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What Drives Import Flows, Do Import Standards And Verification For Conformity Matter? A Panel Gravity Model for Kenya

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Abstract

This study sought to determine the factors that drive import flows into Kenya. It also investigated the effect of imports standards requirements and verification procedures on imports flows. Specifically, the aim was to determine whether import standards are trade catalysts or technical trade barriers. The study used a panel gravity model consisting of 14 countries where Kenya sources 80% of its imports for the period spanning 2012 to 2016 on quarterly basis. Dummy variables were used to capture verification procedures implemented on December 2015, regional integration and sharing of borders. Data was obtained from IMF. Firstly import standards are a technical trade barrier probably due to lengthy procedures involved in obtaining certificate of conformity. Secondly import flows in Kenya significantly depend on Kenyan economic performance (GDP), GDP of exporting economies and sharing of borders. A 1% increases in Kenya GDP increases the value of imports by almost 0.17% to 0.39%. In addition, East Africa Community has created a trade diversion other than the expected trade creation effect.

Keywords

Kenya; Non technical trade barriers; Gravity model; Imports verification standards

Introduction

Kenya has a trajectory of trade policy reforms ranging from substitution of imports, liberalization of trade through Structural adjustment programme, exports promotion policy and current multilateral trade agreements. The import substitution strategies aimed at industrialization through promotion of infant industries. Unfortunately, the infants did not penetrate international markets as expected. In early 1980s, under structural adjustment reforms and due to pressure from the multi-lateral financial institutions, Kenya shifted from imports substitution strategy and adopted exports promotion to address deteriorating exports performance. The principal exports promotions strategies put in place included Manufacturing under Bond, Exports Processing Zones, (EPZs) in 1990 and the rejuvenation of the Kenya Export Trade Authority. The EPZs were subject to a tax holiday of ten years, import duty exemptions on processing equipment investments and from payments of VAT. Firms receive exemptions from import duties when their outputs are exported under MUB. Likewise, they receive exemptions from VAT on all their inputs.

After the year 2000, the key trade policy measures for Kenya included treaties with the East African Community(EAC), Common Market for Eastern and Southern Africa (COMESA) and the Intergovernmental Authority on Development, (IGAD). The EAC has achieved significant market growth for member country goods and services. It has made Market expansion possible through instruments such as EAC Customs Union Protocol and Common Market Protocol. However, its full potential has been constrained by the slow pace of implementation.

In 2015, Kenya implemented Pre-Export Verification of Conformity (PVOC) program for all imports. The program is applied to regulate goods/products in the respective exporting countries to ensure that they comply with the applicable Kenyan Technical Regulations and Mandatory Standards. The general objectives of applying Pre-Export Verification of Conformity (PVOC) program is to ensure quality of products, health and safety, protect the environment for Kenyans and meet requirements of the Kenya PVOC.

The key concerns for the PVOC program are to curb undervaluation and concealment of imports. Therefore, all consignments which are subject to the PVOC must obtain a Certificate of Conformity (CoC) issued by authorized verification agents. Empirical analysis has classified import standards measures under non–tariff barriers of trade (NTB) known as Technical Barriers to Trade (TBT) [1,2]. TBT mainly includes standards, conformity assessments, certification, and technical regulations that are introduced for environmental protection, safety, national security and consumer information.

There are two opposing arguments on the effect of TBT on trade flows. One postulates that TBT promotes trade while the other is to the contrary. Theoretical argument linking TBTs to reduction of imports and tax revenue has that if a country imposes a TBT; it raises both the fixed cost and variable cost to exporters of other countries. Exporting firm's variable cost of production increases as they invest in new technology and inputs so as to improve their product quality to meet the new standards. In addition, they incur cost on material investment in inspection equipment, quarantine process, and the coordination of technique experts to pass the examination consequently raising the fixed cost for exporting to the TBT imposing country. Hence, the total cost of production raises leading to a decline in both export extensive margin (the number of exporting countries) and intensive margin (the export volume or value of each exporting country) [3,4].

On the other hand, the theoretical argument linking TBTs to increase in imports hence increase in tax revenue postulates that TBTs inform consumers that the imported products have met specific standards consumers' demand, thereby raising both the extensive and intensive margins. Quality attracts demand of importing country, changes consumer preference, and increases imports especially in

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developed markets. However, this will be realized in the long run but in the short run producers/exporter incur compliance cost but stabilize in the long run. Empirical analysis by Maskus et al. [3,5-8], show that TBTs have a significant effect on trade flows therefore effecting tax revenue generated.

In Kenya, the Pre-Export Verification of Conformity (PVOC) program was implemented with effect from 1st December 2015. In the wake of the implementation of the PVOC programme the values of imports declined [9].

As shown in Figure 1, above the aggregate imports per month shows a declining trend especially the post PVOC period of December 2015. Similar period is marked by decline in number of containers with growth rate of imported containers decreasing from 4% in December 2015 to a drastic decline of 9% in January 2016. China and India recorded post-PVOC import value declines of 5.2% and 11.5% respectively with China imports shifting from a growth of 22.0% pre-PVOC to register decline in value of imports of 5.2% post PVOC. Other economies contributing to this decline in import values in the post-PVOC period are United States of America (51.1%), South Africa (21.5%) and United Kingdom (25.4%).

Therefore, this study intended to determine the effect of standards on trade flows into Kenya. It has sought to investigate the effect of selected macroeconomic variables on imports flow into Kenya.

Literature review

This section reviews theoretical and empirical literature on import standards and their impact on import flows.

Mercantilisms doctrine: One of the theoretical underpinnings of import standards commonly referred to as technical trade barriers (TBTs), which includes PVOC programme, are protectionist theories. TBTs can be used for antidumping purposes. Protectionist theories are based on mercantilists' trade doctrine of 16th to 18th century which promoted government interventions to boost the accumulation of species through trade. Mercantilist advocated for import restrictions and export promotion [10].

Partial equilibrium model: A partial equilibrium model based on single market approach is more precise in analyzing the effect of a TBT on the economy using a quota for illustration purpose. A quota limits import levels at q_A^1 as shown in Figure 2. This causes a rise in the imports domestic price to p_{AD}^1, a price above world price a p_A. This causes the world price of the imported good to fall to p_A^1. In a case where the quota is set above the level of free trade, the quota has no effect. Non-tariff measures could have similar effects but also are bound to generate other various economic effects. The cost-price raising effect of a TBT is due to compliance cost which changes the fixed cost of production from producers' point of view. Fixed cost manifests in upgrading of equipment, operations, obtaining certificate, quality checks and altering production strategies. This is the trade barrier effect of a TBT. Contrary, quality standards may signal high quality of imports via information disclosure e.g. trademarks, labeling requirements etc. leading to an increase in imports. This demand enhancement effect of a TBT is also known as standards catalyst argument [11].

Gravity model: One of the models frequently used to measure the effect of import standards is the gravity model. The trade gravity framework is cited by Roy et al. [12] as one of the most successful models in empirical economics so far. In its basic form it alludes that trade between a pair of countries is an increasing function of their GDP sizes and a decreasing function of the distance between them. This simple framework explains most of the variations in observed volumes of trade flows. For these reasons, the gravity model has become one of the standard empirical tools for analyzing trade patterns [13]. Gravity model originates from the Newtonian physics notion and was first applied in international trade by Tinbergen in 1962 [14]. Newton's gravity law in mechanics states that two bodies attract each other proportionally to the product of each body's mass (in kilograms) divided by the square of the distance between their respective centers of gravity (in meters).

The model is occasionally extended by researchers to include gravity variables such as distance, contiguity, official language, colonial relationship, common colonizer and dummy variables capturing shared trade blocks and technical barriers of trade, 2008 including [15].

The estimated version of the model is expressed as:

$$TV_{ij} = \beta_0 \frac{y_i^{\beta 1} y_j^{\beta 2}}{D_{ij}^{\beta 3}} \quad (1)$$

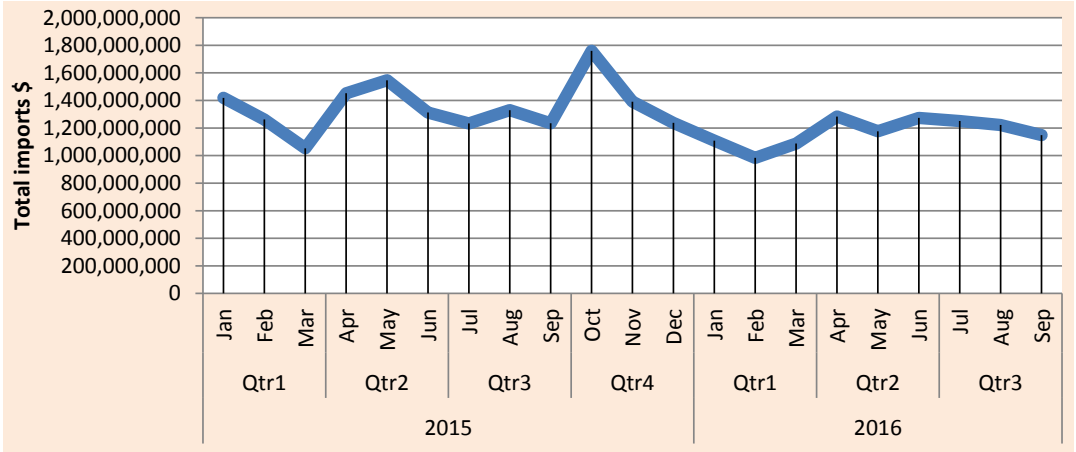

Figure 1: Aggregated imports value trend between 2015-2016 in US $.

Source: Author, IMF data

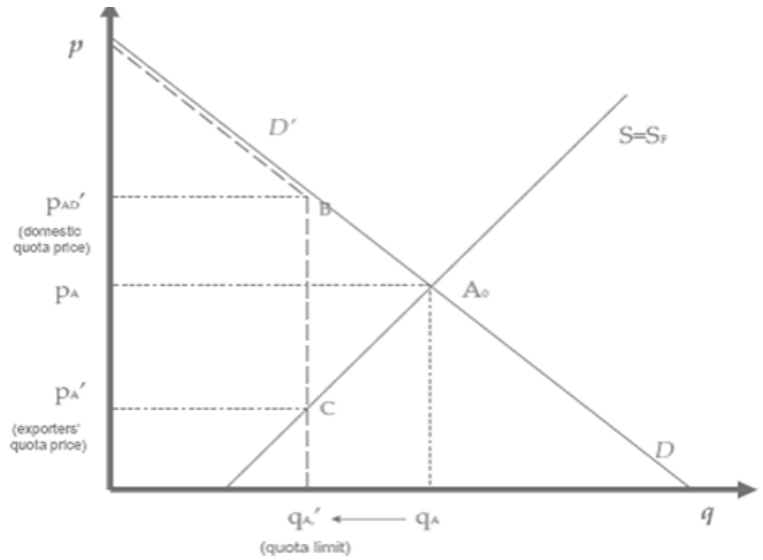

Figure 2: Partial equilibrium model.

Source: Otsuki et al 2001

Where T_{ij} is trade volume, *i* represent origin country, *j* represents destination country, y is GDP and D_{ij} is the distance between the two trading countries capital city. On the other hand, B_0, B_1, B_2 and B_3 are parameters to be estimated. The empirical form of the model is normally linearized to include policy variables.

Empirical literature review

Effect of Non-technical barriers on trade flows: According to United Nations Conference on Trade and Development (UNCTAD) (2010 and 2013) [16] NTMs are policy measures other than ordinary customs tariffs that can potentially have an economic effect on international trade in goods, changing quantities traded, prices, or both. NTMs are classified into sanitary and phytosanitary (SPS) measures and import standards that can hamper trade among trading partners in different ways [17].

Literature is rich with studies on the effect of import standards on trade flows both in developed and developing economies. However, whether the effect is positive or negative has been a debate Maskus et al. [3]**.** Some of the studies are summarized below.

Surveys on technical trade barriers in Kenya: In 2014, International Trade Centre (ITC) [18] in collaboration with Kenya Institute for Public Policy Research and Analysis KIPPRA, Ministry of trade and Ipsos Synovate ltd conducted a non-tariff measures survey in Kenya. In a population of 1097 targeted importing and exporting firms, 74.1% registered various complains on restrictive trade regulations majorly applied by trade agencies in Kenya. Notably, respondents agreed that the measures are good for imports quality and safety, but the procedural obstacles related to time and cost are the issues of concern.

Conformity assessment program constitutes 38% of the raised concerns. Other procedural barriers are charges by clearance agencies (21%), informal payments (9%) and technological constraints relating to Simba system (6%). On agency based procedural obstacles on imports, 51% 0f the reported cases are in KRA, 18.4% in KEBS and 15.7% in KPA.

Similarly, 85% of agricultural and manufacturing importers were affected by non-tariff trade barriers citing that Kenya imposes many regulations making it difficult to import. A third of the barriers are related to conformity assessment, pre-shipment inspection, administrative procedures, red tape and high fees charged for the services offered by agencies such as the Kenya Revenue Authority (KRA), the Kenya Plant Health Inspectorate Services (KEPHIS), the Kenya Bureau of Standards (KEBS) and the Horticultural Crops Development Authority (HCDA) increase the costs for exporters and thus undermine their competitiveness [19].

Majority of manufactures reported that conformity assessment measures applied by KEBs and KRA are burden to importing manufactures in terms of cost and time. It is worth noting that conformity assessment creates extreme barriers to importers and exporters due to high costs and administrative hurdles involved with testing and certification or lack of proper certifying facilities. This result indicates that exporters and importers have the capacity to produce up to the standards required by importing countries, but face obstacles in demonstrating conformity with these requirements. Other raised challenges where KRA and KEBS not returning multiple samples picked, mishandling of products, congestion in port and slow processing. The process of getting a product tested or certified by Kenyan agencies was hectic.

Relatively, the survey revealed that there is a significant difference in barriers across sectors with agricultural importing and exporting companies experience more impediments to trade than manufacturers. Specifically, importers in the agricultural sector are more affected by burdensome regulations (85%) compared to exporters (76%). This suggests that Kenya itself imposes many regulations that make it difficult to import agro-food products. In conclusion, this study alludes that the prevailing domestic problems for importers stem from procedural obstacles and not from the regulations themselves.

Categorically, surveyed exporters and importers emphasized that the difficulties with conformity assessment do not stem solely from

the requirements of the importing countries. They are also caused by the burdensome process of getting the product inspected, tested or certified in Kenyan agencies. In addition, congestion at the port and slow processing means that products are held up in the port for a long time. Another issue frequently mentioned by importers was KRA's online Simba system breaking down too frequently.

Another survey on barriers of trade in Kenya in relation to EAC trade partners Kiriti et al. [17] focused on the effect of technical barriers on businesses. This study classified KEBS and KRA quality standards and certificate of conformity as a TBT. The study identified a set of procedural barriers to trade that severely affect business operations by increasing the cost of operation. Some of the identified obstacles by businessmen respondents were: delays in clearance of goods at the port of Mombasa due to lengthy clearance processes, non-recognition of certificates of origin, verification and classification of goods, varying procedures for issuance of certification marks, technical standards, inspection and testing by bureaus of standards (83.3%), cumbersome testing procedures for certain imports, administrative levies and corrupt practices (90%). However, a survey from customs agents denied that (PV_oC) programme was a hindrance to trade citing that delays in clearance of goods at customs is as a result of customs departments' staff lack of institutional capacity, poor staffing levels, poor infrastructure and insufficient human resources.

A similar survey was done by International Trade Centre (ITC) covering 250,000 firms in 28 European Union (EU) countries and 26 sectors regarding Non-tariff trade barriers in 2016. EU exporters reported difficulties meeting technical and conformity assessment requirements related to technical barriers to trade (TBT) and sanitary and phytosanitary measures (SPS) imposed by their respective partner countries. They raised issues regarding compliance procedures with EU or home country regulations (export-related measures), as well as with the procedures to obtain certificates of origin. One striking revelation is that 36% of the exporters face procedural obstacles for instance the process of obtaining certificates of conformity is long and burdensome. Specifically, 90% of the burden is in the procedure of getting the certification other than the strict requirements need for certification. On the other hand, conformity assessments constitute 66% of the total problems faced by EU exporters to various countries including Kenya. The problem manifests in delays in clearance and certification, administrative delays and discriminative behavior of officials. Notably, the surveyed companies are more affected when exporting to developing countries and economies in transition than to developed partners. For instance, for the captured export flows from EU to Kenya, 75.9% were reported to have specific burdens compared to 48.8% in Ghana and 44.4% in USA, Majorly on procedural obstacles.

The findings in the surveys above echoes the findings in KRA survey on manufacturers in 2016 where 67% of the respondents cited PVOC implementations as trade barrier. The issues raised about PVOC were purely procedural. They include inspections delays, increased cost of production due to delays and system/machinery break down which makes it very difficult to prepare list for exemption. In conclusion, the surveys consistently raise procedural obstacles around PVOC implementation other than the programme itself as a non-tariff barrier to trade.

Effect of technical trade barriers based on gravity model: Ferro et al. [20] investigated the effect of food standards on exports from developing countries using gravity model. Empirical results suggested that standards negatively affect the decision to export at firm level. This has a downward effect on trade flows with a decrease in imports, thus reduction in revenue collection. This study argues that a product standard limits the type and design of products that can be marketed and reduces incentives for innovation. Secondly, differing requirements between countries can result in substantial additional costs for producers and the exclusion of foreign firms from markets. Similar findings are echoed in Kapuya et al. [21] on the impact of European Union standards on export of South Africa oranges. Gravity model simulation revealed that reducing trade barriers would increase orange exports by 0.1%.

Anders and Julie (2009) reviewed the effect on Hazard Analysis Critical Control Points (HACCP) programme imposed to check quality and safety of seafood processing in United States of America. Using gravity model and controlling for regional trade blocks using dummy variables, it was established that mandatory HACCP standards have significantly reduced exports from 9 developed and 26 developed countries resulting to an annual loss of $ 51.9 million in trade value. These results support trade barrier effect of quality and safety standards on imports.

Notably, the marginal effect is intense in developing economies as compared to developed countries contrary to ITC findings on EU 2016 survey that revealed that TBTs in form of procedural barriers are more in developed counties than in developing countries [22]. Similar findings are echoed in Disdier et al. [23] in investigation of the effect of sanitary and phyto-sanitary (SPS) and Technical Barriers to Trade (TBT) adopted by OECD countries on agricultural trade inflows. Estimates of a gravity equation reveal that SPS and TBT significantly reduce developing countries' exports to OECD countries. However, there is no trade effect between OECD members. Furthermore, European imports are more negatively influenced by SPS and TBTs.

A study by Bao et al. [24] covering 105 countries and regions from 1995 to 2008 estimated the trade effects of technical barriers to trade (TBT) using modified two-stage gravity model to control for both sample selection bias and firm heterogeneity bias. The study defined non-tariff trade barriers as technical trade barriers which mainly include standards and technical regulations introduced for a range of reasons like environmental protection, safety, national security and consumer information. The empirical findings revealed, firstly, that a country's TBT notifications decrease other countries' probability of exporting. This is explained by an increase in both variable and fixed cost that exporters incur in a bid to meet the standards.

Secondly, the study revealed that a TBT imposed by a developing country will significantly affect exports of other developing countries. However, the TBT has no effect on imports of developing countries. On the other hand, a developed country's TBT has significant effects on the exports from both developed and developing countries but the effect is more severe on the former. A similar argument is advanced by Anderson et al. [25].

In another study, Maskus et al. [3], raises a concern over the role of trade barrier techniques. The study associates TBTs with increase in cost for the importing foreign firms compared to the domestic firms. This makes TBTs a trade barrier. The increase in cost may be attributed one-time costs of compliance to the administrative system and product redesign. Recurrent costs arise from quality control maintenance, testing and certification. Verifications to ensure that regulations are met pose as the greatest technical barrier to trade. Importing governments have to ensure that their goods pass the

conformity assessment for every product they are exporting. These governments may refuse to recognize the tests provided by the clearing agencies or other public authorities. This subjects the process to unwanted bureaucratic procedures. Moreover, time delays also affect products with short life cycle such as perishable goods.

Stephenson (1997) highlights one of the reasons that developing countries lag behind developed nations is their lack of capacity in effective certification and poor testing facilities. This implies that developing nations have not reached a consensus on conformity of assessment standards with other nations. It also implies that they have not integrated their systems with test requirements from abroad. Lastly, there is lack of trust from developed countries with inspection.

Contrary, Felbermayr et al. [26], argue that technical barriers to trade are often used as fixed regulatory costs in relation to market entry of exports. From their study which applied a model capturing heterogeneous firms, differentiated goods and variables capturing external economies of scale, their results showed that TBTs have a positive impact of trade. This impact is seen through increased number of productive firms participating in trade thus increasing trade volumes. A similar argument is advanced by Rippel et al. [27]. In their paper, they cite an example of how trade facilitation has improved trade between Zambia and Zimbabwe. With the creation of the one stop border post, the countries have noted significant improvement in reduced waiting time at the border from five days to two days or even a few hours. However, for this to be realized, there's need to view the implementation of TBTs as a long term project.

In studying pre-shipment inspection programs, Dequiedt et al. [28] uses a hierarchical agency model to understand the linkage between incentives governments (the regulator) can offer importing firms and pre shipment inspection (PSI) firms (the supervisors). The supervisors' role is to control an agent's declaration on imports. The regulator has to handle aspects of asymmetric information since the agents know more about the value of their imports, under declaration by the agent, and corruption by the customs officer in the event they collude with the agent. From the model, the authors concluded that the design of the PSI programs is critical to profitability. However, they caution that PSI programs may not be an optimal solution to all countries especially they with high levels of corruption. This is more so in developing countries.

Michael et al. [29] did a study to determine whether customs trade facilitation programs enhance efficiency. From their study, they found that trade facilitation programs do impact trade facilitation by reducing corruption which in turn enhance efficiency at customs offices. On average, state treasuries lose over $2 billion globally in trade taxes excluding excise taxes and VAT. In particular, World Bank estimates showed that Kenya lost on average $9m annually. According to Ferreira (2007), traders give bribes for three main reasons; favorable classifications of imports that will attract lower taxes, to have smoother conditions for clearance and as a way of avoiding inspections. The effect of this is undervaluation which in turn affects trade profitability. Therefore, one cannot ignore the relationship between trade facilitation and corruption within the customs offices. Trade facilitation programs are thus geared towards curbing corruption as well.

Pre shipment inspection programs are examples of such programs that are instrumental in the enhancement of trade. These programs have been adopted worldwide as part of custom related initiatives that can enhance efficiency of the customs departments. According to Jean et al. [30], trade facilitation programs have an overall impact on reducing customs tax trade evasion. These programs reduce cases of under declaration consequently increasing the revenue generated.

The empirical findings seem to be biased on application of gravity model, however the findings are contradicting. The catalyst argument suggests that quality goods resulting from TBTs lead to a rise in domestic demand for imports leading to increase imports. This study investigated the effect of PVOC program on trade and revenue flows in Kenya.

Methodology

An empirical panel econometric model capturing the effect of standards and other macroeconomic variables on imports from:- Burundi, China, Germany, India, Indonesia, Japan, Rwanda, Saudi Arabia South Africa, Tanzania Uganda, United Arab Emirates, United Kingdom, United States was estimated. However, several gravity model concerns were addressed prior model estimation.

Firstly, do we use imports values in nominal or real terms? Shepherd et al. [31] asserts that trade flows should be in nominal, not real terms. The reason is that exports are effectively deflated by the two multilateral resistance terms, which are special price indices. Deflating exports using different price indices, such as the CPI or the GDP deflator, would not adequately capture the unobserved multilateral resistance terms, and could produce misleading results. A similar analysis applies to the GDP data used in the model: they too should be in nominal, not real, terms. The reason is again that they are effectively deflated by the multilateral resistance terms, which are unobserved price indices. Deflating by some other factor, such as readily observable price index, is likely to be misleading. The other key issue is choosing between imports in CIF or FOB values as a dependent variable. De Benedicti and Taglioni (2011) answer this question. According to Benedictis and Taglioni (2011) using CIF data may lead to simultaneous equation biases, as the dependent variable includes costs that are correlated with the right hand side variables for distance and other trade costs. This study used Fob values.

Econometric model specification

To capture the effect of the program on trade flows from specific economies, the study estimated a modified gravity model with both gravity variables, additional policy dummies and control macroeconomic variables.

The basic gravity model is captured as:

$$TV_{ij} = \beta_0 \frac{y_i^{\beta 1} y_j^{\beta 2}}{D_{ij}^{\beta 3}} \quad (2)$$

Applying natural logarithm transformation and modification, we obtain equation 3 below

$$\ln X_{ijt} = \beta_0 + \beta_1 \ln Y_{it} + \beta_2 \ln Y_{jt} - \beta_3 \ln D_{ij} + \beta_4 EACd_{jt} + \beta_5 PVOCd_i + \beta_6 \ln NEER_{it} + B_7 X_{jt} - \beta_8 p_{it} + \varepsilon_{it} \cdots 3$$

The variables in the model are explained in Table 1 below.

Data and Empirical Results

The study conducted the following pre-estimation tests:-

Hausman test

Hausman test was used to decide between fixed or random effects model. The null hypothesis is that the preferred model is random affects vs. the alternative which states that fixed effects model is more

appropriate. The statistic follows a chi-distribution as shown below. The p-value for the computed chi-statistic is 0.5746. Therefore, we cannot reject the null at all conventional significance level hence we do a random effects model (Figure 3).

Breusch and Pagan Lagrangian multiplier test

Breusch and Pagan Lagrangian multiplier test for random effects was done where the null is: there are no panel effects hence we should do a pool model. The alternative hypothesis is that variance across entities is not zero hence we use random effects model. Breusch and Pagan Lagrangian multiplier test for random effects rejects the null suggesting that we have random effects across entities (Figure 4).

Test for cross sectional dependence

Cross sectional dependency is a common problem in macro-panels with longtime series. Cross sectional dependence is caused by common factors which are observed but uncorrelated with model regressors. In such cases, random effect estimates are consistent but not efficient and standard errors are biased. The study used both Peseran cd test and Friedman's test as shown in Figure 5. The tests show that there is a weak cross sectional dependency with an average absolute correlation coefficient of 0.236 and 0.236 for both tests respectively. The remedy for this problem is to use adjusted standard errors.

Panel heteroskedasticity

In panel data, heteroskedasticity is caused by variations in country sizes. The study tested for heteroskedasticity using LR test. The results in Figure 6 shows presence of heteroskedasticity, therefore we used robust standard errors in estimation as a remedy.

Model estimates

The results in Table 2 show that import flows in to Kenya positively and significantly depend on Kenyan economic performance (GDP) which is also a proxy for imports demand, GDP of exporting economies-which also reflects their supply constraints or ability to produce export goods and sharing of borders. These findings are consistent with gravity model which assert that trade flows are positively related to economic mass for the two economies.

From the estimated model, a 1% increases in Kenya GDP increases the value of imports by almost 0.17%. Correspondingly, the coefficient of GDP for the countries exporting into Kenya is positive and significant as expected. Exporter GDP captures the ability for an exporting country to produce exportable goods. It's a proxy for imports supply constraint. From the estimated models, a 1% GDP growth for exporter increases the supply of Kenyan imports by 0.54%.

Distance between Kenya's capital city and that for exporters has a negative sign but it is not significant at the conventional statistical levels. Distance is used as a trade resistance factor in gravity model.

Table 1: Variable description.

SN	Variable name	Description
1	LNX	Dependent variable -CIF or FOB imports and trade revenue values by source country in dollars
2	lnYit	Natural logarithm of real GDP of Kenya trading partners at time t
3	lnYjt	Natural logarithm of real GDP of Kenya trading partners at time t
4	lnD	Natural logarithm of the distance between Nairobi and capital cities of Kenya's trading partners (see appendix 1), which is time invariant.
5	Lnexr	Natural logarithm of real effective exchange rate
6	$EACd_j$	A dummy variable for EAC membership
7	pij	Proxy for procedural trade barrier.
8	PVOCdi	A dummy variable capturing PVOC programme with 0 and 1 for pre and post PVOC periods respectively

```
                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       fe           re          Difference          S.E.
-------------+------------------------------------------------------------
      PVOC_d |  -.2002608    -.2071195        .0068587        .0070607
       lnykn |   .1231901     .1719194       -.0487293        .0346152
       lnexr |  -.0475274    -.0566865        .0091591        .0209531
         lnx |   .1803772     .1750594        .0053178        .0075564
        lnyn |   .5814991     .4879052        .0935939        .0732236
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
        B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        3.83
                Prob>chi2 =      0.5746
```

Figure 3: Hausman test results.

Source: Author 2017

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Breusch and Pagan Lagrangian multiplier test for random effects

        lnm[id,t] = Xb + u[id] + e[id,t]

        Estimated results:
                         |       Var      sd = sqrt(Var)
                ---------+------------------------------
                     lnm |    4.241679       2.059534
                       e |    .2331439       .4828498
                       u |    .7696936       .8773218

        Test:   Var(u) = 0
                                chibar2(01) = 10378.20
                             Prob > chibar2 =   0.0000
```

Figure 4: Breusch and Pagan Lagrangian multiplier test.

Source: Author 2017

```
. . xtreg lnm lnd border_d EAC_d PVOC_d  lnykn lnexr lnx lnyn, re

Random-effects GLS regression                   Number of obs     =      1,098
Group variable: id                              Number of groups  =         14

R-sq:                                           Obs per group:
     within  = 0.0627                                         min =         68
     between = 0.8942                                         avg =       78.4
     overall = 0.8361                                         max =         81

                                                Wald chi2(8)      =     143.67
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =     0.0000

------------------------------------------------------------------------------
         lnm |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         lnd |   -.9771992   .6566427    -1.49   0.137    -2.264195    .3097968
    border_d |    2.628249   .9651556     2.72   0.006     .7365789    4.519919
       EAC_d |   -4.911212   1.461226    -3.36   0.001    -7.775163   -2.047261
      PVOC_d |   -.2071195   .0529712    -3.91   0.000    -.3109411   -.1032978
       lnykn |    .1719194   .1103187     1.56   0.119    -.0443012      .38814
       lnexr |   -.0566865   .0495344    -1.14   0.252    -.1537721    .0403992
         lnx |    .1750594    .044872     3.90   0.000     .0871118    .2630069
        lnyn |    .4879052   .1351292     3.61   0.000     .2230569    .7527535
       _cons |    19.70034   5.562748     3.54   0.000     8.797557    30.60313
-------------+----------------------------------------------------------------
     sigma_u |   .87732185
     sigma_e |   .48284976
         rho |   .76751578   (fraction of variance due to u_i)
------------------------------------------------------------------------------

. xtcsd ,pesaran abs

Pesaran's test of cross sectional independence =     6.258, Pr = 0.0000

Average absolute value of the off-diagonal elements =     0.236

. xtcsd, friedman show abs

Correlation matrix of residuals:

          c1       c2       c3       c4       c5       c6       c7       c8       c9      c10      c11      c12      c13
 r1   1.0000
 r2  -0.5579   1.0000
 r3  -0.1782   0.0165   1.0000
 r4  -0.4472   0.3589   0.1030   1.0000
 r5   0.3416  -0.6586  -0.0134  -0.2527   1.0000
 r6  -0.5741   0.3316   0.1900   0.1810  -0.2845   1.0000
 r7  -0.2398   0.0269   0.1912   0.2177   0.0312   0.1437   1.0000
 r8   0.3780   0.3304   0.0549  -0.1212  -0.1971  -0.2686  -0.0934   1.0000
 r9   0.0939   0.1916  -0.0237  -0.0781  -0.1935   0.3244  -0.0529   0.1341   1.0000
r10   0.1268   0.4130  -0.0210  -0.0515  -0.2758  -0.1754  -0.3587   0.7835   0.1000   1.0000
r11  -0.5614   0.5361   0.2587   0.3604  -0.2959   0.2791   0.7340   0.2619  -0.0388   0.2110   1.0000
r12   0.8294  -0.1795  -0.2123  -0.4115   0.0638  -0.5009  -0.3384   0.6327   0.2168   0.4812  -0.3952   1.0000
r13  -0.0969   0.1575   0.1501  -0.0430  -0.0658   0.3284   0.1829  -0.0504   0.1826   0.0097   0.1931  -0.0959   1.0000
r14  -0.0751  -0.0921   0.2170   0.0753   0.1785   0.1665   0.1420  -0.0067  -0.1460   0.1451   0.2116  -0.1445   0.2670

          c14
r14   1.0000

Friedman's test of cross sectional independence =   107.256, Pr = 0.0000

Average absolute value of the off-diagonal elements =     0.235
```

Figure 5: Peseran and Friedman tests for cross sectional dependency.

Source: Author ,2017

```
. *To indicate to lrtest the number of implied constraints
. local df=e(N_g) - 1

. display e(N_g) - 1
13

. *Run the lrtest
. lrtest hetero . , df(13)stats

Likelihood-ratio test                                 LR chi2(13) =   1061.28
(Assumption: . nested in hetero)                      Prob > chi2 =    0.0000

Akaike's information criterion and Bayesian information criterion

-----------------------------------------------------------------------------
       Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
-------------+---------------------------------------------------------------
           . |      1,098         .  -1185.437       9    2388.873   2433.885
      hetero |      1,098         .  -654.7977      23    1355.595   1470.624
-----------------------------------------------------------------------------
               Note: N=Obs used in calculating BIC; see [R] BIC note.

. *Note: LR Chi2 should not be negative?
```

Figure 6: Test for Heteroskedasticity.

Source author 2017

Table 2: Shows the results of the estimated Gravity model.

Independent Variables		
	Model 1-RE	**Model 2-RE**
	Ln_imports(FOB$)	Ln_imports(FOB$)
Ln_distance	-0.9771 (0.6566)	-0.3784 (0.5425)
Border_dummy	2.6282*** (0.9651)	3.475*** (0.782)
EAC_dummy	-4.911**** (1.4611)	-4.468*** (1.146)
PVOC_dummy	-0.2071*** 0.0529	-0.1790 (0.1428)
Lngdp_kenya	0.1719** (0.1103)	1.267*** (0.2607)
Ln_exchange rate	-0.0656 (0.4912)	-0.3146*** (0.0913)
lnGDP_exporter	0.5408 (0.1319)	0.4173** (0.1369)
TTI(Time to import)		-0.1800*** (0.0438)
constant	22.374 (5.084)	19.137*** (4.641)
R^2	0.84	0.85

****significant at 1%, **significant at 5%, *significant at 10% and Standard error in parenthesis*

It is a proxy for unit cost of transporting goods from one economy to another. According to Buch et al. [32], globalization and technology have gradually diminished the importance of distance in determine bilateral trade relationships although we expect economies that are close to trade more than those that are far from each other. The coefficient of exchange rate is negative as expected in theory implying that exchange rate variations do influence trade flows between economies.

The rest of the variables are dummies, therefore interpretation of such variables in semi-logarithmic equations requires some transformation for theoretically consistent results as suggested by Halvorsen et al. [33]. The proper representation of the proportional impact of coefficient β_j of a zero-one dummy variable, d, on the dependent variable x is expressed as, $\beta_{ij}^{T}=\left[e^{\beta_{ij}}-1\right]*100$, where e is the exponential constant and β_{ij}^{T} is the transformed dummy coefficient.

Kenya being a member of EAC has negative effect on import flows and trade revenue collection suggesting a possibility of trade diversion other than the expected trade creation effect. Border dummy is positive and significant as expected. Economies that share borders are likely to share language, culture and they are likely to create more trade ties. Our main variable is PVOC programme which was measured using a dummy variable of 1 in post PVOC period and 0 in pre-PVOC period.

Estimates in model 1 and 2 reveals that PVOC lead to decline in value of imports by 11 %; In model 2, we control for procedural trade barrier using the time it takes to import (TTI). TTI is based on average time it takes on documentary compliance (preparing documents, processing documents and presenting) and border compliance (clearance) within the overall process of exporting or importing a shipment of goods. TTI coefficient is negative and statistically significant at 1% implying that one hour increase in TTI reduces imports by 0.18%. Notably, in model 2, PVOC coefficient is negative but insignificant.

Conclusion

The results revealed that quality standards are an impairment to trade flows in Kenya nullifying the trade catalyst hypothesis. The technical barriers are probably caused by procedural barriers involved in obtaining certificate of conformity, verification and clearance. Therefore, it is advisable that relevant trade policy authorities design a programme for implementing verification procedures that is efficient, transparent and convenient to importers.

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