Potential effects of the United Kingdom's departure from the European Union on South African citrus exports: a case of non-tariff measures

by M.S. Mshengu and M. Kalaba

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ABSTRACT

The role of regional integration in generating trade and economic benefits was questioned when the UK decided to exit EU in 2017. This put a spotlight on several countries that have signed agreements with the EU in search for such benefits. The EU market is important for South African citrus exporters, however the increase in NTMs use by the EU to some extent may have an impact on South African citrus exports. The adoption of such NTMs contributes to a greater challenge for South African exporters incur a greater cost of complying with higher standards which some may likely not apply in the UK post-Brexit. Accordingly, the study uses the inventory analysis and gravity model to evaluate potential impact of NTMs imposed by EU on South African citrus to UK post-Brexit. The study results showed that SPS measures had a negative effect on oranges and mandarins in the rest of EU and UK and the effect is higher on exports to the rest of EU as compared to UK. This implies that, elimination of regulations that are pests and plant health related in UK post-Brexit, would reduce the negative effect of SPS measures on South African oranges and mandarins exports.

Keywords: NTMs, citrus exports, European Union, United Kingdom, gravity model

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1. INTRODUCTION

The global and regional integration initiatives have been increasing at an exponential rate since the formation of the World Trade Organization (WTO) in the mid-1990s (United State Department of Agriculture (USDA). 2020). This is because some of the gains from international trade are realized through such formations. The gains are also linked with the depth or degree of integration, i.e., that higher levels of integration results with higher trade benefits (Ghosh, S. and Yamarik, S. 2004). The European Union (EU) exemplifies such a notion due to high levels of intra-regional trade associated with the depth of such integrations. However, the decision of the United Kingdom (UK) to exit the EU raised questions about the notion of gains and depths of regionalism as a concept to advance trade gains (Hadjimichlis, 2020). This led to some reviewing the status of not only the EU, but reliance of market access condition created through integration.

The EU citrus market is critical to South African citrus industry. The citrus industry in South Africa generates an average of 42% of its total citrus export revenue from EU (Citrus Growers Association (CGA), 2019). Citrus exports to EU immensely contribute to the export revenue of above R6.2 billions per annum generated through citrus exports. This further translate to employment. According to Meyer *et al*. (2012), 85 200 people are employed by the industry, comprising of 10,200 that are permanent and 75 000 people employed as seasonal labour. This does not take into account the number of people that are employed on services for instance port management, transport and associated services (Kapuya *et al*., 2014).

Despite the significance of the EU citrus market to South Africa, the increase in non-tariff measures (NTMs) such as SPS requirements by the EU to some extent may have an impact on South African citrus export to EU. This constitute NTMs imposed by the EU government for a

range of objectives that are legitimate and may perhaps have less to do with international trade, nonetheless still trade restricting and aid protectionist intentions. These public policy objectives consist of provisions that aim to correct market imperfections for instance information asymmetry or public and environment health externalities, consumer protection, aiming to improve domestic security and other commitments.

Recently the EU Citrus Black Spot (CBS) regulations have been a major challenge to deal with for South African citrus exporters. CBS affect the quality and quantity of the crop and since it has no cure, it can only managed through preventative measures like fungicides. Navels, valencia, lemons and grapefruits are the most sensitive fruits to CBS. CBS is classified as quarantine pests in the EU due to that to concerns about the likelihood of its spreading to Europe, however, there has been extensive research that supports that it is unlikely that CBS could establish in Europe. Amongst the studies, Paula *et al*. (2005) pointed out that climate is a barrier to the establishment if CBS, the potential distribution of it is inhibited by cold conditions. Yet, during 2013, the EU limited South Africa to a maximum of five CBS interceptions and this meant that South Africa had to adhere to strict CBS regulations (National Plant Protection Organization of SA (NPPOSA), 2013). South Africa associated NTMs such as CBS regulations imposed on citrus from South Africa with EU interest of protecting some of citrus producing European countries within the Union, which the United Kingdom (UK) post Brexit may no longer be constrained by outside the EU.

Post-Brexit bilateral trade negotiations amongst South Africa and the UK may provide prospects to consider market access conditions of citrus in the UK. Furthermore, concerns regarding NTMs applicable to citrus that create trade frictions and serve protectionist motives may be negotiated. Due to a fact that UK does not have a domestic citrus industry to protect (United State Department of Agriculture (USDA), 2020), South Africa might be able to negotiate lower, or even the

elimination of tariffs. UK is one of the biggest importers of citrus fruit originating from South Africa, accounting for 42% of all South African citrus fruit was exported to EU in 2018 (CGA, 2019). Therefore, bilateral negotiations between UK and South Africa that encompasses changes in regulations could have immense implications for South African citrus fruit industry. Less stringent regulations could allow the South African citrus fruit exports to UK to increase. This will likely result in the reduction of trade barriers and increased profit margins as the regulatory compliance costs would be reduced. This study accordingly seeks to evaluate the potential impact of reduced NTMs on citrus exports from South Africa to the UK post Brexit.

2. SOUTH AFRICAN CITRUS TRADE WITH EU AND UK

The South Africa fresh fruit industry an important industry currently contributes about 52% of the value of South Africa's agriculture export basket. Citrus exports have been the main agricultural exports and they have been increasing over the years. South Africa is an established player in global citrus fruit exports and is ranked second biggest exporter of citrus globally behind Spain with an export share of 10.25%. The rest of the EU (excluding UK) and UK are South Africa's important market for citrus. According to CGA (2019), 42% of all South African citrus was exported to EU in 2018, the UK was the second largest importer within the EU making up 21%. Figure 2 show that South Africa exported citrus to the rest of the EU and UK throughout the period 2009 to 2018.

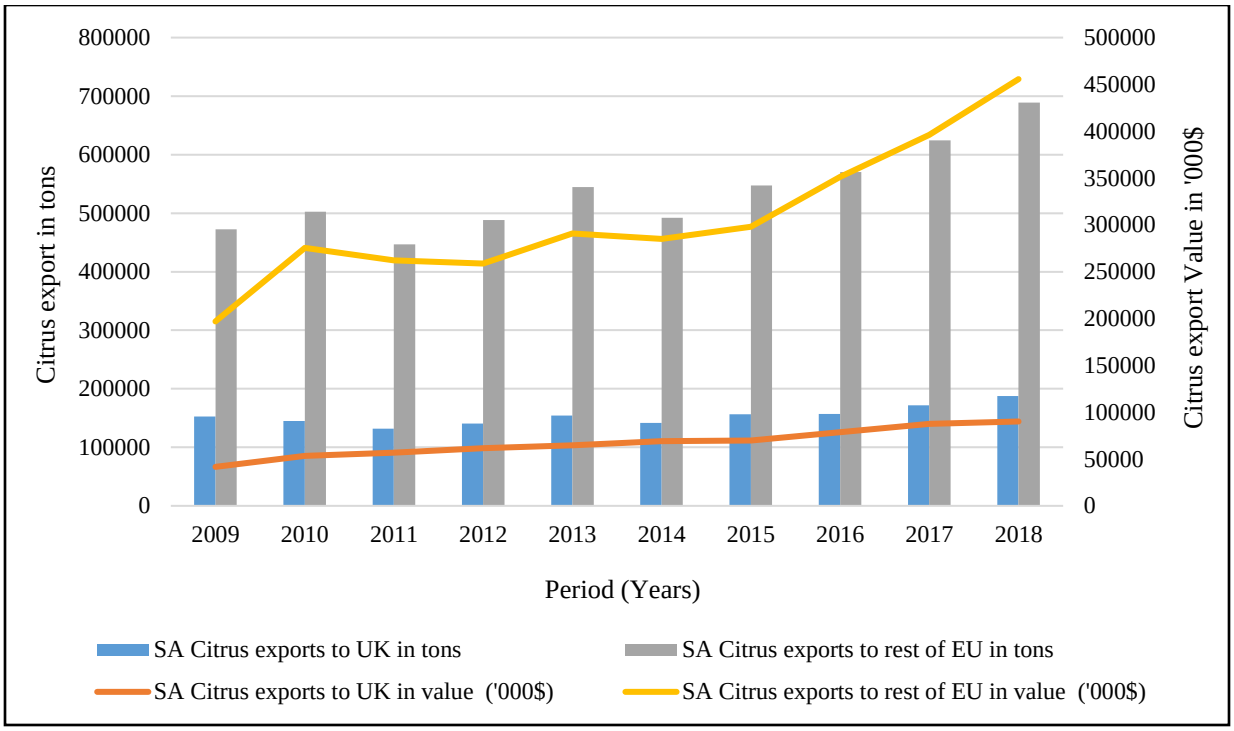

Figure 2: South Africa's total citrus exports to rest of the EU and UK in tons, 2009 to 2018

Source: ITC Trade Map, (2020)

The figure highlights that South Africa exports more citrus to the rest of the EU as compared to UK in terms of quantity and value. In 2009 South Africa exported around 472 281 tons of citrus to the rest of the EU compared to 152 699 that was exported to UK. During 2018, South Africa exported around 688 950 tons of citrus to the rest of the EU compared to 187 449 tons that was exported to UK. South African citrus exports to rest of the EU grew by 45.9% from 2009 to 2018 while exports to UK only grew by 22.7%. Over the years, South African citrus exports to both the rest of the EU and UK have shown positive growth trend despite the country currently being faced with various NTMs imposed by EU. From 2009 to 2018, South African citrus exports to the rest of the EU grew by 106%, and exports to the UK grew by 105%. Figure 3 below show the percentage share of different citrus varieties exported by South Africa to the rest of the EU and UK during 2018.

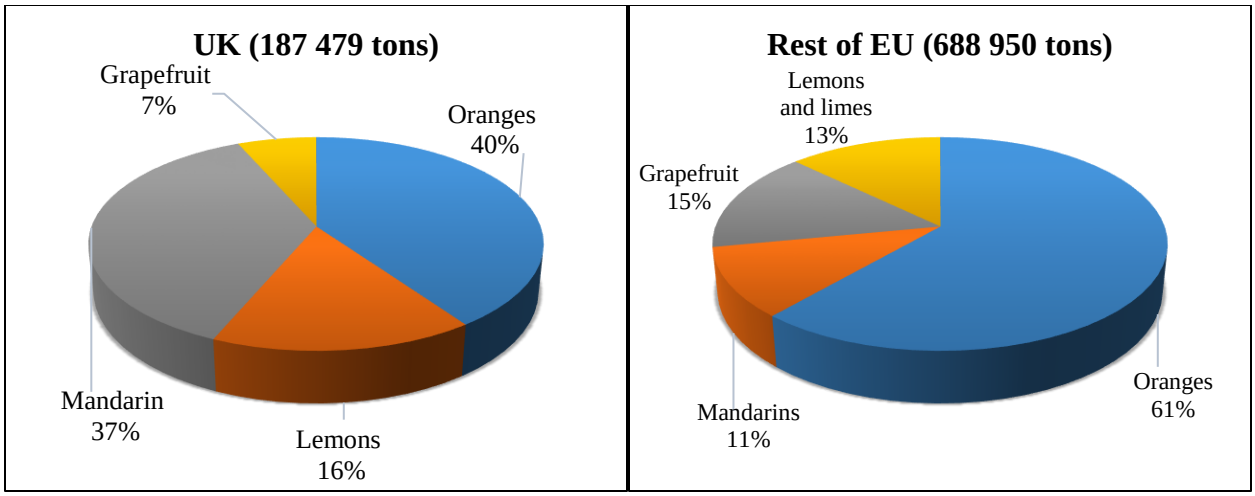

Figure 3: South Africa's disaggregated citrus exports to rest of the EU and UK in percentage 2018

Source: ITC Trade Map, (2020)

Figure 3 shows that oranges were the most exported citrus category by South Africa to both the rest of the EU and UK. Oranges had a share of 40% and 61% of total citrus exports by South Africa to UK and the rest of the EU respectively. Mandarins exports had a share of 37% in the UK and 11% in the rest of the EU. The share of grapefruits exports in overall South African citrus exports in the rest of the EU was 15% while in the UK it was 7%. Lemons and limes exports had a share of 16% in the UK and 13% in the rest of the EU. Other types of citrus had a share of 0% in both the rest of the EU and UK.

Given that South Africa export large quantities of citrus to the rest of the EU and UK, it is critical to identify the extent to which NTMs imposed by EU affect the trade potential of South African citrus exports. Despite the belief that EU stringent NTMs such as CBS regulations are affecting South Africa exports negatively, and that if removed especially in the UK post Brexit, citrus exports are likely going to increase, no study has been done to assess the likely impact of excluding some of the NTMs that plant and pests related such as CBS.

3. NTMS AND THEIR IMPACT ON TRADE

3.1 Introduction

This section discusses the NTMs and their impact on trade. It starts with the NTM definition and classification. Next, the literature review focusing on the impact of NTMs on trade which is followed by a discussion of the methods and procedures for compiling the database. This is followed by discussion on NTMs and tariffs imposed by EU on South African citrus and the last subsection focuses on the inventory analysis.

3.2 NTM definition and classification

There are several robust definitions that have been proposed for the term NTM in a wide spectrum of literature. Generally, NTMs are defined as policies implemented by governments that have an impact on international trade. These policy measures not only serve as tools for health and consumer protection, but they are also often used for different political, social or environmental protection objectives. Often the NTMs are incorrectly cited to be as non-tariff barriers (NTBs) whereas there is a distinction between the two. NTBs form a part of a large pool policy measures that affect trade. The effect that NTMs have on trade is justifiable for some of them and for some is not. NTBs are a part of those NTMs that cannot be justified (Jenson and Yu, 2012).

United Nations Conference on Trade and Development (UNCTAD) (2013) define NTM's as any policy measures, interventions or prevailing conditions, other than ordinary customs tariffs, that can potentially have an economic effect on international trade in goods, changing quantities traded, or prices or both. These measures comprise of all measures that are policy related, it does not matter if the objective is of protectionist or not, so long as they are likely to have impact on international trade. According to UNCTAD (2013), a detailed NTMs classification is important

for better identification and distinguishing between the different forms of NTMs. As result, this study used MAST classification of categories during the database compilation.

The classification comprises of 16 aggregated chapters of different categories labelled in alphabetical order (Chapters A to P). Import related NTMs are covered under Chapters A to O, while chapter P include measures that nations enforce on exports of their own. Technical barriers, SPS, and TBT have a major effect on agricultural trade. SPS are important because they are, by definition, relevant to food protection, animal and plant health, and the environment (WTO, 2010). Under section 3.4 we will go into the specifics of how the MAST taxonomy is used to collected data on NTMs imposed by EU on South African citrus exports.

3.3 Impact of NTMS on trade

A limited number of empirical studies have attempted to measure the impact that NTMs have on international trade flows. Focusing on SPS measures, Gebrehiwet *et al*. (2007) estimated the effect of total aflatoxin levels South Africa's food exports set by five OECD countries namely Germany, Italy, Ireland, Sweden, and USA and they discovered that the SPS standards that are stringent potentially have an adversely affect trade. Furthermore, the study established that if the five OECD were to implement total aflatoxin as suggested in the international standards (CODEX), South African food exports to these countries would increase, resulting to additional export earnings.

Using, the gravity model, Disdier *et al*. (2008) analyzed how notified SPS and TBT measures have had impact on bilateral trade flows. They found that SPS and TBT measures negatively affected agricultural products trade. Furthermore, the study found that these measures did not affect exporters within OECD countries exporting to other OECD members.

Fontagné *et al*. (2012) assessed the trade effect of restrictive product standards on margins of trade. The study found that SPS measures affect intensive and extensive margins of trade, which suggest that SPS measures represents additional variable or fixed cost to entry the foreign market. They found concluded that SPS measures involve costs of compliance, raise unit values and inhibit market access.

Idsardi and Viviers (2018) did a study to explore the impact of NTMs on agricultural exports of four countries from Africa (Cameroon, Kenya, Democratic Republic of the Congo and South Africa) into the EU market from 1992–2014. Their study found that the agricultural export share of all four countries in the EU declined during under analysis. However, could not establish find a conclusive association between diminishing agricultural exports and the prevalence of NTMs.

Kapuya (2015) used the gravity model backed by the price wedge framework to quantify technical barriers impact on oranges exported by South Africa to its major markets. The study found that technical barriers negatively affect exports of oranges destined to South Africa's major markets. He also found that reduced technical barriers will results in a substantial impact on oranges exports by South Africa to other key markets predominantly Russia, Canada, the United States of America and China.

According to (UNCTAD, 2017), data availability on NTMs is a major challenge in studying the trade effects of NTMs applied by countries that are trading among each other. As a result, there is limited literature that aim to assess the extent of the trade foregone as a result of growing number of NTMs. This article therefore, for a 30-year period, provides comprehensive information on NTMs applied by EU on South African citrus exports and uses the data to contribute to already existing literature on the impact of NTMs on trade.

3.4 NTM database compilation

This study used several sources to collect NTM data. This includes the WTO Integrated Trade Intelligence Portal (I-TIP), WTO specific trade concerns (STC), NTM TRAINS, WTO notifications; Rapid Alert System for food and feed (RASFF), research reports obtained from private institutions, published and unpublished research, EU - Pesticides database, International Portal on Food Safety, Animal and Plant Health of the FAO, CGA annual reports etc. The years considered for the assembling of EU NTMs dataset begin from 1988 to 2018. These NTMs were collected for citrus fruits (HS 0805) only and were classified at HS 6-digit level.

After visiting all the above sources to extract the information on NTMs, the next step was compile the NTMs and to build a single database. This study followed a same approach to that followed in the study done by Kalaba (2014) when the author collected SADC NTM data.

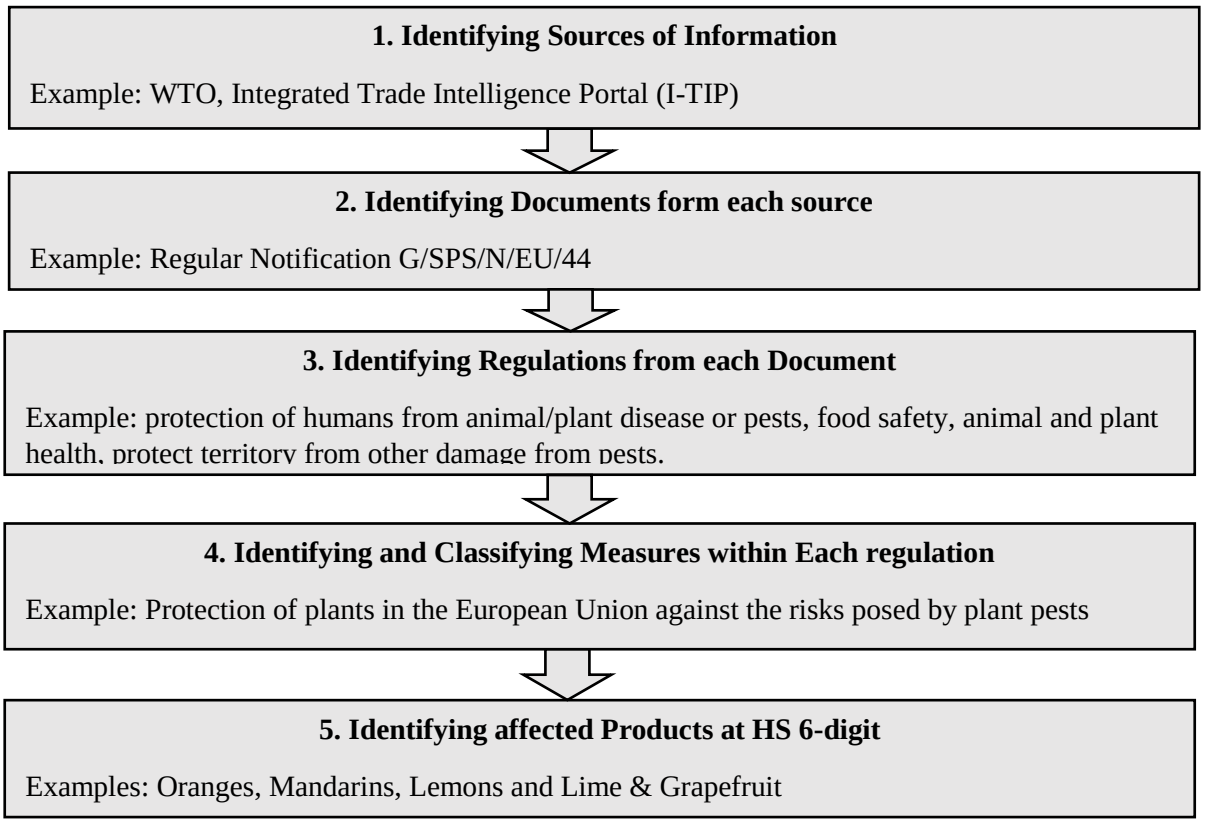

Figure 4: Process of compiling EU NTMs affecting SA citrus exports to EU and UK

Source: (Adopted from Kalaba (2014))

Figure 4 shows the summary of the steps followed in compiling the EU NTMs that affect exports of citrus from South Africa to EU and UK database. Overall, the number of EU NTMs affecting different varieties of South Africa citrus exports to EU and UK compiled is 1 829. This large number of NTMs applied by EU clearly suggest that the use NTMs by EU have gain prominence over the years.

3.5 Trade barriers facing South African citrus in the EU

South African citrus exports to EU have over the years faced variety of trade barriers and those include both tariffs and NTMs. Prior the trade agreement between EU and South Africa, citrus from South Africa were subject to Common Customs Tariff (CCT). The EU external market regulation included seasonally varying ad valorem tariff. (Khuele, 1997). When EU and South African entered into a trade agreement referred to TDCA in year 2000, South African, citrus entered EU without tariffs up until 16th of October every year, when tariffs then increase to 16% (Trade Law Centre (Tralac), 2016). Market access conditions for lemons and certain types of oranges further enhanced under SADC-EPA that entered into force in 2016 whereas for other citrus categories they were kept the same as in the TDCA (Tralac, 2016).

Figure 5 shows the total NTMs introduced per year (left axis) by EU from 1988 as well as average tariffs applied in South African citrus exports (on the right axis) by the EU. It is clear that Prior TDCA, Tariffs imposed by EU on citrus from South Africa were relatively higher whereas the number NTMs introduces was relatively low.

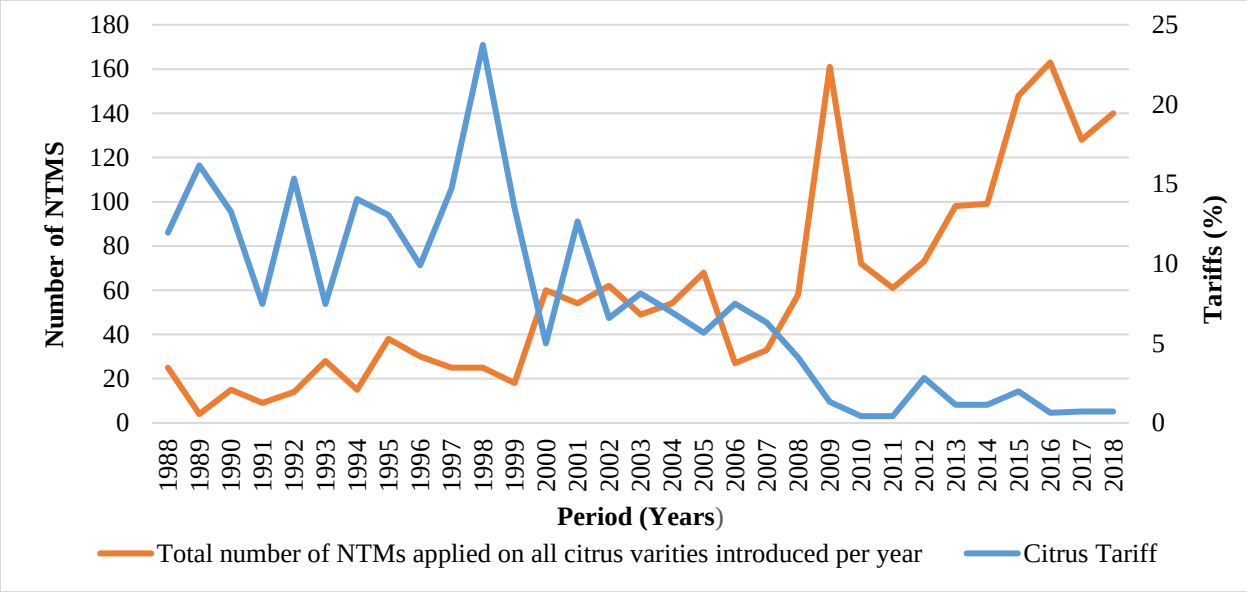

Figure 5: Total EU NTMs and tariffs on citrus from South Africa from 1988 to 2018

Source: ITC Mac Map, TRAINS database and NTM dataset compiled by author, 2020

Figure 5 further show that, as EU average tariffs imposed on citrus from South Africa were declining, the number of NTM measures introduced per year was increasing. Oranges exports from South Africa are the most affected by EU NTMs, they faced a total of 395 NTMs that were introduced per year. SPS measures are the most preferred category used by the EU on citrus exports from South Africa. The decline in tariffs applied by EU on citrus from South Africa was mainly due to both parties signing a trade agreement. Prior the TDCA in year 2000, on average the number of NTMs introduced was below 20 and tariffs applied by EU were on average 15%. From 2000 onwards, the number of NTMs introduced per year began to increase reaching the highest of 163 in year 2018 while the tariffs went down up to less than 1%. This trend clearly show that the role of tariffs as trade barrier declined over the years and the NTMs became significant barriers to trade of citrus between South Africa and EU. The tariff reduction and increase in the use of NTMs suggest that the two can be considered substitute.

3.6 Inventory analysis

There are various available approaches for measuring NTMs to study their effect on trade. Since this section attention is on explaining the NTM data collected, the primary focus is use simple inventory measures to evaluate the effect of NTMs on citrus exports to the rest of the EU and UK. The two that are used are frequency index (FI) and Coverage (CR) to determine the effects of NTMs on citrus exports by South Africa to the rest of the EU and UK. The calculated FI and CR for both the rest of the EU and UK is compared to illustrate the extent of EU NTMs restrictiveness prior and post Brexit on variety of citrus imports from South Africa for a period from 1988 to 2018. The main distinction between FI and CR calculations for the rest of the EU and UK is that the UK NTMs exclude NTMs that are aimed at protecting plant health, preventing plant diseases and pests, and those that are aimed at producer support and competitiveness. The main assumption in this study is that the UK has been considered as not being part of the EU, whereas it actually is.

The FI shows the percentage of products (different citrus varieties) that are affected by at least one or more NTMs (Nicita and Gourdon, 2012). The FI only take into account whether the NTM is present or absent, without demonstrating the value of imports considered. It is calculated as follows:

$$FI_j = \left[\frac{\sum D_i M_i}{\sum M_i}\right]*100 \ldots\ldots\ldots\ldots (1)$$

Where D represents a dummy variable that takes the value of zero if there is no NTM on product *I* and take one if there is any. M is also is a dummy and it takes one if there were imports from

the country that is exporting j good i and zero if there were no imports and t is the year of measurement of the NTM.

In order to obtain the overall measure of significance of NTMs on the rest of the EU and UK citrus imports from South Africa, the CR must be used. The CR reveal the percentage of trade subject to NTMs for the country that is exporting for chosen industry or sector. CR represents the ratio of imports that are subjected to NTMs to the value of total imports. It is used to determine the significance of NTMs on imports. The trade CR is calculated as follows:

$$CR_j = \left[\frac{\sum D_i V_i}{\sum V_i}\right]*100 \text{ .... (2)}$$

D is a dummy variable that takes the value of one and zero if there is no NTM. V represents the value of imports of product *i*. A low ratio means less restrictiveness of NTMs, and a higher ratio means that the NTMs are more restrictive.

In this study, the UK is treated as if it was not part of the EU over the study period, i.e., Brexit. This is to enable the effect of NTMs imposed by EU on citrus exports from South Africa to be compared with those likely to be imposed by UK (All NTMs imposed by EU excluding those that are aimed at protecting plant health, preventing plant diseases and pests, and those that are aimed at producer support and competitiveness). Figure 6 provides a comparison of average FI during pre TDCA, start of TDCA and full implementation of TDCA for the rest of the EU and UK. The rationale for selecting three periods was to test the hypothesis that, as citrus tariffs imposed by the EU declined due to the South Africa and EU trade agreement, the number of NTMs increased. Five citrus categories at HS 6 were considered when FI calculation was done.

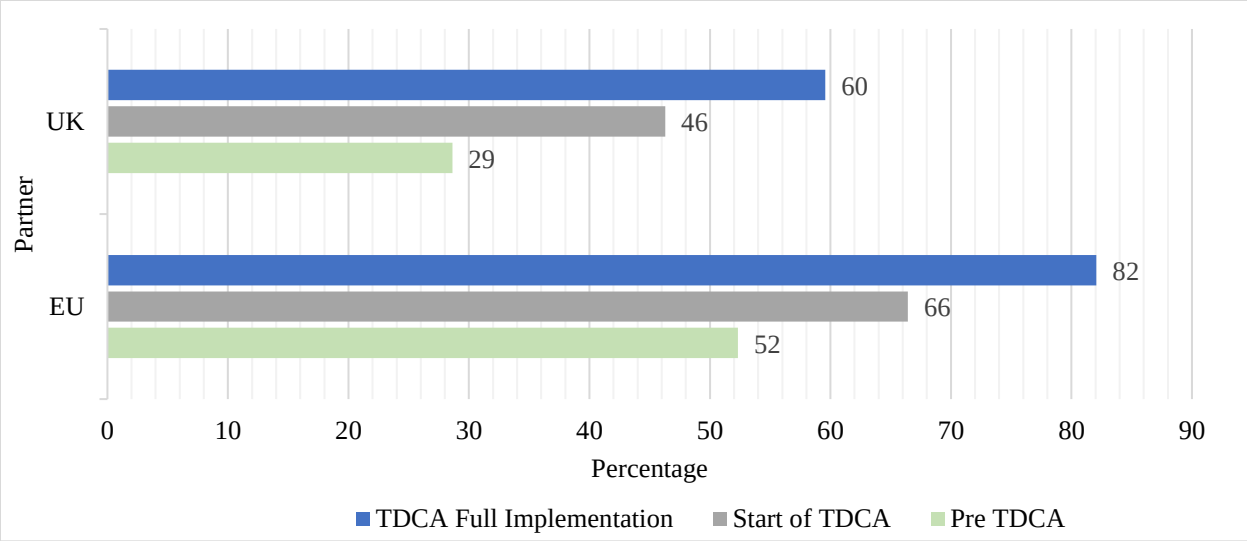

Figure 6: Frequency Index for the rest of the EU and UK, 1988 to 2018

Source: Calculated from author's NTM dataset

Figure 6 on average, the FI shows that almost 52% of citrus product lines exported to the rest of the EU by South Africa are affected by one or more NTMs and only 29% citrus product lines destined to UK will potentially be affected by NTMs during pre TDCA. This indicates, on average, South African citrus face 79% more NTMs going to UK than it should. At the beginning of the TDCA, FI shows that on average, almost 66 per cent of citrus product lines exported to the rest of the EU by South Africa are affected by one or more NTMs and only 46 per citrus product lines destined to UK will potentially be affected by NTMs. This implies that South African citrus face 43% more NTMs going to UK than it should. On average, the FI shows that almost 82 % of citrus product lines exported to the rest of the EU by South Africa are affected by one or more NTMs and only 60 % citrus product lines destined to UK will potentially be affected by NTMs during full TDCA implementation. This suggests that, on average, South African citrus face 37% more NTMs going to UK than it should.

Figure 7 shows the percentage of imported citrus products from South Africa by the rest of the EU and UK that are affected by at least one NTM during pre TDCA, start of TDCA and full implementation of TDCA. The calculated CR shows that on average, almost 60% of the total value of citrus imports in the rest of the EU are subjected to NTMs and only 25% potentially for UK during pre TDCA. This indicates that on average, 140% more of South African citrus exports by values to UK are affected by NTMs than they should.

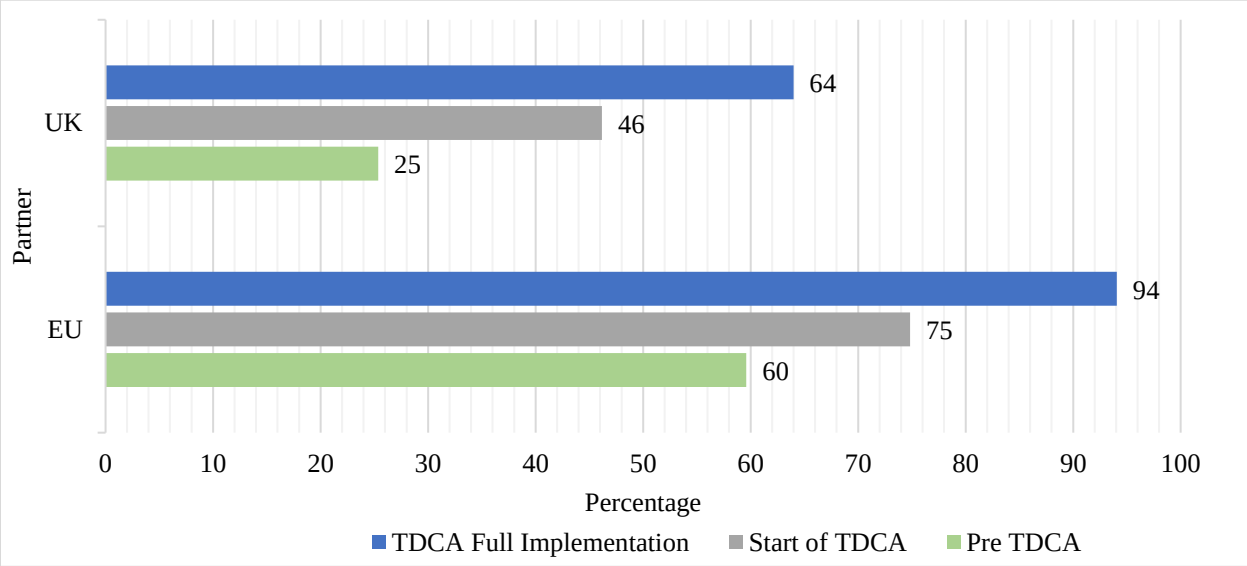

Figure 7: Coverage Ratio for rest of the EU and UK, 1988 to 2018

Source: Calculated from author's NTM dataset

At the beginning of the TDCA, the CR shows that on average, almost 75% of total value of South African citrus exports to EU is subjected to NTMs and only 46% potentially for UK. This implies that 64% more of South African citrus exports by values to UK are affected by NTMs more than they should. During full TDCA implementation on average, almost 94% of total value citrus exported to the rest of the EU by South Africa is subjected to NTMs and only 64%potentially for

UK. This implies that 63% more of South African citrus exports by values to UK are affected NTMs than they should.

Overall, the calculated FI and CR are on average higher in the rest of the EU compared to UK throughout the three-selected period. This implies that the extent of protection provided by the NTMs on citrus from South Africa in the UK will be lower compared to the rest of the EU post-Brexit. There is also clear evidence that the NTMs increased over a period of time. The percentage of citrus products affected by NTMs during the full TDCA implementation period is much higher than in the pre-TDCA period. Although FI and CR are useful in identifying NTMs occurrence and use, as well as the affected products, they are inappropriate when the aim is to determine the magnitude of the NTM protection. This then requires an econometric model to be used to evaluate the effects of the NTMs. The study therefore further attempts to measure and compare the impact of NTMs on the rest of the EU and UK.

4. METHODS

4.1 Data sources

The data used in the study was collected from various sources. The data on GDP per capita for South Africa, EU and UK respectively was sourced from databases of the International Monetary Fund (IMF) (2019) and World Bank. The Trade Analysis Information System (TRAINS) database and ITC trade map were used to get tariffs data. The exchange rate data was retrieved from South African Reserve Bank (SARB). To inform the discussion on the extent to which EU NTMs are negatively affecting various citrus categories exports from South Africa to the rest of the EU and UK, the paper uses a measure of NTM referred to Trade weighted NTM. This measure is also used

to assess how NTMs are likely to affect South African citrus exports to the UK if NTMs that aimed at protecting plant health, preventing plant diseases and pests, and those that are aimed at producer support and competitiveness are removed. This measure considers the importance of exports of citrus from South African in total citrus received by rest of the EU and UK in the world. It considers the share of citrus exports from South Africa to the rest of the EU and UK that is affected by NTMs. The rational for using Trade weighted NTMs is to allocate higher weights for NTMs that coincided with larger value of imports. This measure is mathematically formulated as follows;

$$\text{Trade weighted NTM} = \frac{Z_{ji}^{ot}}{\sum_{o=1}^{n} Z_{ji}^{ot}} NTM_{j}^{ot} * 100 \quad \ldots\ldots (3)$$

Where Z represent the value of citrus category *o* from South Africa represented by j to EU represented by *i*. NTM_j^{ot} is the number of NTMs affecting individual citrus category in period *t*. The term that appears first on the left denotes a fraction of South African value of citrus exports to the EU's total value of citrus imports.

4.2 The gravity model

4.2.1 Model framework

The gravity model of international trade is used to determine the effects of NTMs on South Africa's citrus exports to the rest of the EU and the UK. As discussed in the introduction above, the gravity model has been extensively used to provide an explanation of trade flows among countries, which other economic theories cannot explain. The gravity model uses the concept of gravitational force as an equivalence to explain the flow of trade between countries, globally. Newton's universal law of gravitation states that the attraction due to gravity between the two objects is proportional to their masses, and is inversely related to the square of their distance apart.

Newton's law is specified as follows (Kareem, 2013):

$$F_{ij} = G\,\frac{MiMj}{D2ij} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots .. (4)$$

where F_{ij} represents the gravitational attraction between two masses; M_i,M_j represents the mass of two objects; G represent the gravitational constant; and D_{ij} represents the distance separating the two masses.

Tinbergen and Pöyhönen first applied the gravity model to the study of international trade flows in the early 1960s.

In analysing trade, the basic gravity trade model that has been used in empirical work over the years was originally specified by Tinbergen (1962) and Pöyhönen (1963), as follows:

$$Trade_{ij} = \beta_0\,(GDP_i)^{\beta_1}\,(GDP_j)^{\beta_2}\,(D_{ij})^{\beta_3}\,\varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots .. (5)$$

where $Trade_{ij}$ represents the measured bilateral trade value between country i and country j, while the gross domestic products of both country i and j are denoted by GDP_i and GDP_j respectively. D_{ij} is used as a proxy for bilateral distance between country i and j, generally understood to include all factors that might create trade resistance. β represents unknown parameters, and the signs of β_0, β_1 and β_2 are expected to be positive, while that for β_3 will have an a priori negative sign. ε is a disturbance term, assumed to be statistically independent of the explanatory variables.

Rewriting Equation (5) in logarithmic format, a stochastic linear version of the model can be represented as follows (Ghosh and Yamarik, 2004):

$$Trade_{ij} = \beta_0 + \beta_1 GDP_i + \beta_2 GDP_j + \beta_3 D_{ij} + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

The most prevalent approach used to estimate the multiplicative gravity model for trade given by Equation (6) is to use a log-log transformation yielding:

$$\ln Trade_{ij} = \beta_0 + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j + \beta_3 \ln D_{ij} + \varepsilon \quad \text{..(7)}$$

and then to estimate the parameters of interest by ordinary least squares (OLS).

Numerous empirical studies suggest that Equation (7) fits data well and gives robust results. However, Trabelsi (2013) indicates that there are various other factors that have potential to impact trade flows which are not included in Equation (7). Bikker (2009) indicates that trade flows from one country to another depend on: (i) the exporting country's supply conditions; (ii) the importing country's demand conditions; and (iii) many other factors which may impact trade flows negatively or negatively. In study done by Ghosh and Yamarik (2004), a list of 49 variables (1 independent and 48 independent) is provided and which has been used in the literature to estimate the gravity model in different combinations. Linders and De Groot (2006) augmented the original gravity model by specifying as follows:

$$\ln Trade_{ij} = \beta_0 + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j + \beta_3 \ln D_{ij} + \beta_5 ADJ_{ij} + \beta_4 RIA_{ij} + \beta_6 Lan + \beta_7 Col_{ij} + \beta_8 Rel_{ij} + \varepsilon \quad \text{..(8)}$$

where:

$Trade_{ij}$ is merchandise imports from country i to j;

GDP_i and GDP_j are GDPs of the countries i and j;

D_{ij} is the distance between countries i and j;

ADJ_{ij} is a dummy for common border;

RIA_{ij} is a dummy for the same regional integration agreement;

Lan is a dummy for common primary language;

Col_{ij} is a dummy for a common colonial empire;

Rel_{ij} is a dummy for a common major religion; and

ε is a stochastic disturbance term.

Parameters β_4, β_5, β_6, β_7, and β_8 for the dummy variables for common border, the same regional integration agreement, common primary language, common colonial empire, and common major religion are all time invariant.

4.2.2 Model specification

The gravity model will be used to measure the impact of NTMs on South African citrus exports to EU and UK across four major citrus categories. Many trade researchers use gravity models as a preferred model because of its outstanding accomplishments in analyzing trade flows (Kareem, 2013). In this study, we estimate an augmented version of the basic gravity model specified in (4). This is done by incorporating other factors that facilitate or inhibit South African citrus exports to the rest of the EU and UK and the model is expressed as follows:

$$LnEx_{ijt} = \beta_0 + \beta_1 lnGDPPCSA_{jt} + \beta_2 lnGDPPC_{it} + \beta_3 ln\,(1+Tar_{ijt}) + \beta_5 lnER_{jit} + \beta_8 NTM_{it} + \varepsilon_t \quad \ldots\ldots (9)$$

Where:

Subscript *i* represent the rest of the EU and UK, *j* represents South Africa and subscript *t* represent time period.

The dependent variable, exports (Ex_{ij}), is given as South Africa's citrus exports to country i, given in tons. The trade flow data was obtained from ITC database and Quantec.

The gross domestic product (GDP) per capita for the importing country ($GDPPC_{it}$) and for South Africa ($GDPPCSA_{jt}$) are expressed in real terms as US$ millions. Data for GDP per capita was

obtained from the World Bank Development Indicators (2019) database. The relationship between exports and both GDP per capita measures is expected to be positive.

Tar_{ijt} accounts for bilateral tariffs, where Tar_{ij}, is the ad-valorem tariff and non-ad-valorem tariffs, that country imposes on imports from country i at time t. Based in the economic theory, it is expected that the sign of a tariff coefficient would be negative since tariffs have a trade restricting effects, they form part of trade costs. However in this study, the tariff are expected to be insignificant in explaining the exports of citrus because they have been declining over the years due to the trade agreements that South Africa has with the EU and UK.

ER_{ijt} represent exchange rate between country j and country i. A positive sign in the coefficient of the exchange rate is expected in relation to bilateral trade.

NTM_{it} represent Trade weighted NTM variable and it is expected to have negative sign.

A summary of the variable definitions, data sources and the expected signs is displayed in Table 1.

Table 1: Variables and data sources

Variables	**Unit of measurement**	**Description**	**Data Source**	**Expected Sign**
Ex	Tons	Citrus exports	ITC trade map and Quantec	
GDPPC	USD	Real GDP per Capita	World Bank Development Indicators	+ve
Tar	%	EU tariffs	TRAINS and ITC trade map	-ve
ER	Rand/Pound and Rand/Euro	Nominal exchange rate	SARB	+ve

NTM	Trade weighted NTM	NTM Indicator	Trade data and NTM Database	-ve

Source: Various sources

5. RESULTS AND DISCUSSION

This section presents the results of impact of NTMs on the rest of the EU and UK (post Brexit). The estimation is done in a scenario where UK is presented as if it was not part of EU throughout this study period. A total of 24 estimation model were computed using both OLS model and robust standard error model (for models with a problem of heteroscedasticity) for four citrus categories (oranges, mandarins, lemons and limes and grapefruit) following equation 9 in the methodology section. For each selected citrus category, two models were estimated representing the rest of the EU and UK respectively. The established relationship between exports of citrus from South Africa to the rest of the EU and to the UK and NTMs will help to compare the impact of NTMs on citrus from South Africa to both partners. NTMs were grouped into three groups. The groups consist of TBT and SPS measures and these are WTO authorized NTMs. The third group is a total of all other NTMs, which WTO does not promote their use. Figure 8 below illustrate the breakdown of estimation procedure followed in the study.

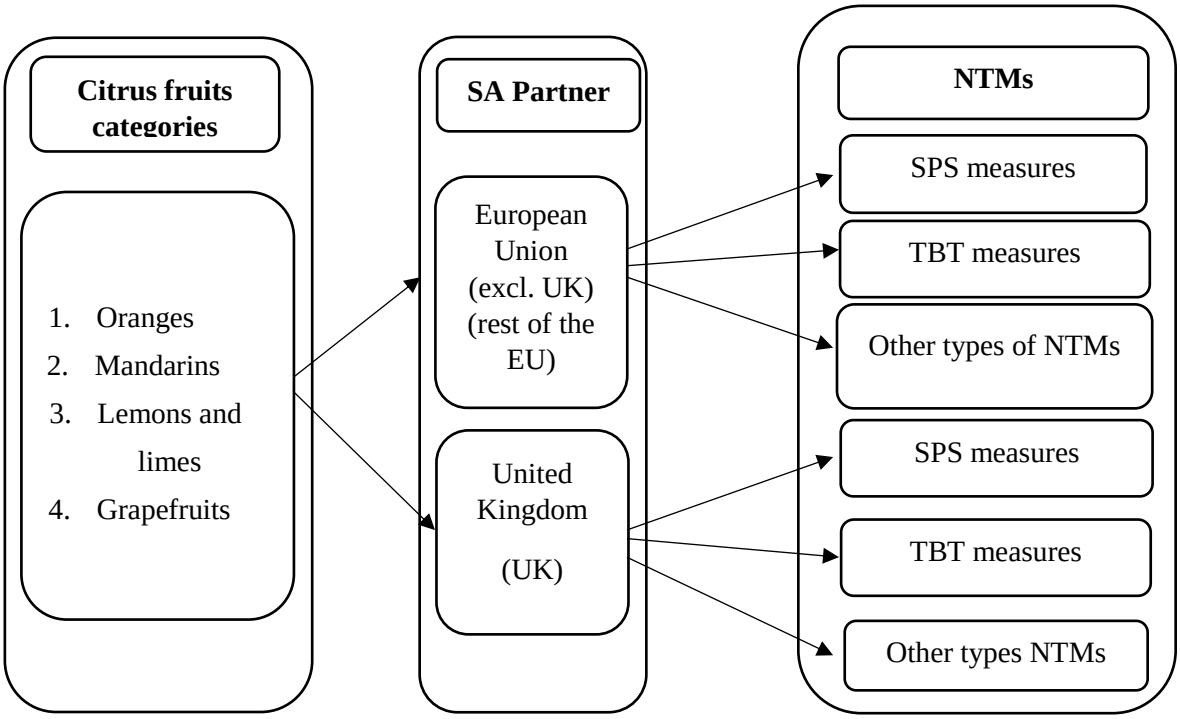

Figure 8: The gravity model estimation procedure

The estimated results of SPS measures, TBT measures and other types of NTMs models are shown in Table 2, 3 and 4 respectively. In all estimated equations, the dependent variable was log of citrus exports to the rest of the EU and UK over the period from 1988 – 2018. Various tests were used to test the robustness of the models estimated. A misspecification test was conducted using the Ramsey RESET test and outcome of the tests revealed that the estimated models have no omitted variable bias. The test for autocorrelation was done using Breusch–Godfrey LM test and test reveal that the estimated models have no autocorrelation. A Breusch–Pagan test was used to test for heteroscedasticity and the results showed that there is no problem of heteroskedasticity on the nine (9) models. The other fifteen (15) estimated models had heteroscedasticity and were estimated using robust standard errors as remedial measure of heteroscedasticity. According to Gujarati and Porter (2009), the technique suitable for getting unbiased standard errors of OLS coefficients even

though there is existence of heteroscedasticity. In terms of the model goodness fit, across all estimated models R^2 statistic ranges from 0.65 to 0.90. This represents a fair to a very good model fit. The F statistic is significant for all products, implying that all variables are jointly significant.

5.1 SPS NTM related measures gravity model results

The SPS NTM related gravity model results are presented in Table 2. The results present the impact of the SPS measures on South African citrus exports to rest of the EU and UK. The table also shows the impact of other important determinants citrus exports from South Africa destined to the rest of the EU and UK i.e. GDP per capita, exchange rates and tariffs. The discussions will primarily focus NTM and tariff variables, as they are fundamental for the main objective of the study. The estimated results show that tariffs have no impact on all citrus categories exported to both the rest of the EU and UK. This can be explained by that tariffs imposed on citrus by EU declined over the years because of the trade agreement between EU and South Africa (shown in figure 5 in section 3.5).

Table 2: **Gravity Model results of only SPS measures for rest of the EU and UK**

Dependent Variables	**Oranges**		**Mandarins**		**Lemons and Limes**		**Grapefruit**	
Explanatory Variables:	**Coefficients**							
Partner countries	**EU**	**UK**	**EU**	**UK**	**EU**	**UK**	**EU**	**UK**
LnGDPPC	**4.185*** **	2.127	**13.183*** **	**11.002*** **	-0.156	**4.690***	**3.835***	-2.741
	0.000	0.140	**0.000**	**0.000**	0.794	**0.091**	**0.090**	0.623
LnGDPPCSA	-0.026	-0.841	-14.989	-13.640	-0.323	1.503	-1.610	2.170
	0.966	0.321	0.560	0.341	0.570	0.417	0.485	0.744
LnTar	0.049	0.025	-0.477	-0.543	0.223	-0.099	-0.049	-0.455
	0.276	0.567	0.215	0.665	0.259	0.541	0.827	0.413
LnER	0.334	**0.485***	**4.686** **	0.073	**2.105** **	-0.328	1.029	1.454
	0.265	**0.091**	**0.009**	0.955	**0.004**	0.546	0.174	0.292
NTM (SPS)	**-0.002** **	**-0.001***	**-0.020** **	**-0.011** **	0.000	-0.001	-0.005	-0.002

	0.002	**0.054**	**0.014**	**0.045**	0.948	0.659	0.729	0.863
Constants	-31.210	-3.334	-64.887	-121.186	9.498	-52.292	-16.207	16.464
	0.006	0.745	0.117	0.003	0.023	0.003	0.595	0.526
R^2	0.886	0.861	0.874	0.870	0.862	0.778	0.658	0.765
F	57.290**	24.750***	47.450**	46.150***	31.240***	23.040***	32.730***	28.960***
Ramsey RESET test Prob>F=	0.515	0.209	0.109	0.140	0.569	0.308	0.468	0.323
Breusch-Godfrey Prob > chi2=	0.311	0.756	0.164	0.654	0.264	0.206	0.262	0.336
Breusch-Pagan test for heteroskedasticity Prob > chi2=	0.003	0.220	0.000	0.000	0.394	0.107	0.036	0.000
Estimation method	Robust standard errors	OLS	Robust standard errors	Robust standard errors	OLS	OLS	Robust standard errors	Robust standard errors

Note: ***, **, * denote significance at the 1%, 5%, and 10% level, respectively.

All citrus categories reveal no proof of SPS measures impact on exports apart from oranges and mandarins. The model results demonstrate negative and statistically significant influence of SPS measures on orange and mandarin exports from South Africa to the rest of the EU and UK. The results are consistent with expectation owing to that there are added costs towards trade as results of the implementation of SPS measures and thus as they increase, South African exports of oranges and mandarins to rest of the EU and UK should decline.

In the rest of the EU market, the coefficient of SPS measures on oranges from South Africa of – 0.002 suggests that that if the trade weighted SPS measure increases by 1%, South Africa's orange exports in tons to rest of the EU goes down 0.002% per annum. The coefficient of SPS measures on mandarins from South Africa of – 0.020 suggests that that if the trade weighted SPS measures increases by 1%, mandarins exports volumes from South Africa to rest of the EU decline by 0.020% per year.

In the UK market, the coefficient of SPS measures on oranges from South Africa of – 0.001 suggest that that if the trade weighted SPS measures increases by 1%, orange exports volumes from South Africa to UK decline by 0.001% per year. The coefficient of SPS measures on mandarins from South Africa on oranges of – 0.011 suggest that that if the trade weighted SPS measure increases by 1%, orange exports from South Africa to UK decline by 0.011% per year.

The results further show that the impact of SPS measures on oranges and mandarins is low in the UK compared to the rest of the EU. The value of -0.001 which is obtained by subtracting the NTM (SPS) coefficient for exports to the rest of the EU by that of the UK represent a margin by which South Africa oranges exports to UK suffers from SPS measures unnecessarily. The value of -0.009 is a margin by which South Africa mandarins exports to UK suffers for SPS measure unnecessarily. Essentially this imply that, if regulations that are pests and plant health related (including CBS measures) are eliminated in UK, the negative impact of SPS measures on South African export of oranges and mandarins UK can be reduced.

5.2 TBT NTM related measures gravity model results

The result presented in Table 3 are for the TBT NTM related gravity model. They show the impact of the TBT measures and other important determinants on South African citrus exports to the rest EU and UK. Again, in this subsection the discussions will primarily focus NTM and tariff variable results, as they are fundamental for the main objective of the study. The estimated results again in these results show that tariffs have no impact on all citrus categories exported to both the rest of the EU and UK.

Table 3: Gravity Model results of only TBT measures for rest of the EU and UK

Dependent Variables	**Oranges**		**Mandarins**		**Lemons and Limes**		**Grapefruit**	
Explanatory Variables:	**Coefficients**							
Partner countries	**EU**	**UK**	**EU**	**UK**	**EU**	**UK**	**EU**	**UK**
LnGDPPC	**4.097*** **	2.286	**9.081** **	**13.837*** **	-0.123	**4.473***	3.612	-4.402
	0.000	0.140	**0.002**	**0.000**	0.838	**0.095**	0.119	0.468
LnGDPPCSA	0.036	-1.074	-14.739	-13.258	-0.302	1.902	-1.630	4.170
	0.958	0.277	0.988	0.771	0.542	0.325	0.501	0.579
LnTar	0.041	0.033	-0.582	-0.434	0.175	-0.115	-0.029	-0.424
	0.413	0.497	0.349	0.387	0.351	0.399	0.898	0.441
LnER	0.287	0.341	**4.450***	-0.302	**2.256*** **	-0.254	0.885	1.554
	0.342	0.312	**0.024**	0.815	**0.000**	0.595	0.215	0.251
NTM (TBT)	**-0.013** **	-0.008	**-0.125** **	-0.052	-0.007	-0.015	-0.022	-0.013
	0.029	0.399	**0.101**	0.565	0.806	0.421	0.271	0.665
Constants	-30.753	-2.734	-55.161	-122.373	8.844	-53.620	-13.565	16.134
	0.008	0.804	0.246	0.006	0.043	0.003	0.665	0.527
R^2	0.881	0.842	0.865	0.857	0.862	0.780	0.667	0.651
F	55.490***	21.290***	46.030***	35.840***	31.320**	22.640**	56.760***	34.750***
Ramsey RESET test Prob>F=	0.385	0.375	0.107	0.546	0.197	0.102	0.380	0.361
Breusch-Godfrey Prob > chi2=	0.407	0.641	0.107	0.416	0.272	0.297	0.374	.0.775
Breusch-Pagan test for heteroskedasticity Prob > chi2=	0.004	0.208	0.001	0.002	0.482	0.106	0.040	0.000
Estimation method	Robust standard errors	OLS	Robust standard errors	Robust standard errors	OLS	OLS	Robust standard errors	Robust standard errors

Note: ***, **, * denote significance at the 1%, 5%, and 10% level, respectively

The results show that TBT measures have a negative only on oranges and mandarins exported by South Africa to rest of the EU. In the rest of the EU market, the coefficient of TBT measures

applied by EU on oranges from South Africa of – 0.013 suggests that if the trade weighted TBT measures increases by 1%, oranges exports volumes originating from South Africa to the rest of the EU would go down by 0.013% per annum *ceteris paribus*. The coefficient of TBT measures applied by EU on mandarins from South Africa of – 0.125 suggests that if the trade weighted TBT measure increases by 1%, South Africa's mandarins exports volumes to the rest of the EU decline by 0.125% per year *ceteris paribus*. The model results imply that various forms of TBT measures, such as food standards, labelling, nutrition information, plant health regulations, play a key part in decreasing potential oranges and mandarins exports from South Africa to the rest of the EU but not in the UK. Furthermore, these results support the argument of the study that if TBTs such as the restrictions established for reasons related plant health or life, or the environment are removed, exports to UK will not be negatively affected by TBT measures. For an instance, removing the ban that applies to South African citrus shipments from regions where the CBS is present, which covers the bulk of the country's production, will allow exporters that were excluded to export to UK.

5.3 Other NTMs gravity model results

Other NTM gravity model results for both the rest of the EU and UK are presented in Table 4. This group of NTMs represent the aggregate of NTMs imposed by EU on citrus from other than SPS and TBT measures. This group of NTM measures is also referred to non-technical measures.

Table 4: **Gravity Model results of only other NTM measures for rest the EU and UK**

Dependent Variables	**Oranges**		**Mandarins**		**Lemons and Limes**		**Grapefruit**	
Explanatory Variables:	**Coefficients**							
Partner countries	**EU**	**UK**	**EU**	**UK**	**EU**	**UK**	**EU**	**UK**
LnGDPPC	**4.653*** **	**2.683** **	**12.940** **	**6.409**	-0.750	**10.060*** **	3.935	**15.598***
	0.000	**0.094**	**0.002**	**0.078**	0.211	**0.000**	0.123	**0.077**
LnGDPPCSA	-0.317	-1.459	-14.315	-7.983	0.355	0.824	-2.642	0.826
	0.613	0.153	0.830	0.860	0.511	0.476	0.263	0.892
LnTar	0.100	0.042	0.163	0.052	0.227	-0.013	-0.032	0.055
	0.641	0.383	0.593	0.694	0.240	0.863	0.894	0.915
LnER	0.027	0.242	**3.603** **	**1.269***	**2.204*** **	-0.869	0.456	-0.921
	0.920	0.473	**0.019**	**0.101**	**0.000**	0.181	0.488	0.401
NTM (Other NTMs)	0.066	-0.043	0.205	1.487	0.126	-0.563	0.118	-1.776
	0.550	0.680	0.379	0.890	0.320	0.900	0.389	0.780
Constants	-33.394	-3.342	-59.113	6.056	9.156	-100.424	-7.599	-155.782
	0.003	0.785	0.190	0.826	0.009	0.000	0.830	0.113
R^2	0.895	0.838	0.857	0.950	0.886	0.868	0.658	0.621
F	37.910***	20.720***	36.120***	54.540***	38.690***	32.930***	32.730**	34.260***
Ramsey RESET test Prob>F=	0.658	0.112	0.139	0.376	0.858	0.485	0.299	0.005
Breusch-Godfrey Prob > chi2=	0.948	0.460	0.126	0.168	0.271	0.404	0.406	0.198
Breusch-Pagan test for heteroskedasticity Prob > chi2=	0.014	0.176	0.001	0.000	0.785	0.785	0.066	0.000
Estimation method	Robust standard errors	OLS	Robust standard errors	Robust standard errors	OLS	OLS	Robust standard errors	Robust standard errors

Note: ***, **, * denote significance at the 1%, 5%, and 10% level, respectively

The models results further show the NTM variable is statistically insignificant in all estimated equations. The estimated results also show that tariffs have no impact on all citrus categories

exported to both the rest of the EU and UK.

In a nutshell, the estimated model results show evidence that oranges are the most affected citrus category by NTMs followed by mandarins. These findings are explained by the fact that oranges and mandarins are the most exported citrus categories by South Africa to the rest of the EU and UK and they faced more SPS and TBT than any other citrus categories over the years. The rest of the other categories were not affected by NTMs. Moreover, it was discovered, that the effects of NTMs that are authorized by WTO (SPS and TBTs) applied by the rest of the EU and the UK on citrus from South Africa varies from non-technical measures (other types of NTMs). The other NTMs were found not to have an influence on South African citrus exports. Furthermore, the results reflects that tariffs are not an important barrier to South African exports to the rest of the EU and the UK. Overall, the model results show strong evidence that trade will be easier or improve under UK compared to when UK is part of EU.

6. CONCLUSION

This study evaluated the potential impact of NTMs on South African citrus exports to the rest of the EU and the UK. The study was primarily motivated by the fact that citrus production in the UK is non-existent. Therefore, the UK is unlikely to impose plant health, producer support and competitiveness measures on citrus imports from South Africa. The second fact is that the UK is an important market for South Africa, as it is the largest importing country of citrus from South Africa in the EU. Consequently, the study endeavoured to determine the effects of NTMs on citrus exports from South Africa to the rest of the EU and UK (post Brexit) by using the inventory approach. The study further evaluated the potential effects of NTMs on South African citrus exports to the UK after Brexit by using the gravity model approach.

Inventory analysis results show clear evidence that the NTMs increased over a period of time. The percentage of citrus products affected by NTMs during the full TDCA implementation period is much higher than in the pre-TDCA period. The inventory analysis results further showed evidence that the NTMs effects are higher on citrus destined to the rest of the EU than on those that are destined for the UK.

The estimated gravity model results show that SPS measures had a statistically significant and negative effect on oranges and mandarins in both the rest of the EU and UK. The findings further show that the effect of SPS measures is higher on exports to the rest of the EU as compared to UK. This imply that SPS measures applied on oranges and mandarins exports from South Africa carried additional costs to exporters, which in turn restricted export opportunities. For that reason, it is important to address SPS measures particularly those that are restrictive to ensure that South African exporters continue to benefit from the EU and UK market. Since negotiations between South Africa and UK are still open, the study therefore recommend that the South African trade policy makers should priorities negotiations on reduction or removal of some of the measures that do not apply to UK due to absence of orchards in UK.

It has also been shown in the study that TBT measures had no negative effect on citrus exports to UK. Therefore, the study recommends that South African citrus producers should focus on exporting more citrus to the UK and export less to the rest of the EU. The results of this study also revealed that the effect of other types of NTMs had no significant effect on citrus export to both EU and UK. However, the study showed that while tariffs were declining over the years, the overall

application of NTMs by the EU increased. This clearly suggest that there is possibility that other types of NTMs can still rise in the future and may likely have a negative impact on South African citrus exports. Hence, the study recommends that policy makers should continue to monitor other types NTMs and make sure the status quo remains.

Furthermore, the study found that tariffs applied by EU and UK had no significant effect on citrus exports to rest of the EU and UK. This is due to a fact that from year 2000, South Africa had a trade agreement with the rest of the EU and UK that resulted in a significant decline in tariffs on citrus trade. This clearly show the significance of trade agreements in trade. Therefore, the study recommends that South African policy makers should consider opening trade agreement negotiations in other lucrative markets such as Asia i.e. China, Japan and the whole of Association of Southeast Asian Nations (ASEAN) that will results in the reduction or removal of tariffs. Future research could look to follow up on the study with real data and less assumptions on similar issue when the Brexit is complete.

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