Estimating the Quantity Effects of Non-Tariff Measures on SADC Meat and Milk Trade

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Abstract

Global trade protection in the form of tariffs has been on the downward trend since the conclusion of the World Trade Organisation Uruguay Round of negotiations. The same pattern was observed in SADC as well as other regional integration groups. In SADC the declining trade protection was not accompanied by improvement in trade performance. If anything, the share of intra-SADC trade has actually declined during the phase down of tariffs in the eight year period. This study explores the possible reason for poor trade performance in the tariff reducing environment using meat and dairy markets as case studies over the period 2000 to 2010. It is hypothesised that non tariff measures (NTMs) are more trade restricting that tariffs. The statistics show that on average each agricultural product traded is affected by about ten NTM. These vary from country to country, with Mozambique having the highest incidence of NTMs, and the lowest being Malawi. On a product level, fruits are the most affected products with more about 40% of all NTMs applied. The gravity model was used to estimate intra-SADC trade and to evaluate the quantity impacts of NTMs on tariffs. The NTMs applied to meat products were found to be as high as 400% compared to roughly 200% for dairy. Furthermore, it was found that in the case of dairy tariffs and NTMs were used jointly as means of protection. This implies that there is a need to focus attention, both in research and policy on the NTMs.

Key words: Non-Tariff measures, gravity Model, intra-SADC Trade, tariff equivalent

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1. INTRODUCTION AND BACKGROUND

The conclusion of the Uruguay round has led to substantial reduction in trade protection, mainly tariffs. This reduction was further intensified by the increasing number of regional and preferential trade agreements (RTAs and PTAs). The WTO database has a record of more than 500 notifications of RTA and PTA involving goods and services. Large components of these (more 90%) were notified later than 1995, after the establishment of the WTO.

Over the years, multilateral trade negotiations have helped to substantially reduce tariff rates globally, and further pressure on RTAs to do so. According to the United Nations Conference on Trade and Development-Trade Analysis and Information System (UNCTAD-TRAINS) database, the tariff averages on both agricultural goods and on non-agricultural products declined steadily from 19.9% and 6.7% in 1995 to reach 7.4% and 2.4% in 2008, respectively. This decline in the global tariff barrier is due to eight rounds of multilateral trade negotiations under the auspices of the GATT/WTO, as well as under bilateral and regional arrangements.

These regional arrangements exerted downward pressure on tariff protection and thus further reduction was possible in the years following the formation of the WTO (2012). The pressure is due to the desire by individual members to gain more and better access in the RTA or PTA than those offered at the multilateral level of the WTO. Additional pressure to these RTAs is added by the Most Favoured Nation (MFN) Clause[2]. All these pressures to reduce tariffs were also evident in southern and eastern Africa as countries also engaged in formation of RTAs. During the period following the formation of the WTO, the groups in southern and eastern Africa were involved in more than six RTAs and more than a two dozen PTAs (WTO, 2012).

The major ones in the region are the formation of the Common Markets of Eastern and Southern Africa (COMESA) customs union and the Southern African Development

[2] Article XXIV of the General Agreement of Trade and Tariffs (GATT) has a provision that if a member offers better market access in an RTA to WTO member; it should extend the all other members. Although there is a consideration for developing countries, in some cases it has been enforced or included in the negotiations, e.g., EU-SADC EPA negotiations.

Community (SADC) free trade area (FTA). There were other agreements which involved countries outside the region such as the SACU-EFTA free trade area, EU-SA Trade and Development Co-operation Agreement (TDCA) and well as the Economic Partnership Agreements (EPA) with several country groups in the region. The SADC FTA which was being implemented over the eight year period, between 2000 and 2008 has resulted in 85% tariff reduction between the participating countries (Southern Africa Trade Hub, 2011). The objectives of SADC FTA have always been to increase the intra-SADC trade.

The observed results for SADC trade have however showed very mild improvements. During the period when SADC was implementing the trade protocol, tariffs did not improve at a similar rate of tariff reduction. While the remaining tariffs on intra-SADC trade are at 15% and less than 5% in the case of SACU, intra-SADC trade is still below 20% of total SADC trade. It can then be concluded that despite global tariffs being pushed down and SADC even lower, trade performance has been disappointing.

An indicator of trade performance, intra-SADC trade share was calculated over the period when SADC was implementing the trade protocol. The results of that performance are shown in Figure 1, and are compared with the tariff reduction over the same period. The intra-SADC trade share improved for the first three years, from about 15% of total exports to 25% in 2002. Then from there it declined to the mid-20s and stayed there for most of the period. The average share of the period was about 21%.

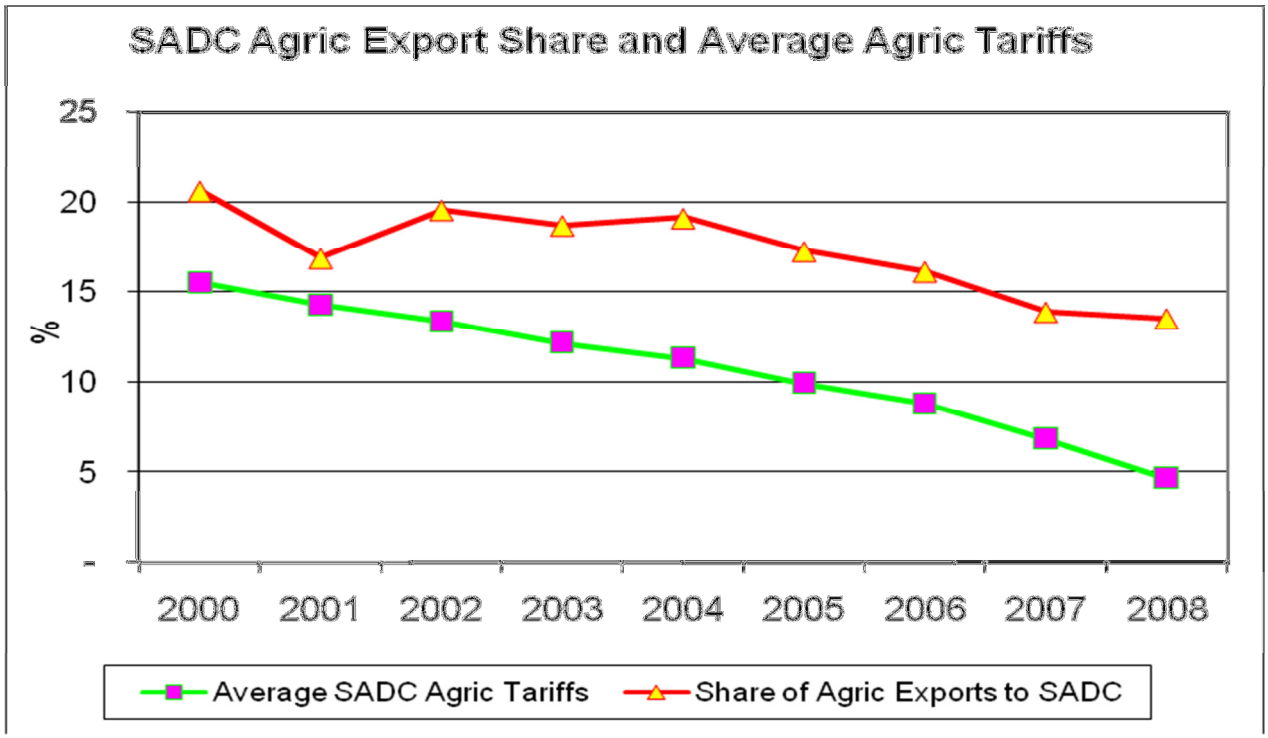

Figure 1: Intra-SADC trade in agricultural and average tariffs applied on agricultural products.

Source: UnComtrade Database and SADC Secretariat.

The SADC trade has actually been the opposite of what was hoped to be achieved with the tariff reduction, and this present a problem situation. What is observed in Figure 1 raises several questions.

- Why was there poor trade performance when tariffs declined substantially?
- Were tariffs not the main barriers to intra-SADC trade?
- Were tariffs just mere distractions and therefore by focusing only on them, important factors were left out?
- While tariffs were being reduced, did other factors start growing in importance as restrictions to trade?

This study addresses some of the questions raised, as we try to explain and understand trade in SADC as well as trade cost. One of the possible factor that is hypothesised to be more trade restricting is the presence and use of non tariff measures (NTMs). WE further argue that the decline in tariffs has also raised the relative importance of NTMs, which are used more as both protectionist and regulatory trade instruments in controlling and hampering the free flow of international trade.

Therefore the objectives of this study are to:

- explore the use of NTMs in SADC,
- estimate the effects of NTMs on intra-SADC trade, and
- calculate the quantity effects of tariffs on trade.

These questions will be answered by analysing the effects of NTMs on intra-SADC in meat and dairy products using the gravity model. The SADC countries included in this study are eleven, however SACU countries are aggregated into one. Other countries are Mozambique Malawi, Mauritius, Tanzania, Zambia and Zimbabwe. The period of evaluation extends from the year 2000 when started implementing the protocol on trade up to 2010.

The questions are not on relevant for study purposes, but have implication in both policy spaces as well as for research purposes. The policy relevance at this questions have to do with the fact that the there is a need to understand NTMs better. The types, uses and frequencies of these NTMs must be known and understood in order to facilitate monitoring of such measures. This will help policy makers to decide on monitoring, whether they need to add these on the negotiation list and with which negotiating partners. Some of the NTMs that are used are legal or compliant with the WTO regulations, while others are not. The cost of compliance with such NTMs must also be considered. These are very important questions that can provide policy makers that have to deal with NTM challenges.

For research purposes, there is so much scope out there on the subject of NTMs. The first thing that needs to be understood is whether NTMS are really replacing tariffs or not. It also needs to be known which countries use what NTMs on what products and in what form. Other areas that need to be understood are around the impact on market access and whether NTMs are trade creating or trade diverting.

The rest of the study is organised as follows: Section 2 discusses the NTMs in detail, from the definitions, taxonomy and those that are applied in SADC. In section 3 we look at the data that is used to explain some of the NTM phenomenon and we also discuss the gravity model. In addition, we derive the measure of calculating the NTM that can directly be compared to tariffs (or advalorem equivalent tariff of an NTM). Section 4 discusses the empirical results and concluding remarks are discussed in the section 5.

2. NTMS AND SADC TRADE

As tariffs have been reduced in subsequent rounds of trade negotiations, attention has focused on the impacts of domestic policies on international trade and the use of NTMs. According to Deardoff (2012,) evidence from an inventory of business complaints, natural resource based industries, such as agriculture and food, mining, and textiles, are most strongly affected by NTMs relative to their export volumes. Certification procedures, quantity control measures, and technical regulations are the types of NTM most frequently complained about. Concerns about domestic governance practices, such as impediments related to government procurement, investment restrictions, or insufficient intellectual property rights protection account for almost a third of all NTM observations and are in most cases not sector-specific, but of a general nature.

Empirical analysis concerning the use of NTMs is frequently being based on qualitative and quantitative information drawn from inventories and surveys (Bijit, *et al*, 2002). Data on the prevalence of regulations, for example, has been used to derive simple indicators, such as frequency measures. The latter can be unweighted, as in the case of frequency ratios that correspond to the share of tariff lines subject to certain NTMs (Swann et al., 1996; Brenton et al., 2001, Nicoletti et al., 2003), or weighted, as for import or export coverage ratios that measure the percentage of imports or exports subject to particular NTMs (Carrere and Demelo, 2009; OECD, 2005; Bora et al., 2002).

Non-tariff measures (NTMs) are increasing in number and complexity, making it difficult to analyse and mitigate against them. They further pose increasing challenges to exporters

2.1 Definition of NTM

With all the trade distortions which are applicable to trade, some are justifiable while others are not. When a distortion is introduced explicitly to protect domestic industry by restricting import demand, then it is classified as non tariff barrier (NTB). NTBs may include internal measures such as production subsidy and many other administrative measures.

Sometimes as government pursue justifiable causes such as ensuring food safety, building standards and environmental requirements they end up implementing them in a restrictive

manner. Irrespective of the intended objective, they may end up constraining the volume of imports.

The key distinguishing feature of NTBs from NTMs is that NTBs have protectionist intent. Some examples of NTBs include quotas, tariff-rate quotas, licensing regimes and price bands. On the other hand, NTMs include all interventions that distort trade. In the context of all NTMs, there are some which are allowed by the WTO such as those intended to protect human life, such as those that are imposed for food safety reasons.

There are different approaches and initiatives towards dealing with these NTMs. At the multilateral level, there have been changes approaches since the days of GATT and to WTO. The first approach was basically that NTMs can be negotiated in order to facilitate trade and remove barriers. This was mainly on NTMs that affect mainly imports. For exports, GATT granted the authority for affected importing countries to impose countervailing duties. GATT recommended that in cases where measures and regulations are applied and do affect traded goods, that such measures should be non-discriminatory.

The formation of the WTO in 1995 meant that other approaches were adopted to deal with NTMs issues. For example, the WTO Subsidies and Countervailing Measures (SCM) Agreement strengthens the prohibition against export subsidies. The WTO Technical Barriers to Trade (TBT) and Sanitary and Phytosanitary Measures (SPS) Agreements represent a strengthening of the non-discrimination or national treatment obligations regarding certain kinds of domestic regulations. In addition, the WTO SCM Agreement contains substantial commitments regarding domestic subsidies that were not included in GATT.

Over the years there have been several taxonomies of NTMs. The latest one is the Multi-Agency Support Team (MAST) nomenclature, adopted by UNCTAD's Group of Eminent Persons in 2009. This nomenclature is currently under revision by the World Trade Organization's (WTO) legal department in order to make it suitable for the notification of measures by member states. The logical structure of the nomenclature is almost similar to the harmonized system of product classification.

Table 1 NTM Classification

NTM Code	Description
A	Sanitary and phytosanitary measures
B	Technical barriers to trade
C	Pre-shipment inspection and other formalities
D	Price control measures
E	Licences, quotas, prohibitions and other quantity control measures
F	Charges, taxes and other para-tariff measures
G	Finance measures
H	Anti-competitive measures
I	Trade-related investment measures
J	Distribution restrictions
K	Restriction on post-sales services
L	SUBSIDIES (excluding export subsidies under P700)
M	Government procurement restrictions
N	Intellectual property
O	Rules of origin
P	Export related measures

Source: MAST, 2009

The NTM classification is hierarchical in nature. It starts with the highest degree of aggregation consisting of 16 groups. The groups are labeled in alphabetical order, from A through to P, where A is the category for SPS measures, B is TBT measures and so on. Table 1 shows the rest of the NTM classification at the broad level. Each category is disaggregated further into sub-units.

2.2 NTMs that are predominant in agricultural trade

Increasing regulations in food and agricultural products lead to more use of NTMs as more countries follow the Codex Alimentarius food standards. Thus, agricultural trade is more affected by NTMs relative to non-agricultural products (WTO, 2012). Part of the reason is that the WTO allows countries to adopt appropriate protection for human, plant and animals under the SPS and TBT agreements. Members are even allowed to set more stringent measures if there is scientific evidence for such threats and risks (WTO, 2012). However, the protectionism seems to be escalated by the fact that there is no international food safety, animal and plant standards for majority of food and agricultural products that are traded throughout the world. This result in countries developing own standards which are different from one region to another and the same with countries. Some of the most used NTMs include SPS and TBT following their agreements which permit their use.

SPS Agreement

The SPS agreement applies to all measures that directly and indirectly affect international trade. For any measure to comply with the SPS agreements, it should be necessary to protect human, animal life or plant life (WTO, 2012). This means that there has to be some level of risk assessment before considering the SPS application. In applying this, there must be consideration that it does not result in unfair trade.

One of the main principles of the WTO is "non-discrimination, and thus for SPS measures to be compliant, they need not be discriminatory or be disguised restriction on international trade. So the SPS measures must be based on scientific principle and there must be sufficient scientific evidence to justify the use of such measures. The scientific evidence is required to avoid arbitrary or unjustifiable use of the agreement. Therefore the measures may not be maintained without sufficient scientific evidence.

TBT Agreement

The purpose of the TBT agreement is to preserve the ability of the government and other technical groups to set the necessary standards, while at the same time guarding against the unjustified standards to protect their domestic industries. Unlike in the case of SPS agreement, TBT measures are not determined on the basis of scientific principle or evidence. They are applied when it is necessary to a legitimate objective (WTO, 2012). Legitimate objective include national security requirements, prevention of deceptive practices, protection of human health or safety, animal or plant life or health, or environment. In the case of TBT requirements scientific data is not the only determinant of legitimate objective.

2.3 NTMs IN SADC

Generally the studies on NTMs rely on data from the TRAINS database or some of the business surveys which are conducted with the companies that are involved in trade (OECD, 2005; Donnelly and Manifold, 2005; Martinez *et al*, 2009). For work on SADC the TRAINS database was not applicable as it does not cover many countries in the region. The scarcity of

NTM data in the SADC region limits the amount and quality of work that can be done in this area.

Mmasi and Ihiga (2007) have done a survey of NTMs in covering the EAC, SADC and COMESA. However the scope of work was limited to interviews with stakeholders and border officials. The end results were mainly identification of what was observed during the survey as key NTMs. Similar outcomes were reported in studies by Jensen and Keyser (2009), Charalambides and Gilson (2011), Mthembu-Salter (2007) and several consultancy work (Imani, 2007 and SAIIA, 2007). The availability of data limit the research work to identification or analysis based on frequencies and coverage ratios. Analysis based on this information will not adequately address some of the questions raised in the first section.

There is work that started recently by the Trademark Southern Africa institution of recording NTMs by border SADC, EAC and COMESA border posts. The reporting of complaints is done by the traders or truckers as they experience challenges, and the matter is recorded to be taken further with the affected countries. There is also information on the notifications such as SPS and TBT to the WTO and fellow SADC partners. There is transparency on this initiative as all the information is made available online as well as contact details for each an every responsible institutions in the countries, so it a good initiative.

The work is however not sufficient to explain what really happened in the previous years. Furthermore, its focus is narrow as it hardly includes issues beyond the border. In other words, it barely scratches the surface in terms of what is happening with the NTMs. There are regulatory issues, state trading and licensing requirements which are not necessarily part of what is happening at the border. Therefore such NTMs will not make it to the portal, yet they do affect trade flows.

The authors collected information on NTMs taking place in SADC over a four year period and then classifying them into the MAST taxonomy. The information was collected from gazetted documents from the governments of the seven SADC countries in this study, other survey reports, WTO notifications and policy briefs. Interviews were held with various government officials and institutions involved in trade, trade regulation and trade negotiations. There were also visits to some of the SADC border posts to observe what

happens at the border when some of the consignments arrive, how they are handled, how long it takes to process the documents and other administrative issues of relevance.

The end result is a database of NTMs in SADC by country according to the MAST taxonomy. The database shows incidences of NTMs by country and by product. The database is a work in progress as it needs to be updated regularly. The NTMs are evolving and adapting with time, and therefore an NTM database should follow suit.

Overall more than 2 400 NTMs were identified in the agricultural sector for SADC. These NTMs were applied on 250 agricultural products at the HS 4 digit. That is an average of 10 NTMs per product. Figure 2 shows the utilisation of NTMs by SADC country on these agricultural products, or coverage. For example, the 45% on Mozambique indicates the percentage of products that are affected by the NTMs. This implies that roughly 110 agricultural products that are traded with Mozambique are affected by NTMs.

So the countries that apply NTMs more than others in SADC are Mozambique, Tanzania, South Africa and Mauritius. In all these countries, more than 40% of trade in agricultural products face one or more NTMs. The country that uses NTMs relatively less compared with others in Malawi, with coverage of less than 20%. Malawi is followed by the three SACU countries of Namibia, Botswana and Lesotho, all with coverage of less than 30%.

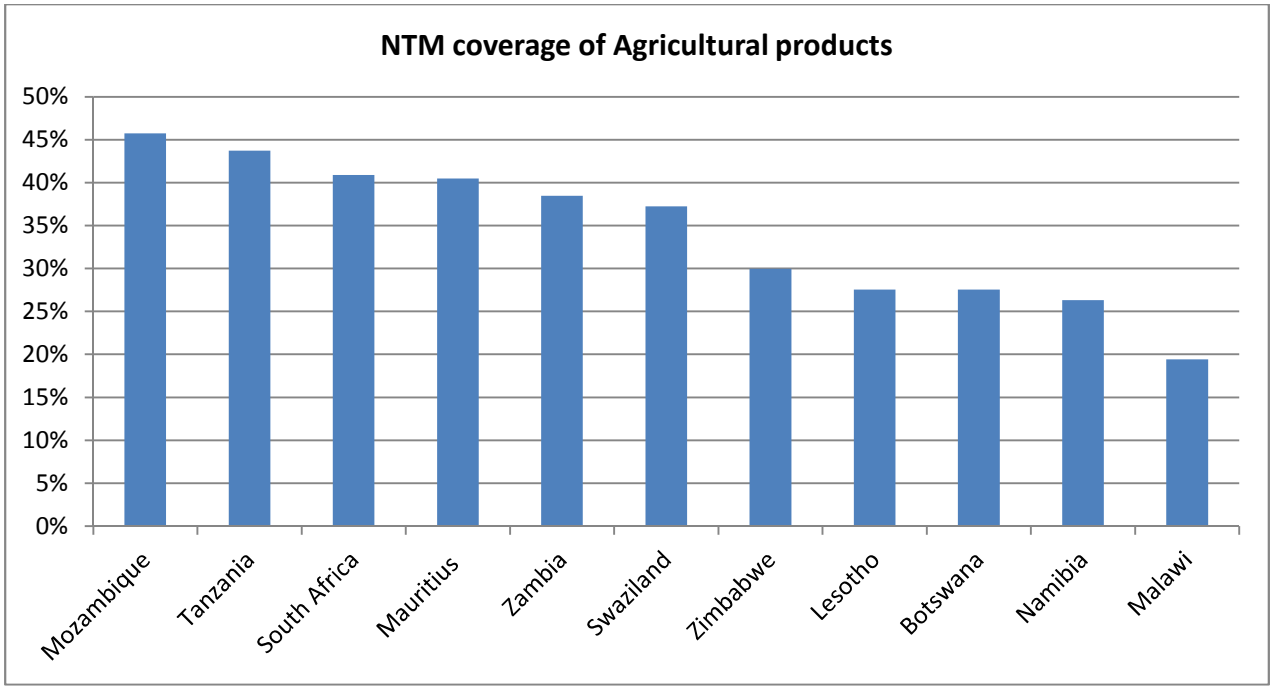

Figure 2: NTM coverage of agricultural products by country

The disaggregation of NTMs by type is shown in **Figure 2**. This figure is an aggregation of all countries, but then disaggregated according to the type of NTM. It is evident from the figure that SADC countries use SPS measures more than others, accounting for 37% of all NTM incidences. This is also a trend in global usage of NTMs. This is also because the use of SPS is allowed by the WTO as long as it complies with those requirements. The use of SPS measures is followed by the licensing and quantity requirements, with a share of 20%. The third most used NTM is the export control measures. This is very interesting as these measures are actually applied by both the exporter or the supplier and importer.

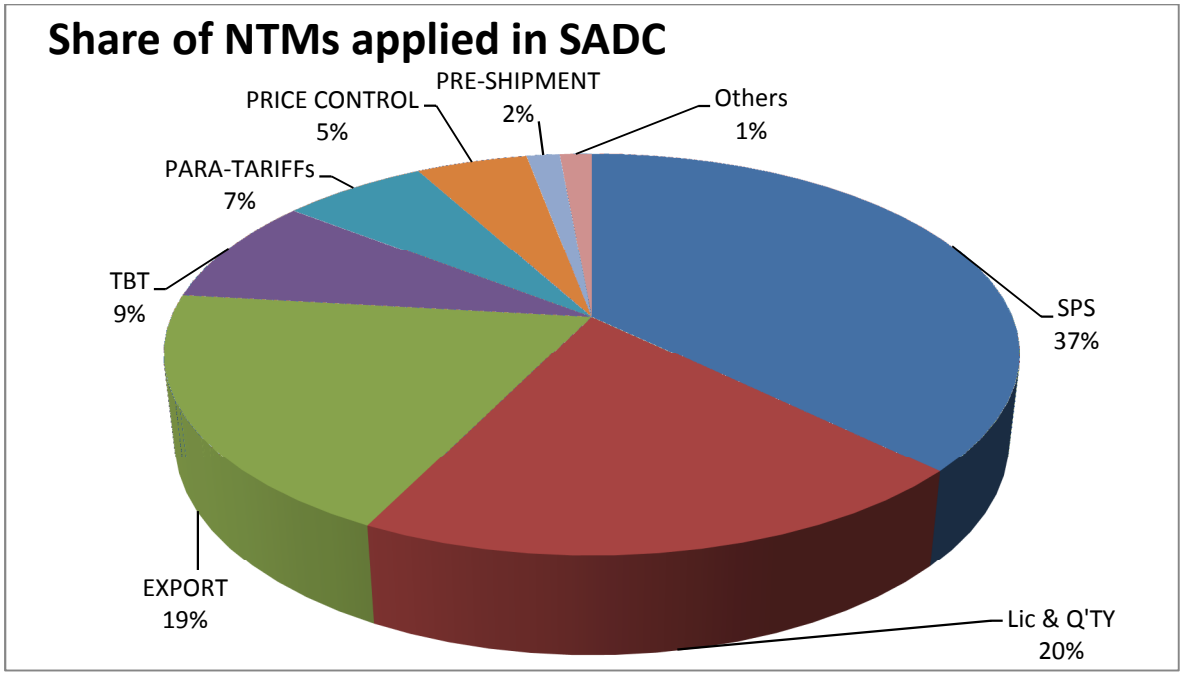

Figure 3: Share of Aggregated NTM incidences in SADC for the period 2000 - 10.

Figure 4 provides a different view, but same information as in Figure 3. It shows application of NTMs by type, but this time using the actual incidence numbers rather than shares. Incidences of SPS measures applied were nearly 900 times across all products over the whole period. It is followed by licensing and quantitative controls as well as export measures with 485 and 469 incidences, respectively. The rest of the NTMs are falling way behind in terms of incidences.

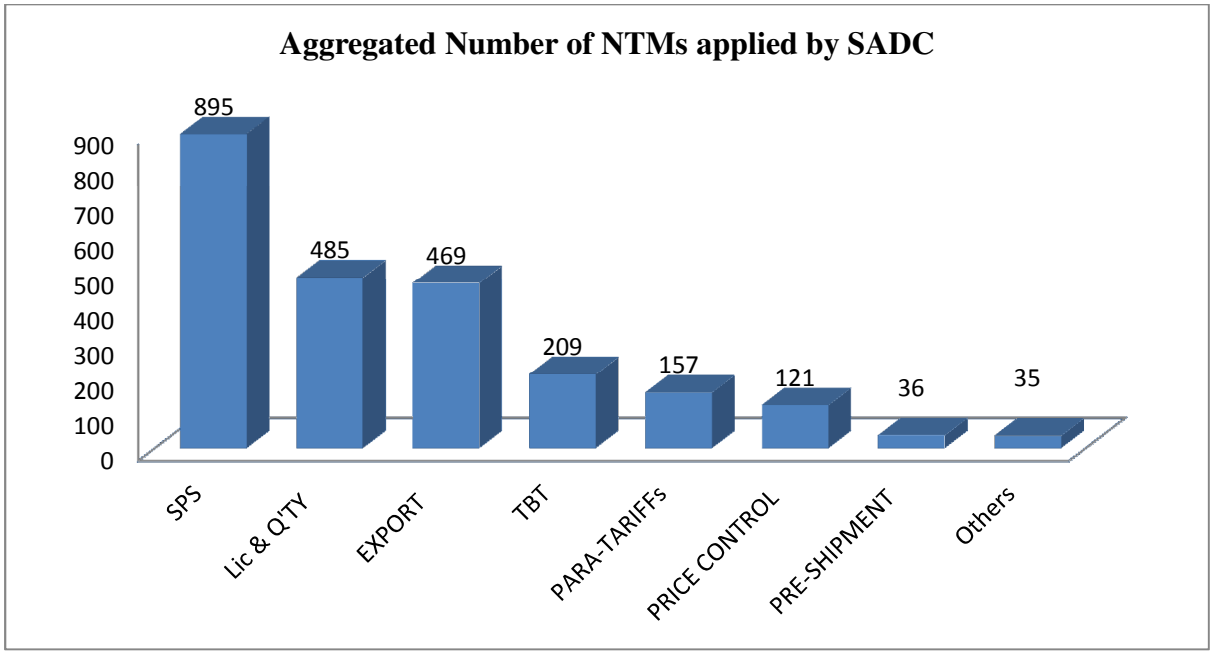

Figure 4: Aggregated number of SADC NTMs by type

Aggregation of NTMs by product shows that the most affected products are fruits. The products are defined at HS2 digit in order to summarise information into Figure 5. In the NTM database Products were defined at HS4 digit, so they were aggregated for the purpose of this graph. The sub-group fruit in SADC is affected by more than 400 incidences of NTMs. That is almost double the number of the second group. They are followed by meat and dairy products both with incidences of more than 200. The most concerning is that NTMs on cereals have more than 150 incidences, implying that the basic food crops get affected substantially by application of such measures.

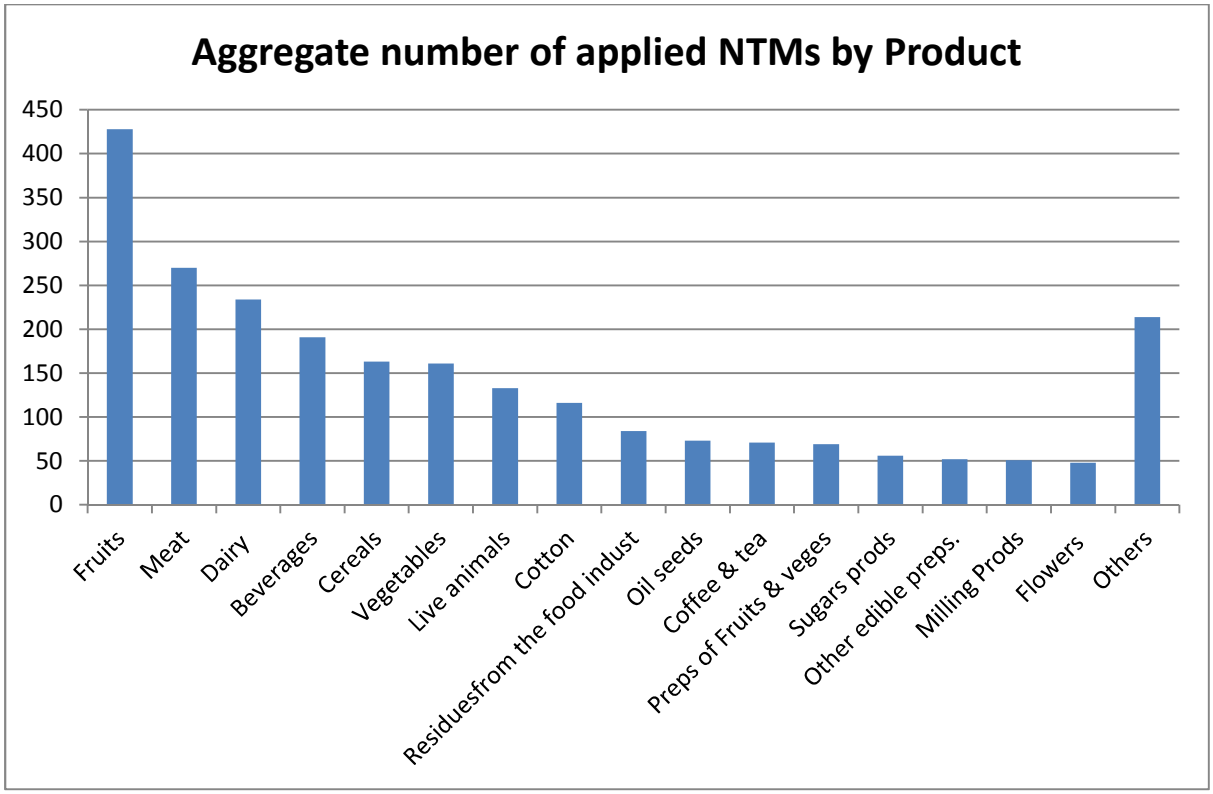

Figure 5: Aggregated number of SADC NTMs by product

The incidences of NTMs were based on information that the authors were able to collect as well as the classifications. In some of the cases there is a very fine margin between the definitions and descriptions in some of the classifications. For examples the measures that involve finances and admin can easily into any of the following groups: D, (price controls) F, (charges, taxes and para-tariffs) and G (Finance measures). So, to some extend it is possible that there may have been mis-classifications. These categories are not used substantially in SADC, as we have seen in Figure 3 and Figure 4.However, the NTM Database is still a fair representation of what is happening in that area.

3 DATA AND METHODOLOGIES

This section discusses some of the data to be used for analysis as well as other data issues. Furthermore it looks at the gravity equation, both the theory and the background. Towards the end of this section, an equation that will be used to estimate the tariff equivalent of an NTM is derived.

3.1 DATA

Estimation of the gravity model requires data on bilateral trade flows, gross domestic product (GDP), distances, tariffs as well as other determinants of bilateral trade. These bilateral trade factors include contiguity, common language, colonial ties, landlock-ness, islands, exchange rates, and others that capture cultural similarities. The trade flow data used come from the commodity trade database of the United Nations Statistics Division (COMTRADE) and was in $1000. The GDP data is from the World Bank, the World Development Indicators and it was converted to $ billion. The annual bilateral tariff data for SADC was accessed from the phase down schedule of the SADC Secretariat, which was submitted for the implementation of the trade protocol.

The difficult part was on data regarding NTMs. Many studies use the TRAINS database (Kee, Nicita and Olarreaga, 2009; Anderson and Neary, 1992 & 2003, Deardoff and Stern, 1997) which has useful information on NTMs of many countries. Unfortunately, as it is the case with many international databases, information on NTMs for many SADC countries is not reported. So information was gathers over a four-period from official statistics, border posts and trade officials. Additional information was also provided by the Trademark Southern Africa through a portal which depends on reporting by members states. Unfortunately that captures only the data that gets reported at the border when there are problems with the consignments. So the Trademark portal is useful, but it captures only a small portion of the NTMs.

The equations that will be estimated are for meat and dairy products. The variable that is being regressed is actually the import trade flow. The choice is basically for the reliability of that trade flow relative to the export flow. For the year 2000 Mozambique had not reported any data at the Comtrade. So for only one year, Mozambique data was mirrored, using trade flows of partner countries. The timeframe for analysis was for the period 2000 – 2010.

The countries that are included in the analysis are Southern African Customs Union (SACU combined), Malawi, Mauritius, Mozambique, Tanzania, Zambia and Zimbabwe. This covers eleven of the fifteen SADC countries. The countries which excluded were on the basis of there being no information or very difficult to access. This includes Madagascar and the Seychelles. Angola and the Democratic Republic of Congo were excluded on the basis that

the two have not ratified the SADC trade protocol, and are understood to be outside the SADC free trade area.

3.2 METHODS

The gravity model of international trade is used to estimate the impact of NTMs on Intra-SADC trade. The gravity model provides the main link between trade barriers and trade flows. The model has been used since the seminal work of Tinbergen in 1962. The gravity model has been widely used to infer substantial trade flow effects of institutions such as customs unions and exchange rate mechanisms. The equation approximate bilateral trade flows between any two countries using proximity and their sizes, which are represented by the gross domestic product (GDP). The gravity model has stability and power to explain bilateral trade, however has been criticised for being atheoretic.

The initial attempt to provide theoretical foundations for gravity model was done by Anderson (1979). He contextualised the model by differentiating goods by their origin and consumer preferences were also defined over differentiated products. His theoretical foundations were based on constant elasticity of substitution (CES) or Armington assumptions.

Anderson's work was followed by Bergstrand (1985 and 1989) showing that gravity equation can be based on trade model of monopolistic competition developed by Krugman (1980). Monopolistic competition differentiates products by location, which is a feature that suits gravity model well. Deardoff (1998) derived the gravity equation from traditional factor proportions explanation of trade. Eaton and Kortum (2002) derived the equation from a Ricardian model while Helpman (2002) and Chaney used the theoretical model of international trade in differentiated products with affirm heterogeneity. Lately there have not been many concerns regarding the foundations of the gravity model.

The standard procedure for estimating gravity equation is by taking the natural logarithm of all variables and end up with a the log-linear equation. Then this equation can be estimated using ordinary least square (OLS) method. Other methods can be used to estimate the equation. The OLS technique is preferred as an estimation procedure. It is stated as follows:

$$lnX_{ijt} = \alpha + \beta_1 lnGDP_{it} + \beta_2 lnGDP_{jt} + \beta_3 lnT_{ijt} + \beta_4 lnG_{ij} + \beta_5 NTM_{it} + u_{ijt} \text{ .....(1)}$$

Where:

Subscripts *i,j* and *t* are for importing and exporting countries as well as the time period.

$lnX_{i,j,t}$= natural log of exports from country *i* to country *j* in period *t* (US$ 1000);

$lnGDP_{it}$ = log of GDP in the exporting country (US$ billion);

$lnGDP_{jt}$ = log of GDP in the importing country (US$ billion);

lnT_{it} = log of Tariffs imposed by the importing country;

lnG_{ij} = are time invariant variables which are generally used to capture trade costs.

NTM_{it} = a dummy that denotes presence of NTM

μ_{ijt} *is the error term*

The variable G typically captures a proxy for trade costs with a bilateral distance. The traditional gravity equation has additional variables in G. These include dummies for landlocked countries, islands, common border, language and colony. The dummies are used to reflect the hypothesis that trade costs increase with distance and that they are higher for islands and landlocked countries but lower for countries sharing the border. Dummies for language, colony and other cultural features are used to capture information costs.

In the gravity literature, trade costs generally take the form:

$$G_{ij} = D_{ij}^{\gamma_1} * \exp(\gamma_2 bord_{ij} + \gamma_3 Lang_{ij} + \gamma_4 Col_{ij} + \gamma_5 Landl_i + \gamma_6 RTA_{ij} \text{.....(2)}$$

Where D_{ij} is a bilateral distance, and $bord_{ij}, Lang_{ij}, Col_{ij}, Landl_{ij}$ and RTA_{ij} are dummy variables denoting respectively whether two countries have common border, language, coloniser, whether one of the two is landlocked country, including both or whether both countries are members of a regional trade agreement.

In order to estimate the impact of NTM on trade, we need to include dummy variable for NTM. The variable will take the value of 1 when it is present in the product being trade and zero otherwise. We must then decompose the overall trade costs as from Equation 2 into their tariff and non tariff equivalent components.

3.3 DERIVING A TARIFF EQUIVALENT OF AN NTM

The gravity model was also preferred for its use in deriving the tariff equivalent of an NTM. From Equation (1), T_{ijt} and NTM_{it} are tariff and NTM imposed by country *i* on *j* in the sector in question at time *t*. So, the equation looks like this:

$$lnX_{ijt} = \alpha + \beta_1 lnGDP_{it} + \beta_2 lnGDP_{jt} + \beta_3 \ln(1 + T_{ijt}) + \beta_4 lnG_{ij} + \beta_5 NTM_{it} + u_{ij} \ldots.(3)$$

Equation (3) is different from (1) in that 1 has been added before the tariff. Since the equation is estimated in logs, this is to avoid taking the log of zero where tariffs are not applied. Zero tariffs would send the log to negative infinity while the log of 1 would be equal to zero. After running the model, we can use the estimates to retrieve the tariff equivalent of the NTM. First, we group together all other variables except NTM together from α to β_4. We then use Ψ_{nt}^{ij} as an explanatory variable. Then we have,

$$ln\hat{X}_{ijt} = \sum_{n\neq 5}\left(\hat{\beta}_n \Psi_{nt}^{ij}\right) + \hat{\beta}_5 NTM_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.(4)$$

Note that NTM is equal to 1 when the measure is present, and zero otherwise. So the predicted difference between country pair with an NTM and the same country pair without the NTM would be,

$$ln\hat{X}_{ijt,NTM} - ln\hat{X}_{ijt,no\ NTM} = \sum_{n\neq 5}\left(\hat{\beta}_n \Psi_{nt}^{ij}\right) + \hat{\beta}_5(1) \quad - \left(\sum_{n\neq 5}\left(\hat{\beta}_n \Psi_{nt}^{ij}\right) + \hat{\beta}_5(0) \quad \right) \ldots..(5)$$
$$= \hat{\beta}_5$$

The same calculations can be performed for the effects of a tariff at rate), T_{ijt} and compare it to "a no tariff" at all. So,

$$ln\hat{X}_{ijt,tariff} - ln\hat{X}_{ijt,no\ tariff} = \sum_{\iota\neq 3}\left(\hat{\beta}_\iota \Psi_{\iota t}^{ij}\right) + \hat{\beta}_3\left(\ln(1 + T_{ijt}\right) \quad -$$
$$\left(\sum_{\iota\neq 3}\left(\hat{\beta}_\iota \Psi_{\iota t}^{ij}\right) + \hat{\beta}_3(0) \quad \right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(6)$$
$$= \hat{\beta}_3 \ln(1 + T_{ijt})$$

A tariff equivalent of NTM_{it} is the tariff that has the same effect on trade flows. This is the same as equating the left hand- sides of (6) and (7). Then, if the left-hand sides are equal, so are the right-hand sides. Thus, the tariff equivalent $\hat{T}$ of measure NTM_{it} satisfies,

$$\hat{\beta}_3 \ln(1 + T_{ijt}) = \hat{\beta}_5 \quad \text{.....(7)}$$

or

$$Tariff\ Equivalent = exp\left(\frac{\hat{\beta}_5}{\hat{\beta}_3}\right) - 1 \quad \text{.....(8)}$$

Then this calculation is made after the estimation of the gravity equation. This then provides the tariff equivalent of an NTM. It is from this equation that we will evaluate the tariff equivalent on an NTM.

4 EMPIRICAL RESULTS

The first part of analysing the modelling results from econometric view is to check whether the specific effects of the constant term can be treated as random variable or fixed effects. The generic form of gravity model is a two-way fixed effects panel data model (Bergstrand, 1985). This means that the restriction is imposed that $\alpha_{ijt} = 0$. However since we are interested in these effects, they are formalised as unknown parameters.

To test these parameters we use the Hausman test to decide whether to use the random or fixed effect model (Gujarati and Porter, 2009). The underlying null hypothesis is that fixed effects and random effects estimators are not substantially different. If the null hypothesis is rejected, it implies that the random effect is not appropriate as the error term is probably correlated with some of the repressors. In that case then the fixed effect model is preferred.

The Hausman[3] results for all eight equations show that affixed effect model is preferred. Therefore all regressions were estimated with fixed effect model as it has proven to have consistent estimators relative to the random effects.

[3] The Hausman results reported in this section are not included due to the length of the paper. However, authors can and will provide them should they be required.

The regression results for the gravity equation estimated for intra-SADC meat and dairy trade are shown in Table 2 and Table 3, respectively. For the meat market, the R^2 statistic ranges from 0.435 to 0.748. This represents a fair to a very good model fit. The F statistic is significant for all meat products, implying that all variables are jointly significant. The Durbin-Watson test ranges from 1.866 to 2.172 suggesting absence of autocorrelation.

Most explanatory variables have expected sign with few exceptions on *LnImp_GDP* for chicken, *LnTariff* for beef, *Border* for pork, *Landlock* for beef and sheep meat, and *NTM* in the case of sheep meat. These represent 12% of all estimated variables in the meat market. Starting the explanation with *LnImp_GDP* or the GDP of the importer, the number **0.882** appearing in column 1 and the row LnImp_GDP, is the estimated value of coefficient β_1 in equations (1) and (4). It gives an approximation of the price elasticity of SADC importing countries' demand for beef on average for all the years. This elasticity can also roughly be interpreted as income elasticity of beef. Since it is less than unity, it is probably a slight underestimation as beef in many households' budgets tends to rise with income.

The elasticities for colony and language are very high and significant in most meat products suggesting that information costs (contracts and communications) are very important in SADC. Elasticity for distance is also very high for meat products as it is more than unity in cases where it shows to be significant. This is part of the trade cost and plays a very important role in determining the impact on trade. Landlock is one of the variables capturing parts of the trade costs, and is significant for chicken market with a very high elasticity.

Table 2: Gravity model estimates for meat market

Dependent Variable	Beef	Pork	Sheep meat	Chicken
Explanatory Variables:		Coefficients		
(Constant)	11.220***	19.864***	5.170	23.171***
LnImp_GDP	0.882***	0.196	0.123	-0.317
LnPartner_GDP	0.218**	0.006	0.483***	0.431***
LnTariff	0.211	-4.2428**	-0.920	-0.834
LnDistance	-1.489***	-2.3757***	-0.872	-3.111***
Language	6.588***	10.867***	0.716	4.009**
Border	0.347	-0.596	1.345*	1.090
Colony	-5.545***	-4.169***	-1.981***	0.576
Landlock	0.630	-1.207	0.056	-2.836***
NTM	-2.858*	-5.657***	1.356	-1.366

R^2	0.748	.435	0.533	0.458
F	20.442***	7.449***	6.836***	7.127***
Degrees of freedom	71	96	63	85
D-W	2.054	1.866	2.172	1.941
NTM Tariff Equivalent	**100%**	**280%**	**77%**	**415%**

*** represents significance at the 1% level, ** represents significance at the 5% level and * stands for significance at the 10% level

Another proxy for trade costs is the NTM, which also has high elasticity but significant for beef and pork. The NTM elasticity as well as the tariff are combined to arrive at the tariff equivalent of an NTM, as well as its impacts. The last row of Table 2 shows the calculated tariff equivalents of NTMs on the four meat products. The tariff equivalent of an NTM ranges from 77% in sheep meat to 415% in the case of chicken. These amounts estimates the level which NTMs have price raising effects, and thus trade restricting.

The dairy model also shows fair to very good fit and all dairy equations show that variables are jointly significant. It also has the same percentage of variables with unexpected sign as the meat model. There are more significant explanatory variables for the concentrated and unconcentrated milk markets compared with butter and cheese. Income of the partner (*LnImp_GDP*), which is a proxy for supply is a very important factor in all milk products. The same is the case for distance variable. This can be explained by high perishability of milk products as well as the requirements for specialised transportation. So the supplier is required to have sufficient equipment in order to be responsive to the trade demands.

Table 3: Gravity model estimates for meat market

Dependent Variable	Concentrated	Unconcentrated	Butter	Cheese
Explanatory Variables		Coefficients		
(Constant)	22.2792***	8.923***	1.662	7.435***
LnImp_GDP	-0.691***	0.336**	-0.128	0.154
LnPartner_GDP	0.7621***	1.048***	1.093***	1.103***
LnTariff	-3.463***	-0.667	-4.569***	0.098
LnDistance	-2.6127***	-1.192***	-0.388	-1.084***
Language	1.112	1.402**	-0.466	-0.143
Border	-0.669*	-0.224	0.351	-0.847**
Colony	1.392*	-1.599**	0.215	-0.338
Landlock	-3.571***	0.962**	-0.589	0.002

NTM	-2.858*	0.067	1.787**	0.521
R^2	0.44	0.477	0.738	0.755
F	13.6573***	18.377***	26.341***	36.292
df	147	190	93.000	115
D-W	1.986	2.083	1.840	1.938
NTM tariff Equivalent	**128%**	**10%**	**32%**	**200%**

*** represents significance at the 1% level, ** represents significance at the 5% level and * stands for significance at the 10% level

The NTM variable is significant in explaining concentrated milk as well as the butter and cream. The same products also have a significant tariff variable. This may be interpreted as a case where tariff and NTM are used as complements rather than as substitutes. Most of the literature suggests that more often the two are substitutes, basing the arguments on the proliferation of NTMs following the WTO Uruguay round of negotiations which led to substantial tariff reduction. The estimated tariff equivalent of an NTM ranges from 10% to 200%. These are much lower compared to the meat market.

These results of NTM equivalents may appear too high, particularly on meat products. However, when one takes into account the nature of the countries in this estimation, as well as other estimation from other countries, they are not completely implausible. Adriamananjara *et al* (2004) estimated the ad valorem equivalent of NTMs for 12 groups of products for 18 regions/countries using the GTAP model. The range estimates for apparels were between 16 and 190%. Kee *et al*, 2009 in their estimations of trade restrictive indicators arrived at an estimate for apparels ranging between 0% and 249%. Such results do confirm that actually NTM equivalents can and are in most cases very high relative to tariffs.

In a study done in Southern Africa measuring integration and efficiency in Maize grain market, Traub *et al (*2010) found that a $1 increase in the SAFEX price result in about $4 increase in the market in Maputo. This was after they have taken into account tariffs, other taxes as well as transport costs. The quadrupling of the price in the Maputo may be an indication of all these other trade costs related with NTMs that makes the price so high. And this difference the grain prices between the two markets is not that different from the estimated NTM effects on some of the meat products.

5 CONCLUSIONS

The reduction of tariffs in the world and for regional trade has focused attention on the use of NTMs as an alternative means of protection. The case for SADC is emphasised by the fact that intra-SADC trade has not improved despite substantial tariff reduction. However, the difficulties of dealing with NTMs is that they are difficult to quantify, and sometimes not so transparent. So availability of information on NTMs poses another challenge in studying the effects of such measures.

In this study we estimated the quantity effects of NTMs in SADC using data collected from member countries as well as regional institutions on such measures that affect trade. Using the gravity model we decomposed the trade costs into tariff and NTMs, and then estimated tariff equivalent of NTMs for meat and dairy products. The results show that effects of NTMs on trade flows range between 70% and 400% for meat products, compared to the effects of tariffs. These NTM effects were slightly lower for dairy products, between 10% and 200%.

In the case of dairy products there seems to be evidence of complementing tariffs with NTMs as protection means. This basically implies that while in the case of meat tariffs were reduced, tariffs on dairy products remained fairly high, and that also explains why the tariff equivalent are lower than in the case of meat. The gap between tariffs and NTMs is not that big, relative to meat market.

The implications of these results or high trade costs are at three levels trade, price and welfare. Just as high tariffs are trade restricting, so are the NTMs. As it was explained, NTMs are more restricting than trade as they are already very high. Secondly at the price level it means that the consumers are paying much higher price than they should if these NTMs were to be reduced. Thirdly, trade restrictions, high prices and reduced trade flows are all welfare reducing. In this case, most of them are as result of the effects of NTMs.

In terms of future work on NTMs, globally there are discussions to expand the coverage of data collection and also to find some methodological framework for impact assessment. Developing countries should seek to invest their own resources in building capacity to

analyse NTMs for both research and policy purposes. Regional institutions in southern and eastern Africa are still lagging behind global trends, despite their stated intensions of reducing restrictive NTMs. This makes it difficult to address some of the challenges that restrict trade.

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