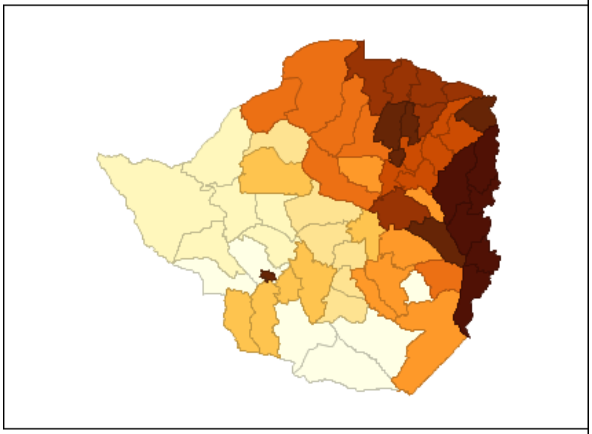
5.1 Appendix

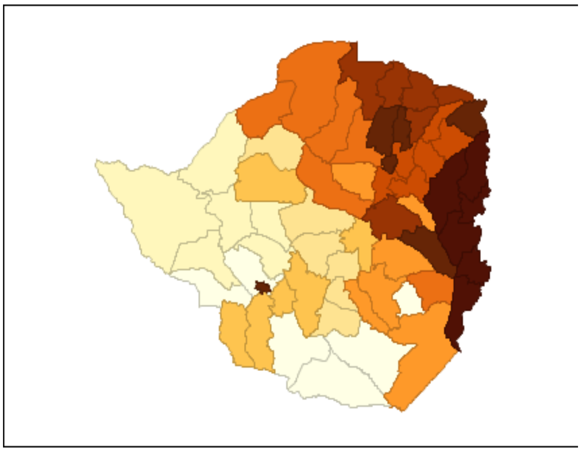
Appendix A1: Spatial maps of domestic prices in Zimbabwe (2009-2014)



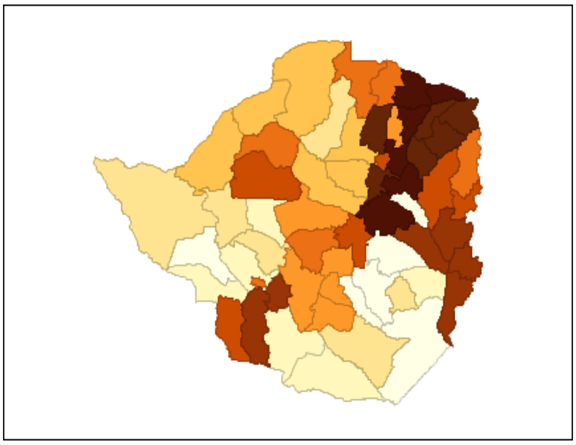
non-Alcohol beverage



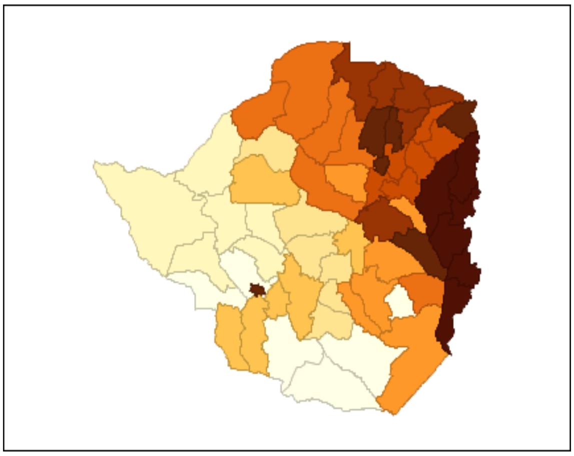
Clothes



Footwear



house hold textiles



Fuels

Appendix A2: Description of the variable used.

Variable-description	Measurements	Expected relationship with goods prices	Source
Food prices	average prices of all food items per liter/per kilogram in US dollars		Zimstat (2009-2014)
Non-alcohol beverage prices	average per unit (750 ml/350ml) of all non-alcohol beverages in US dollars		Zimstat (2009-2014)
Alcohol beverage prices	average price of per unit of alcohol (750ml/350ml) in US dollars		Zimstat (2009-2014)
Cloth prices	average per unit of cloth items in US dollars		Zimstat (2009-2014)
Footwear prices	average per unit price of footwear in dollars		Zimstat (2009-2014)
Fuel prices	average per liter of fuel price in US dollars		Zimstat (2009-2014)
Vehicle fluids	average per liter of vehicle fluid (engine oil, brake fluid and grease) price in US dollars		Zimstat (2009-2014)
Furniture prices	average per unit of furniture products in US dollars		Zimstat (2009-2014)
Location	rural of urban location , a dummy variable with 1=rural and 0= urban	High price in the rural areas relative to urban area	Zimstat (2009-2014)
Exchange rate	average US$ to South African ZAR exchange rate	Positive relation between exchange rates and price	Reserve bank of Zimbabwe (2009-2014)
Money supply	average official money supply in US$ as reported by the Central bank	Positive relation between money supply and prices	Reserve bank of Zimbabwe (2009-2014)
Distance	average distance between district in kilometers	We expect lower price in districts which are closer to borders	calculations from the shape file collected from the ArcGIS website
Import tariffs	average ad-valorem/ converted ad-valorem tariffs rate	Positive relation between import tariffs and prices	Zimbabwe Revenue Authorities (2009-2014)
Rainfall	average rainfall received in milliliters	High price in area which receive low rainfall	Rasta file collected from ArcGIS website

Table A3: Geary C, Getis & Ord's G

Panel A: Geary's c					
Variables	c	E(c)	sd(c)	z	p-value*
All goods	0.839	1.000	0.037	-4.316	0.000
Furniture	0.873	1.000	0.060	-2.100	0.018
Vehicle fluids	0.408	1.000	0.022	-26.431	0.000
Household textiles	0.689	1.000	0.027	-11.726	0.000
Fuels	0.422	1.000	0.023	-25.087	0.000

Footwear	0.573	1.000	0.027	-15.767	0.000
Cloth	0.592	1.000	0.031	-13.366	0.000
Alcohol beverages	0.733	1.000	0.029	-9.152	0.000
Non-Alcohol beverage	0.742	1.000	0.035	-7.318	0.000
Food	0.738	1.000	0.039	-6.716	0.000
Panel B:Getis & Ord's G					
Variables	G	E(G)	sd(G)	z	p-value*
All goods	0.066	0.064	0.000	3.290	0.001
Furniture	0.065	0.064	0.000	0.320	0.375
Vehicle fluids	0.080	0.064	0.001	10.857	0.000
Household textiles	0.072	0.064	0.001	6.900	0.000
Fuels	0.093	0.064	0.002	13.102	0.000
Footwear	0.075	0.064	0.002	7.014	0.000
Cloth	0.075	0.064	0.001	9.232	0.000
Alcohol beverages	0.068	0.064	0.001	6.010	0.000
Non-Alcohol beverage	0.070	0.064	0.001	4.146	0.000
Food	0.071	0.064	0.001	9.409	0.000

Appendix: A4 Appropriate spatial model (queen weights matrix)

	Appendix: A3 Appropriate spatial model				
Variables	SDM_ind_fxd_effects	SDM_fxd_time_effects	SDM_re_effects	SDM_both_fxd_effects	SDM_without_effects
rho	0.832***	0.392***	0.359***	0.865***	0.842***
LM	4.852***	7.322***	8.327***	**4.805*** **	4.852***
AIC	1716,27	1856,52	1879,936	**1708,49**	1716,27
BIC	1902,79	2043,05	1988,75	**1895,02**	1902,79
Observations	360	360	360	360	360
R-squared	0.439	0.434	0.265	**0.465**	0.039
Variables	SAR_fxd_ind_effects	SAR_re_effects	SAR_fxd_time_effects	SAR_fxd_both_effects	SAR_without_effects
rho	0.528***	0.526***	0.564***	0.591***	0.651***
LM	5.719***	8.380***	8.634***	**5.630*** **	4.852***
AIC	1736,41	1882,61	1865,12	**1725,74**	1716,27
BIC	1833,56	1987,54	1962,27	**1822,89**	1902,79
Observations	360	360	360	360	360
R-squared	0.067	0.509	0.001	**0.532**	0.039
Variables	SEM_fe__ind_effects	SEM_re_effects	SEM_fe_time_effects	SEM_both_effects	SEM_without_effects
rho	0.534	0.471***	0.619***	0.591***	0.534
LM	5.726***	8.048***	8.083***	**5.557*** **	8.048***

AIC	1741,46	1874,26	1852,16	**1725,59**	1874,26
BIC	1838,61	1979,18	1949,31	**1822,75**	1979,18
Observations	360	360	360	360	360
R-squared	0.032	0.484	0.081	**0.424**	0.484
Variables	SAC_fxd_ind_effects	SAC_fxd_time_effects	SAC_both_effects	SAC_without_effects	GSPRE_re_effects
Rho/lambda	0.591***	0.526***	0.564***	0.591***	0.649***
LM	4.852***	7.322***	4.805***	7.328***	4.526***
AIC	1716,27	1856,52	1798,49	1865,71	1875,81
BIC	1902,79	2043,05	1895,02	2060,01	1984,62
Observations	360	360	360	360	360
R-squared	0.039	0.034	0.565	0.580	0.486

Source: Own computation using STATA, the dependent variable is average consumer goods price

Appendix: A5 Appropriate spatial model (K-nearest distance weights matrix)

VARIABLES	SDM_re_effects	SDM_fxd_time_effects	SDM_both_fxd_effects	SDM_without_effects	SAR_fxd_ind_effects
rho	0.522	0.471***	0.517***	0.531***	0.731***
LM	4.528***	5.526***	**7.704*** **	5.594***	4.651***
AIC	2232.828	2379.103	**1924.387**	2366.186	2222.242
BIC	2337.753	2487.914	**2024.389**	2467.224	2323.281
Observations	360	360	360	360	360
R-squared	0.519	0.018	0.264	0.042	0.064
	SAR_re_effects	SAR_fxd_time_effects	SAR_fxd_both_effects	SAR_without_effects	SEM_re_effects
Rho/lambda	0.423***	0.624***	0.663***	0.694***	0.648***
LM	4.534	5.471***	**6.669*** **	4.594***	5.647***
AIC	2210.355	2363.421	**1913.851**	2363.421	2365.357
BIC	2408.546	2472.231	**2023.181**	2472.231	2336.303

Observations	360	360	360	360	360
R-squared	0.513	0.001	0.212	0.042	0.493
	SEM_fe__ind_effects	SEM_re_effects	SEM_fe_time_effects	SEM_both_effects	SEM_without_effects
lambda	0.547***	0.604***	0.547***	0.681***	0.559***
LM	5.504***	5.647***	4.581***	4.649***	5.647***
AIC	2352.735	2220.843	2363.421	2210.355	2213.851
BIC	2453.774	2321.881	2472.231	2408.546	2551.89
Observations	360	360	360	360	360
R-squared	0.015	0.493	0.137	0.195	0.493
	SAC_fxd_ind_effects	SAC_time_ind_effects	SAC_both_effects	GSPRE_re_effects	GSPRE_without_effects
lambda	0.649***	0.649***	0.619***	0.647***	0.522***
LM	4.594***	5.526***	5.564***	5.649***	**6.659*** **
AIC	2357.409	2201.174	2364.708	2364.708	**1923.178**
BIC	2551.714	2395.479	2477.405	2477.405	**2102.744**
Observations	360	360	360	360	360
R-squared	0.042	0.018	0.264	0.494	0.494

Source: Own computation using STATA, the dependent variable is average consumer goods price

Appendix: A6 Appropriate spatial model (rook weights matrix)

VARIABLES	SDM_re_effects	SDM_fxd_time_effects	SDM_both_fxd_effects	SDM_without_effects	SAR_fxd_ind_effects
rho	0.661***	0.544	0.481***	0.627***	0.563***
LM	4.528***	4.526***	**6.692*** **	4.564***	5.451***
AIC	2592.479	2524.763	**2167.666**	2671.038	2658.121
BIC	2700.67	2629.688	**2257.668**	2779.849	2759.159
Observations	360	360	360	360	360
R-squared	0.519	0.018	0.264	0.041	0.064
VARIABLES	SAR_re_effects	SAR_fxd_time_effects	SAR_fxd_both_effects	SAR_without_effects	SEM_re_effects
Rho/lambda	0.664***	0.491***	0.551***	0.434	0.371***
LM	4.534	4.471***	**7.749*** **	5.592***	4.547***
AIC	2514.177	2655.355	**2502.479**	2523.313	2655.355

BIC	2764.166	2700.67	**2615.216**	2628.238	2764.166
Observations	360	360	360	360	360
R-squared	0.513	0.001	0.212	0.041	0.493
VARIABLES	SEM_fe__ind_effects	SEM_re_effects	SEM_fe_time_effects	SEM_both_effects	SEM_without_effects
lambda	0.604***	0.547***	0.481***	0.559***	0.547***
LM	5.259***	5.447***	4.531***	**7.704*****	5.647***
AIC	2655.355	2644.67	2512.777	**2166.458**	2582.479
BIC	2764.166	2745.709	2693.816	**2266.46**	2700.67
Observations	360	360	360	360	360
R-squared	0.015	0.493	0.137	0.195	0.493
VARIABLES	SAC_fxd_ind_effects	SAC_time_ind_effects	SAC_both_effects	GSPRE_re_effects	GSPRE_fe_effects
Rho/lambda	0.571***	0.515***	0.554***	0.591***	0.541***
LM	4.592***	5.526***	4.564***	**6.634*****	5.634***
AIC	2156.796	2649.344	2493.109	**2256.874**	2256.874
BIC	2745.689	2843.649	2687.414	**2619.571**	2619.571
Observations	360	360	360	360	360
R-squared	0.041	0.018	0.264	0.498	0.498

Source: Own computation using STATA, the dependent variable is average consumer goods price

Appendix: A7 Appropriate spatial model (Arc distance weights matrix)

VARIABLES	SDM_re_effects	SDM_fxd_time_effects	DSM_both_fxd_effects	SDM_without_effects	SAR_fxd_ind_effects
rho	0.528***	0.526***	0.691***	0.564***	0.651***
LM	5.558***	4.326***	**6.772*****	5.824***	4.811***
AIC	2709.64	2731.894	**2340.275**	2878.169	2865.252
BIC	2907.831	2836.819	**2440.277**	2986.98	2966.29
Observations	360	360	360	360	360
R-squared	0.519	0.018	0.264	0.041	0.064
VARIABLES	SAR_re_effects	SAR_fxd_time_effects	SAR_fxd_both_effects	SAR_without_effects	SEM_re_effects
rho	0.534	0.471***	0.689***	0.591***	0.647***
LM	5.392	5.391***	**6.579*****	5.521***	5.837***

AIC	2721.308	2709.64	**2652.487**	2730.444	2862.487
BIC	2822.347	2907.831	**2571.297**	2835.369	2971.297
Observations	360	360	360	360	360
R-squared	0.513	0.001	0.212	0.041	0.493
VARIABLES	SEM_fe__ind_effects	SEM_re_effects	SEM_fe_time_effects	SEM_both_effects	SEM_without_effects
rho	0.659***	0.647***	0.581***	0.704***	0.647***
LM	4.539***	3.691***	4.211***	**7.704*** **	4.327***
AIC	2339.067	2851.801	2719.908	**2702.487**	2709.64
BIC	2639.069	2952.84	2820.947	**2607.297**	2907.831
Observations	360	360	360	360	360
R-squared	0.015	0.493	0.137	0.195	0.493
VARIABLES	SAC_fxd_ind_effects	SAC_time_ind_effects	SAC_both_effects	GSPRE_re_effects	GSPRE_without_effects
rho	0.591***	0.526***	0.564***	0.649***	0.649***
LM	3.943***	3.446***	4.744***	5.059***	4.618***
AIC	2829.739	2856.475	2700.24	2863.774	2863.774
BIC	2718.632	3050.78	2894.545	2976.471	2976.471
Observations	360	360	360	360	360
R-squared	0.041	0.018	0.264	0.494	0.494

Source: Own computation using STATA, the dependent variable is average consumer goods price

Appendix A8: Details of the Queen weighted matrix

Number of borders shared	Observation
2	2
3	8
4	11
5	12
6	13
7	9
8	4
9	1
Sum	60

Source: Stata output using the shape file from https://www.arcgis.com

Appendix A9: Comparison between the traditional and spatial import tariffs models (Queen spatial weighted matrix)

Variables	Traditional	SAR	Traditional	SAR	Traditional	SAR	Traditional	SAR	Traditional	SAR	Traditional	SAR	Traditional	SAR
Import tariffs	0.260***	0.040***	0.256***	0.049***	0.256***	0.049***	0.316***	0.059***	0.339***	0.062***	0.205**	0.071**	0.329**	0.084**
rho		4.805***		6.431***		5.458***		5.873***		5.643***		5.557***		5.668***
Exchange rates	0.056	-0.778	0.082	-0.978	0.008	-0.0948	0.017	-0.059	0.038	-0.093	0.098	-0.112	0.193	-0.142
Money supply	0.001*	0.002*	0.022*	0.072*	0.042*	0.067*	0.091*	0.092*	0.036*	0.074*	0.064	0.103	0.037	0.453
location	1.112*	2.956*	1.082*	2.056*	1.094**	2.068*	1.303**	1.602	1.205**	2.106**	1.250*	1.146	1.320**	1.146**
Rainfall	-0,075**	-0.009***	-0,035**	-0.014***	-0.002**	-0.023*	-0.0053**	-0.069**	-0.0047**	-0.058**	-0.002***	-0.013**	-0.012***	-0.024**
Nightlight			-0.004***	-0.091***	-0.006***	-0.101***	-0.011***	-0.081***	-0.014***	-0.171***	-0.041***	-0.171***	-0.004***	-0.091***
Distance to Harare					0.028	0.048**	0.038	0.068**	0.028	0.048**	0.014	0.019***	0.028	0.048**
Distance to Bulawayo							-0.015**	-0.006	-0.053**	-0.056	-0.053**	-0.082*	-0.015**	-0.006
Distance to Beitbridge									0.073***	0.064*	0.029*	0.023***	0.073***	0.054*
Distance to Mutare											0.015	0.010	0.015	0.010
Bulawayo prov dum													0.529	3.078
Harare province dum													-4.585*	2.122
Manicaland prov dum													1.914***	2.520
Mashonaland central prov dum													0.237	4.62**
Mashonaland east prov dum													0.824	3.50**
Mashonaland west prov dum													-0.294	-2.755*
Masvingo prov dum													-2.911*	-3.453
Matabeleland south dum													-2.811***	-1.823
Midlands prov dum													-3.105***	3.255
R-squared	0.424	0.532	0.365	0.584	0.265	0.558	0.424	0.465	0.365	0.465	0.373	0.507	0.436	0.545

Source: Own computation using STATA, the depend variable is average consumer goods (significant level *** p<0.01, ** p<0.05, * p<0.1)

Appendix A10: Comparison between the traditional and spatial import tariffs models (SDM and SEM)

Variables	SDM	SEM	SDM	SEM	SDM	SEM	SDM	SEM	SDM	SEM	SDM	SEM	SDM	SEM	SDM	SEM	SDM	SEM	SDM	SEM
Import tariffs	0.1014**	0.097**	0.093**	0.062**	0.091**	0.010**	0.0166***	0.091***	0.014***	0.087***	0.013***	0.097***	0.017***	0.059***	0.083***	0.062***	0.0905**	0.071**	0.012**	0.084**
rho	6.730***	5.630***	5.017***	4.805***	5.821***	5.557***	5.427***	4.668***	5.841***	4.431***	5.838***	5.458***	4.433***	5.873***	4.759***	5.643***	4.867***	5.537***	5.436***	5.668***
Exchange rates			0.193	-0.142	1.482**	3.056**	0.056	-0.778	0.082	-0.978	0.008	-0.0948	0.017	-0.059	0.038	-0.093	0.098	-0.112	0.193	-0.142
Money supply					4.754***	5.651***	0.001*	0.002*	0.022*	0.072*	0.042*	0.067*	0.091*	0.092*	0.036*	0.074*	0.064	0.103	0.037	0.453
location					0.393	0.598	1.112*	2.956*	1.082*	2.056*	1.094**	2.068*	1.303**	1.602	1.205**	2.106**	1.250*	1.146	1.320**	1.146**
Rainfall							-0,075**	-0.009***	-0,035**	-0.014***	-0.002**	-0.023*	-0.0053**	-0.069**	-0.0047**	-0.058**	-0.002***	-0.013**	-0.012***	-0.024**
Nightlight									-0.004***	-0.091***	-0.006***	-0.101***	-0.011***	-0.081***	-0.014***	-0.171***	-0.041***	-0.171***	-0.004***	-0.091***
Distance to Harare											0.028	0.048**	0.038	0.068**	0.028	0.048**	0.014	0.019***	0.028	0.048**
Distance to Bulawayo													-0.015**	-0.006	-0.053**	-0.056	-0.053**	-0.082*	-0.015**	-0.006
Distance to Beitbridge															0.073***	0.064*	0.029*	0.023***	0.073***	0.054*
Distance to Mutare																	0.015	0.010	0.015	0.010
Bulawayo prov dum																			0.529	3.078
Harare province dum																			-4.585*	2.122
Manicaland prov dum																			1.914***	2.520
Mashonaland central prov dum																			0.237	4.62**
Mashonaland east prov dum																			0.824	3.50**
Mashonaland west prov dum																			-0.294	-2.755*
Masvingo prov dum																			-2.911*	-3.453
Matabeleland south dum																			-2.811***	-1.823
Midlands prov dum																			-3.105***	3.255

R-squared		0.518	0.438	0.549	0.418	0.495	0.424	0.532	0.365	0.584	0.265	0.558	0.424	0.465	0.365	0.465	0.373	0.507	0.436	0.545

Source: Own computation using STATA, the depend variable is average consumer goods (significant level *** p<0.01, ** p<0.05, * p<0.1

Appendix A11: Regression estimates

	Panel A: Food Prices			
Variables	Traditional	SDM	SAR	SEM
Import tariffs	0.271**	0.063***	0.048**	0.011*
exchange rate	0.0176	0.0416*	0.126**	0.00985***
money supply	0.0192**	0.0123***	0.0219**	0.0128***
rainfall	-0.032***	-0.020***	-0.004**	-0.008***
rho		0.484***	0.501***	
LM		0.224***	0.257***	0.250***
lambda				0.552***
R-squared	0.602	0.593	0.420	0.405
	Panel B: Cloth prices			
Import tariffs	0.362**	0.056***	0.057**	0.025**
exchange rate	0.0347	-0.0471	0.202*	0.219**
money supply	0.00952**	-0.0100	-0.00130	-9.71e-05
rainfall	-0.033***	-0.0135***	-0.00232	-0.00237
rho		0.526***	0.561***	
LM		0.789***	0.847***	0.843***
lambda				0.574***
R-squared	0.726	0.464	0.429	0.561
	Panel C : Alcohol Beverage			
Import tariffs	0.432**	0.0428**	0.022**	0.011***
exchange rate	0.0132	0.116**	0.00885	
money supply	0.00161***	0.00197	-0.00132	

rainfall	-0.031***	-0.0044***	-0.0078	
rho		0.373***	0.429***	
LM		0.047***	0.051***	0.053***
lambda				0.440***
R-squared	0.647	0.443	0.514	0.501
	Panel D : Furniture			
Import tariffs	0.390**	0.0336***	0.140***	0.0529***
exchange rate	6.911*	12.89*	3.808	1.568
money supply	-0.00760	-0.0284	-0.0186	-0.0160
rainfall	-0.011***	-0.196	0.00155	0.00688
rho		0.582***	0.650***	
LM		0.035***	0.057***	0.032***
lambda				0.702***
R-squared	0.362	0.316	0.431	0.610
	Panel E : Vehicle Fluids			
Import tariffs	0.208**	0.095***	0.061***	0.049***
exchange rate	0.103	0.433	0.101	0.161
money supply	0.00875**	-0.022	0.0136	0.0242
rainfall	-0.065	-0.00369	2.59e-05	-0.00346
rho		0.490***	0.499***	
LM		0.962***	1.039***	1.031***
lambda				0.520***
R-squared	0.480	0.523	0.461	0.482
	Pane F : Household Textile			
Import tariffs	0.251***	0.032***	0.081***	0.047***
exchange rate	0.0891	0.0633	0.229*	0.238*
money supply	0.0131**	-0.00692	-0.00272	-0.0282
rainfall	-0.098*	-0.0226***	-0.00531*	-0.00467
rho		0.496***	0.523***	
LM		1.426***	1.524***	1.521***
lambda				0.533***
R-squared	0.345	0.516	0.479	0.499

	Panel G : Fuel			
Import tariffs	0.277***	0.062*	0.043***	0.08***
exchange rate	0.378	1.262*	0.751**	0.675***
money supply	0.00125	-0.00720	-0.00219	-0.00106
rainfall	-0.074	-0.0126	0.00388	-0.000883
rho		0.507***	0.614***	
LM		5.553***	6.861***	6.748***
lambda				0.648***
R-squared	0.363	0.409	0.562	0.501
	Panel H : Footwear			
Import tariffs	0.331**	0.033***	0.065***	0.032***
exchange rate	0.0913	0.229	0.249*	0.252**
money supply	0.0108**	-0.00965	-0.00179	-0.00129
rainfall	-0.034	-0.0133**	-0.00854	-0.00153
rho		0.481***	0.532***	
LM		1.100***	1.234***	1.226***
lambda				0.550***
R-squared	0.489	0.528	0.552	0.551
	Panel I : Non-alcohol Beverage			
Import tariffs	0.695**	0.061***	0.027***	0.014***
exchange rate	-0.0134	-0.128	0.0529	0.0898**
money supply	0.00270	-0.00180	-0.00201	-0.00194
rainfall	-0.029	-0.00618**	-0.00113	-0.000688
rho		0.574***	0.627***	
LM		0.153***	0.171***	0.167***
lambda				0.662***
R-squared	0.452	0.471	0.487	0.359

Source: Own computation using STATA, the depend variable is average consumer goods (significant level *** p<0.01, ** p<0.05, * p<0.1)