EFFECTS OF CONSUMER GOODS AND INDUSTRIAL PRODUCTS STANDARD ON EXPORT DIVERSIFICATION IN SOUTH AFRICA

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ABSTRACT

The initial stages of economic development are generally characterized by rising per capita income alongside structural changes in both production and export activities. These changes often entail the development of new products and the establishment of additional trade partnerships, thereby fostering broader diversification within the economy. This study therefore, examined the effect of consumer goods and industrial products standard on export diversification in South Africa. The study employed Generalized Least Square (GLS) Model which estimated the effect of European Union (EU) product standards and the harmonized EU product standard (EU_ISO). Data used for the analysis were from year 2011 to 2022, and were sourced from WIT-TRAINS, and WDI. The results revealed that the distance and common language were positive and significantly affects countries ceramic (ED_CER) export diversification (P = 0.000; 0.001). However, the effect of distance on ceramic (ED_CER) was stronger than its effect on sugar & confectionary (ED_SUC). This implies that the farther away the countries are from each other, the larger the export basket and that export diversifications are not only driven by standards requirements but by language and distance. The EU standard positively affected both sugar & confectionary and ceramic export diversification (P = 0.941; P = 0.638). This indicates that a one per cent increase in the EU product standard results into 0.9 and 0.6 per cent increase in sugar & confectionary and ceramic export diversification. The result also revealed that the EU standards that are harmonized with ISO standards are positive (P = 0.465) on South Africa's sugar & confectionary export diversification. The study concludes that South Africa's export diversification and the harmonization of the EU to international standards acts have beneficial factors even when the overall impact of product standards was positive but insignificant. The study recommends that the development of infrastructure should be given importance as it leads to reduction in transaction cost (distance) of trade.

Keywords: European Union, Product Standards, Consumer Goods, industrial Products

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1 | Introduction

Economic diversification is strongly correlated with increased growth rates, particularly in low-income economies. As noted by UNCTAD (2024), the initial stages of economic development are generally characterized by rising per capita income alongside structural changes in both production and export activities. These changes often entail the development of new products and the establishment of additional trade partnerships, thereby fostering broader diversification within the

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economy. Economic history as indicated by Orebiyi & Ubong, (2023), has showed that without diversification into manufacturing and service, and away from simple resources extraction, the long-term development prospects of countries are always futile. More so, most African governments have not taken advantage of the last decade's growth surge to move toward diversification; neither in their economic structures, nor in their export baskets (Mora, and Olabisi, 2023). Countries that are natural resources endowed are anything but an example of sustainable growth.

The late 20th century witnessed major shifts in global trade, particularly following the establishment of the World Trade Organization (WTO) in 1995. These changes, driven by reforms in unilateral, bilateral, and regional trade agreements, significantly impacted terms of trade (Espoir, 2020). African countries, whose exports are predominantly primary commodities (56%), have been prompted to diversify their export structures. To fully harness the benefits of international trade, this diversification may involve introducing new products to existing or new markets, as well as expanding existing products into new markets (Karahan, 2017).

The South African export growth during the 1990_s was showed to be mediocre when compared to many middle-income economies and other similar natural-resource abundant economies. Several scholars have highlighted the structural limitations of South Africa's export profile, which, much like Nigeria's, remains heavily reliant on natural resource-based products that are losing ground in global markets (Espoir *et al.*, 2021). In contrast to East Asian economies that have effectively restructured their production systems to focus on high-technology goods, South Africa and Nigeria have failed to make similar transitions. This inability to diversify into technology-intensive exports is frequently cited as a key factor behind their underwhelming export performance during the 1990s (Orebiyi and Ubong, 2023). The limited growth of South Africa's manufacturing exports is, therefore, often attributed to its continued dependence on natural resource sectors, whose global trade shares have progressively declined.

According to Kareem (2010), non-tariff measures constitute the most significant trade restrictions that Africa's export face in the market of their trading partner. Collier and Venables (2007) have argued that trade preferences could serve as a viable strategy to promote export diversification in developing countries, particularly by broadening the variety of goods exported. However, such initiatives often concentrate primarily on tariff reductions, while overlooking the significant barriers posed by non-tariff measures especially product standards as well as the persistent challenges linked to supply-side constraints (Hoekman, 2007). For most African nations, reducing dependence on primary commodity exports remains a pressing challenge. Achieving meaningful economic transformation that ensures wage-based employment will require a deliberate shift from enclave economies centered on a narrow range of exports toward a more diverse and dynamic export portfolio encompassing non-traditional products and new markets (Karahan, 2017).

African nations continue to encounter significant obstacles in building the domestic capacity necessary to comply with the production and quality standards demanded by international markets. This involves enhancing production processes, strengthening firms' quality assurance and management systems, and improving mechanisms for monitoring, evaluation, product testing, and packaging all aimed at adapting to the evolving technical requirements of global trade

partners (UNCTAD, 2023). For Africa to fully capitalize on its involvement in global trade, it must broaden its export base, improve product quality, and expand its market reach. However, in countries like South Africa, the diversity of export products may be constrained by the rising costs associated with accessing foreign markets. These costs are often driven by the use of stringent product standards by developed countries, which can act as non-tariff trade barriers.

Product standards represent a key policy factor influencing export diversification. Among the various trade-related policies, they are particularly impactful because they often function as fixed trade costs rather than variable ones. This is largely due to the significant expenses associated with modifying products or production processes to align with the regulatory requirements of destination markets (Osakwe and Kilolo, 2018). While developing countries may also face increased variable costs related to testing and certification, these tend to be relatively minor compared to the substantial upfront investments required for product and process redesign. Consequently, product standards especially when harmonized across multiple markets can play a critical role in shaping the extent and success of export diversification (Shepherd, 2009).

This paper used the secondary data on export varieties, international Organization of Standardization (ISO) harmonized European Union (EU) standards, ISO non harmonized EU standards, Gross domestic product (GDP), Distances and the Gravity variables. The analysis of the study was on 13 High Standard (HS) classifications of year 2022 Ceramic Products as variables for industrial goods sector and 21 HS classifications of 4 digits Sugar and confectionery products as variables for consumer goods sector. The demand for these products and the year of export diversification served as the justification for the selection of the products. The time frame for the analysis of the study was from the period of 2011 to 2022 and the sample included the selection of South Africa (ZAF). Analysis was done for each of these two countries against each of the 27 European Union countries (EU27) namely; Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, and the United Kingdom.

2 | Literature Review

Rogneda *et al*., (2025) evaluate the determinants of export diversification in Russian region using hydrocarbon. The hydrocarbon sector accounts for 50% of Russian exports, leading to high commodity price volatility risks for the economy. Prior literature emphasizes the role of export diversification in development and in hedging external shocks. The study investigates factors affecting regional export diversification, applying method of moments quantile regression. The study devise two export diversification measures, using Theil and Herfindahl indices. The empirical findings demonstrate that innovations spur export diversification in industrial regions, while small and medium enterprises diversify exports in industrial and non-resource regions. Natural resource extraction enforces regional exports concentration. The study develops policy implications for Russian regional policymakers considering the specialization of regional economies.

Vogel (2022) presents a literature review on the factors influencing export diversification and employs Bayesian Model Averaging (BMA) to

address the uncertainty arising from the numerous potential determinants. The study examines the relevance and impact of up to 46 factors on the export diversification of 47 African countries and 123 trading partners from 1995 to 2018. It concludes that both exporter and importer characteristics, as well as bilateral factors, play significant roles in shaping diversification patterns. In particular, the structural features and trade policies of African countries are crucial determinants. Additionally, the characteristics of trading partners also affect diversification trends. The study underscores the potential of the African Continental Free Trade Area (AfCFTA) to promote export diversification. The findings further suggest that policies aimed at diversifying exports along both extensive and intensive margins may not be effectively pursued through the same policy measures, and could even conflict with each other in the short term. Finally, non-trade factors such as education, institutional quality, and a well-developed service sector are also vital for fostering diversification.

A 2021 study by Yusuf and Sancar analyzed the impact of export characteristics (sophistication, product/market diversification and concentration) and the real effective exchange rate on net exports in 14 emerging and 8 developed economies between 1995 and 2019. Their panel data analysis, which accounted for cross-country connections and structural changes, revealed that for developed countries, greater export sophistication, more concentrated export products, and more diverse export markets increased net exports, while a higher real effective exchange rate decreased them. In emerging countries, however, export market concentration and the real exchange rate were found to have a negative influence on net exports. Furthermore, the study found that export sophistication and export product diversification did not affect net exports in emerging countries, as these factors were not sufficiently developed to boost exports compared to developed nations. The limited share of high-tech exports and the narrow range of products in these countries contributed to the low levels of export sophistication and diversification. This situation poses a significant risk, potentially trapping these nations in the middle-income category.

Espoir's 2020 study investigated what drives export diversification in Southern African Development Community (SADC) countries between 1990 and 2018. Using the Herfindahl-Hirschman index to measure export diversification, the study employed advanced panel data methods like panel unit root tests, cointegration analysis, FMOLS, and DOLS. The unit root test results showed that all the variables became stable after taking their first difference. The Espoir (2020) study on SADC countries also found that in the long run, a country's GDP, how open it is to trade, the buildup of its human skills and infrastructure, and the amount of foreign investment it attracts are significant factors that determine how diversified its exports become.

3 | Methodology

The theoretical framework for this study was derived from the gravity model theory which made provision for economies of scale and imperfect market. This model have been used extensively by Shepherd (2009); Melo *et al* (2012), Lei *et al*., (2013) and Shepherd, *et.al.,* (2013) in the determination of the impact of non-tariff barriers on trade. The gravity model was originally developed by Jan Tinbergen in 1962 for the purpose of predicting bilateral trade flows based on economic sizes (GDP measurement) of and the distance between the trading partners. This implies that trade is more prominent between countries with larger economic sizes and shorter distance

than between countries with smaller economic sizes and longer distance.

In a revised model presented in Shephard (2015), the world is divided into three regions: Home (H), Foreign (F), and the Rest of the World (R). One sector produces a single, homogeneous good, while another sector produces a range of differentiated goods. In this scenario, utility is expressed as:

$$U = q_0^{\mu}\left(\int_a \; q(\omega)^{\frac{\sigma-1}{\sigma}} d\omega\right)^{(1-\mu)\frac{\sigma-1}{\sigma}} \quad (1)$$

where the expression defines q_0 as the quantity of a homogeneous good and q(ω) as the consumption of each differentiated product variety. The parameters μ and (1 − μ) represent consumption weights for the two sectors, while σ measures the elasticity of substitution among varieties in the differentiated goods sector. Production in the homogeneous sector follows constant returns to scale, with developed regions (F and R) having higher labor productivity than the developing region (H), meaning one unit of labor yields more output in F and R than in H. The homogeneous good has a fixed price of one and is traded without cost, so wages in region H are w−, and in regions F and R, also w−. In the differentiated goods sector, the cost c of producing quantity q in region i and selling it in region j is specified separately.

$$C_q(q) = \frac{W_t}{\varphi} q + f_q \quad (2)$$

where fq represents the fixed cost for firms in region i to enter the market in region j. The study defines fg as the costs associated with designing and retooling that a firm in region i must incur to meet product standards in region j, thereby gaining access to its market. For simplicity and to align with the study's focus on the extensive margin, no variable trade costs are considered. Firms are heterogenous in productivity φ, which is drawn from a pareto distribution with support [1,+∞], shape parameter γ > σ-1,, and CDF $G(\sigma)=P(\widetilde{\sigma<\sigma})=1-\sigma^{-\gamma}$,

Labor is the only production factor, with each region having Li units. Unlike Baller's (2007) model, this framework fixes the number of potential entrants in each region based on wi Li. Total regional expenditure (Yi) combines labor income and redistributed profits, with profits allocated through a global mutual fund in which workers hold wi shares each. Under standard assumptions, the model derives firm exports from region i to region j.

$$x_t(\varphi) = (1-\mu)Y_f\left(\frac{P_f(\varphi)}{P_f}\right)^{1-\sigma} \quad (3)$$

Where

$P_f(\varphi) = \left(\frac{\sigma}{\sigma-1}\right)\left(\frac{w_t x_q}{\varphi}\right)$ is the firm's optimal price; and Pj is the CES price index for region j. Net firm profits from producing in region i and selling in region j are:

$$x_q(\varphi) = \left[P_q(\sigma) - c_q(\sigma)\right]q(\sigma) - f_q \quad (4)$$

In the baseline equilibrium, Chaney (2008) fully outlines the solution to the model and its equilibrium characteristics. For the current discussion, the key finding is that firms enter markets based on their productivity. In equilibrium, the zero-profit condition of the form π ij(− ϕ ij) = 0 implicitly establishes a productivity threshold for each market, which is expressed as:

$$\tilde{\sigma}_f = \lambda(\left(\frac{Y}{Y_f}\right)^{\frac{1}{\gamma}}\left(\frac{w_f}{\theta_f}\right) f_q^{\frac{1}{\sigma}} \quad (5)$$

$$\lambda_Q = \left[\frac{\sigma}{\mu}\left(\frac{\gamma}{\gamma-(\sigma-1)}\right)\left(\frac{1}{1+\lambda_t}\right)\right]^{\frac{1}{\gamma}} \quad (6)$$

$$\lambda_F = \frac{\left(\frac{\sigma-1}{\gamma}\right)^{\frac{(1-\mu)}{\sigma}}}{1-\left(\frac{\sigma-1}{\gamma}\right)^{\frac{(1-\mu)}{\sigma}}} \quad (7)$$

$$\sigma_y^{-\gamma} = \sum_{kw(H,F,X)} \frac{Y_k}{Y}(W_k)^{-\gamma} f_k \left[\frac{\gamma}{(\sigma-1)-1}\right] \quad (8)$$

The equilibrium cutoff ϕ^{-}_{ij} is the minimum productivity a firm needs to profitably export from region i to j. Firms with productivity above this threshold export, while less productive ones do not. To reflect real world patterns where firms first serve their domestic markets and only some later export the model assumes domestic entry costs (f_{kk}) are lower than foreign market entry costs (f_{lm}) for all regions. This condition accounts for the fact that foreign exporters face higher compliance costs than domestic firms, as they must invest significantly in understanding the importing country's standards before meeting them.

As indicated by the cutoff condition, stricter or more numerous standards in the importing country i.e., an increase in the fixed cost of compliance pushes lower-productivity exporters out of the market, while high-productivity firms are able to continue exporting (ij df/dϕ > 0, ignoring indirect effects). The θ j term can be understood as an index of region j's remoteness, similar to the inward multilateral resistance term proposed by Anderson and van Wincoop (2003). In simple terms, the more isolated a region is from the global market, the lower the productivity threshold a potential exporter must meet for a given level of bilateral trade costs.

$$\lambda_Q = \left[\frac{\sigma}{\mu}\left(\frac{\gamma}{\gamma-(\sigma-1)}\right)\left(\frac{1}{1+\lambda_t}\right)\right]^{\frac{1}{\gamma}} \quad (9)$$

The Harmonization equilibrium occurs when F adopts R's standard. After harmonization, firms in both F and R can access each other's markets by complying with the new harmonized standard and paying the fixed cost f RR. Firms in H can now access both F and R by meeting R's standard, thus paying only the fixed cost f HR. Intuitively, the impact of harmonization is influenced by at least two opposing factors. On one hand, accessing a larger market by paying a single fixed cost suggests a scale effect, which should make it easier to enter the export market, thereby increasing trade at the extensive margin.

However, the relative fixed costs in F and R before harmonization are crucial in shaping the outcome: the scale effect might be offset if harmonization leads to F adopting a significantly more expensive standard. The equilibrium conditions under harmonization can be easily derived from Equations (5) through (8) above. For the regions F and R that are harmonizing, the new productivity cutoffs are:
this reflects the fact that firms in either region can

$$\bar{\sigma}_{yy} = \bar{\sigma}_{xx} = \bar{\sigma}_{yx} = \bar{\sigma}_{xy} = \lambda\left(\frac{\gamma}{Y_f+Y_k}\right)^{\frac{1}{\gamma}}\left(\frac{\bar{W}}{\theta_f}\right)f_w^{\frac{1}{\sigma-1}} \quad (10)$$

$$\left(\theta_f\right)^{-\gamma} = \left(\theta_y\right)^{-\gamma} = \frac{Y_f+Y_k}{Y}\bar{W}^{-\gamma}f_{kk}\left[\frac{\gamma}{(\sigma-1)-1}\right] + \frac{Y_f}{Y}\underline{W}^{-\gamma}f_{kk}\left[\frac{\gamma}{(\sigma-1)-1}\right] \quad (11)$$

now access both regions by paying f RR, without incurring any further costs. Likewise, the export cutoffs for the excluded region H to the harmonizing regions are:
with θ'_F defined as above. Thus, firms in H can enter

$$\bar{\sigma}_{dF} = \bar{\sigma}_{dR} = \lambda\left(\frac{\gamma}{Y_f+Y_k}\right)^{\frac{1}{\gamma}}\left(\frac{W}{\theta_f}\right)f_w^{\frac{1}{\sigma-1}} \quad (12)$$

the combined F and R market by paying f HR. To assess the impact of harmonization on both insiders and outsiders, the study compares the export productivity cutoffs from F to R and from H to F before and after harmonization. The first comparison shows the effect of harmonization on the harmonizing regions (insiders), while the second considers the spillover effects on non-harmonizing regions (outsiders). This approach allows for the identification of three effects that influence outcomes in different ways, depending on the initial fixed costs and the manner in which

harmonization is implemented. These effects are referred to as the scale effect, the cost effect, and the remoteness effect. From the previous analysis:

$$\frac{\bar{\sigma}_{FR}}{\sigma_{FR}} = \left(\frac{Y_R}{Y_F+Y_R}\right)^{\frac{1}{\gamma}} x \left(\frac{f_{RR}}{f_{FR}}\right)^{\frac{1}{\sigma-1}} x \left(\frac{\theta_R}{\theta_R}\right) \quad (13)$$

$$\frac{\bar{\sigma}_{dF}}{\sigma_{RF}} = \left(\frac{Y_F}{Y_F+Y_R}\right)^{\frac{1}{\gamma}} x \left(\frac{f_{RR}}{f_{FR}}\right)^{\frac{1}{\sigma-1}} x \left(\frac{\theta_F}{\theta_F}\right) \quad (14)$$

In both scenarios, it is clear that the scale effect will always fall between zero and one, regardless of the initial values of the fixed cost parameters or how harmonization is carried out. Since the comparison is based on productivity cutoffs, this means the scale effect typically lowers the productivity cutoff in all countries after harmonization. This result is intuitively logical: harmonization essentially broadens the market accessible to firms in all regions. For the insiders, F and R, the cost effect aligns with the scale effect, as it also lies between zero and one, given the assumption that f RR < f FR.

In summary, this study has introduced a straightforward theoretical framework for examining the effects of product standards and harmonization on the extensive margin of trade. The model demonstrates that the outcome of harmonization on trade's extensive margin is influenced by three key factors: a scale effect, as harmonization enlarges the internal market among the harmonizing regions; a cost effect, since the harmonized standard may sometimes be more burdensome than the original, unharmonized ones; and a remoteness effect, which considers relative price changes. The model emphasizes the crucial distinction between insiders (the harmonizing regions) and outsiders. Ignoring indirect remoteness effects, harmonization is consistently advantageous for insiders at the extensive margin. However, its effect on outsiders is unclear and depends on the relative magnitude of market size and cost effects.

3.1 | Model Specification

The study adopted Generalized least square estimator which was first described by Aitken, (1935) in line with the gravity model theory of Tinbergen (1962) as specified in the theoretical frame work for the purpose of predicting bilateral trade flows based on economic size and the distance between the trading partners. This technique can be applied for linear regression when there is some level of correlation among the residuals in the model. The GLS model was specified as follows; Given the linear specification;

$$y = x\beta_k + \varepsilon$$
$$E[\varepsilon|X] = 0 \quad (15)$$

Let β_k represent a vector of unknown parameters, commonly referred to as "regression coefficients," which need to be estimated using the data. Assume that **b** is a proposed estimate for β. The corresponding residual vector for this estimate is given by **y - Xb**. Given **Ω** as a matrix, the generalized least squares (GLS) approach estimates β by minimizing the squared Mahalanobis length of this residual vector.

$$\hat{\beta} = X^T\Omega^{-1}X^T\,\Omega^{-1}y \quad (16)$$

Since the objective is a quadratic form in **b**, the estimator has an explicit formula:

$$\hat{\beta} = (X^T\Omega^{-1}X)^{-1}X^T\,\Omega^{-1}y \quad (17)$$

The model can be specified thus:

$$\widehat{H}_{it} = \frac{1}{N}\Omega[\beta_1 \ln(stds) + \beta_2 \ln(ISO_{stds}) + \beta_3 \ln(dist) + \beta_4 \ln(GDP_i) + \beta_5(colony) + \beta_6(border) + \beta_7(lang)]$$
$$\beta_1 > 0, \beta_2 > o, \beta_3 < o, \beta_4 > o \quad (18)$$

Where H_{ij} is export variety of country i to country j, Stds is non-harmonized EU standards, ISO_Stds is the ISO-harmonized EU standards, dist is the

distance between the two trading partners, GDP is the economic size of country i, δ is the fixed effect.The dummy variables include colonial relationship (colony), common official language (lang) and geographical contiguous (border). The primary variables of interest in this study are two measures of product standards. The first variable (Stds) represents the count of non-harmonized EU standards for each product-year combination, while the second variable (ISO_Stds) indicates the number of EU standards that are harmonized with ISO standards.

3.2 | Methods of Data Analysis

The estimation of the study was divided into two parts; pre-estimation which contained descriptive statistics and the estimation which involved the use of GLS technique. The pre-estimation analysis consisted of descriptive statistics which showed information about the characteristics and behavioral pattern of the series under observation. This analysis included the mean, median, standards deviation, skewness, kurtosis etc. The estimation technique for the analysis was the Generalized Least Square (GLS) estimation (Aitken, 1935). This method was adopted as a workhorse estimator for gravity model because estimating the log-linear gravity model where the dependent variable can be zero, was not possible with the use of OLS as log (0) was undefined. In order to achieve the main objective of this research work, which was to examine the effect of product standards on South Africa export diversification, the study adopted the Hirschman index (Hirschman concentration index) to estimate export diversification.

This index, originally introduced by Alfred Hirschman in 1945, was first used in industrial organization to assess market concentration. It was later adapted to evaluate the concentration of a country's export portfolio. In its normalized form, the index ranges from 0 to 1, where a value of 0 indicates a high level of export diversification, and a value of 1 reflects a high level of export concentration meaning the country depends heavily on one or a few products for its exports (Ben *et al*., 2006).

3.3 | Methods of Data Collection

The study used secondary data on export variety, GDP, Standards (harmonized and non-harmonized), distance, time to export and the gravity variables such as language and colony. Export variety as the dependent variable were calculated using the Hirschman concentration index as a proxy for export diversification. This index was used because it helped to know if the country's export receipts were divided evenly among different commodities. The index was computed by using the export data of Nigeria and South Africa to each of the 27 European Union countries sourced from World Integrated Trade Solutions Trade Analysis and Information System (WITS-TRAINS) from 2011 to 2022.

Data for export products were collected from 13 High Standard (HS) classifications of year 2022 Ceramic Products as variables for industrial goods sector and 21 HS classifications of 4 digits Sugar and confectionery products as variables for consumer goods sector. The demand for these products and the year of export diversification served as the justification for the selection of the products. Gross Domestic Product (GDP) was sourced from World Development Indicator (WDI) and was measured for economic size of the importing country. Standards (Stds and ISO_Stds) represents the total number of EU standards and ISO standards and were used in the study as independent variable to estimate its effect on export flows.

ISO standards were used in the study because it is a global standard for international trade. The EU member states are mostly developed countries and trading with any of the EU member states requires compliance to their standard. Since the countries under observation trade with the EU countries and EU standards are internationally recognized standards, thus, pertinent to look at its effect on export diversification. Time to export was measured in days while variables such as distance, language, and colony were embedded in all gravity models.

Table 1. Variables and sources

Variables	Definition	Sources
Export variety	Expansion of export basket	WITS_TRAINS, own calculation
Std_{st}	Total number of EU standards	EUSDB
ISO_Std_{st}	Proportion of EU standards that is harmonized with ISO standards	Perinom
GDP	Economic size of trading partner	WDI
Distance	Physical distance between trading partner	CEPII
Border	A dummy variable which equals 1 for exporting and importing countries with common land border	CEPII
Colony	A dummy variable which equals 1 for exporting and importing countries that was once under the same colonial relationship.	CEPII
Language	A dummy variable which equals 1 if the exporting and the importing countries share the same official language	CEPII
Time to export	Number of days need for exporting	

- *WITS-TRAINS: World Integrated Trade Solution- Trade Analysis and Information System.*
- *EUSBD: European Union Standard Database*
- *WDI: World bank Development Indicator*
- *CEPII: Centre D'Etudes Prospectives ET Information Internationales.*

4 | Results and Discussions

4.1 | Descriptive Statistics

Tables 2 summarized the descriptive statistic for South Africa. It showed that the average values of ED_SUC, ED_CER, EU, EU_ISO, GDPh, GDPf, Dist, Lang, Colony and TTE from 2011 to 2022 are 0.41, 0.38, 59001 documents, 48809 documents, $4.72b, $1.10b, 4565.06 meters, 0.125, 0.125 and 44.7 days. The standard deviation values indicated how widely the observations are spread around their respective means, and the ratio of the standard deviation to the mean was used to assess the variability of export diversification ED_SUC, ED_CER, GDPh, Dist and TTE, with coefficient of variation values below 0.25, indicate low variability (i.e., low dispersion). In contrast, variables such as EU, EU_ISO, GDPf, Lang, and Colony exhibit higher variability, as their standard deviation to mean ratios exceed 0.5. Regarding skewness, where a value of zero represents perfect symmetry (i.e., normal distribution), none of the variables are exactly zero though a few are close. The skewness values of -0.1258, -0.1933, and -2.24 for ED_SUC, Dist, and TTE, respectively, suggest these variables are negatively skewed (i.e., skewed to the left). Meanwhile, variables like ED_CER, EU, EU_ISO, GDPh, GDPf, Lang, and Colony show positive skewness, as their skewness values are greater than zero.

On the other hand, the kurtosis value whose

threshold is three indicated that ED_SUC, ED_CER, EU, EU_ISO, dist and TTE are platykurtic (lowly peaked) while GDPh, GDPf, Lang and colony are leptokurtic (highly peaked). Although skewness statistics indicated that ED_SUC, ED_ CER and dist are approximately normally distributed, as their skewness values are close to 0. Additionally, the kurtosis values suggest that ED_SUC, EU, and EU_ISO are also normally distributed, since their values are close to 3. However, neither skewness nor kurtosis alone can definitively confirm the normality of a distribution. Variance is one of several measures of dispersion which are used to evaluate the spread of the distribution of numbers; it has similar interpretation with standard deviation as it is the square of standard deviation.

Table 2 | Country specific descriptive statistic (SOUTH AFRICA)

	Mean	Maximum	Minimum	std.dev	varaince	skewness	kurtosis	Obs
ED_ SUC	0.4149	1	0.2221	0.1188	0.0252	-0.1258	2.5106	294
ED_CER	0.3844	1	0.2045	0.1673	0.0279	0.1041	1.9167	294
EU	59001.39	143300	9542.944	41310.18	1.71E+09	0.9382	2.7059	294
EU_ISO	48809.09	141792	5908	45990.15	2.12E+09	1.0495	2.6119	294
GDPh	1.51E+11	2.29E+11	1.15E+11	3.07E+10	9.41E+20	1.4309	4.5009	294
GDPf	4.77E+11	2.50E+12	9.59E+09	6.58E+11	4.33E+23	1.7228	4.8527	294
Dist	9238.854	10486.7	7843.593	706.8424	499626.2	-0.1933	2.2923	294
Lang	0.0952	1	0	0.2942	0.0866	2.7578	8.6053	294
Colony	0.0952	1	0	0.2942	0.2942	2.7578	8.6053	294
TTE	44.7	48.6	40.8	2.4919	6.2096	-2.24E-07	1.7734	294

Source: Authors Computation (2024)

Note: ED_SUC indicate export diversification of sugar and confectionary while ED_CER indicate export diversification of ceramic product.

4.2 | Sugar and Confectionary on export diversification in South Africa

Estimation of parameter for South Africa using generalized least square model was displayed in Table 3. The result revealed that when the effect of all the variables under consideration in South Africa are held constant, a per cent increase in the differences in the value of the immediate previous and current year ED_SUC made the current year ED_SUC to only decrease by $\beta = -2.2088$ in South Africa but not statistical significance. In the same manner, the result showed that a per cent increase in the number of European Union product standards document had a positive but insignificant effect on the ability of South Africa to diversify its export portfolio to the EU countries ($P = 0.941$). This implied that a one per cent increase in the EU product standard results into 0.0025 per cent increase in sugar & confectionary export diversification. The result also indicated that the effect of EU product standard on sugar & confectionary export diversification was not statistically significant.

The result also revealed that the EU standards that are harmonized with ISO standards had a positive effect ($P = 0.465$) on South Africa's sugar &

confectionary export diversification. That is, a one per cent increase (decrease) in EU_ISO results into an increase (decrease) in the diversification of sugar & confectionary export portfolio. Though this effect was statistically not significant, it conformed to Yusuf and Sancar (2021) concluded that factors such as export sophistication and the concentration of export products and export market diversification positively affects the net export which states that harmonized standards enhance export diversification. The estimated results also showed that the ability of the home country (South Africa) to diversify its sugar & confectionary export was positively affected (P = 0.374) by its GDP that is a one per cent increase in the homes country (South Africa) GDP tend to lead to an increase in export basket of sugar & confectionary commodity thereby enhancing diversification in the sugar & confectionary sector's export. A one per cent increase in home country (South Africa) GDP led to an increase in sugar & confectionary export diversification of South Africa but not statistical significance.

The relationship between South Africa's sugar and confectionary export diversification and foreign importing countries GDP was significant but negative (β = - 0.0358, P = 0.000). This indicated that a one percent increase in foreign countries GPD led to a decrease in South Africa's sugar & confectionary export diversification by 0.0358 per cent. This implied that as foreign countries GDP increase, import of sugar & confectionary commodity tends to reduces thereby leading to a reduction in sugar & confectionary commodity export portfolio of the home countries. This might be as a result of technological advancement; as technology improves; developed countries tend to move away from demand for primary products to demand for industrialized products. The analysis of the model also showed that distance between the home and foreign countries have a positive relationship with sugar & confectionary export diversification.

Table 3 shows that the distance between the home country (South Africa) and the foreign countries

Table 3 | Estimation results of Gravity model Generalized Least Square Regression of Sugar & Confectionary on exports Diversification for South Africa

	Sugar & Confectionary export diversification		
Variables	**Estimated coefficients**	**Standard Error**	**P-value**
Constant	-2.2088	2.1507	0.304
Lneu	0.0025	0.0333	0.941
lneu_iso	0.0206	0.0282	0.465
Lngdph	0.0557	0.0627	0.374
Lngdpf	-0.0358***	0.0076	0.000
Lndist	0.2408**	0.1434	0.053
Lang	-0.0395	0.0399	0.322
Colony	0.0507	0.0409	0.216
TTE	-0.0004	0.0078	0.959
Wald chi-square	28.87***		0.0003
Log likelihood	102.4926		
Number of observations	210		

Source: Authors Computation (2024)
* ** *** *indicate significance at 10%, 5% and 1% critical level respectively.*

positively affected the home countries sugar & confectionary export diversification by β= 0.2408 per cent. The positive effect of distance on export might may as a result of the fact that countries tend to export a larger basket of commodities to other countries with longer distance in order to reduce the cost of exportation. Common official language and South Africa's sugar & confectionary export diversification has an inverse relationship, this effect was not statistically significant; hence common official language negatively affect ED_SUC by 0.0395 per cent. The relationship between colony and ED_SUC for South Africa was found to be positive. That is, common colony positively affects ED_SUC by 0.0507 but this effect was not statistically significant. The relationship ED_SUC and time to export was negative (β= - 0.0004), increase in time to export by a day lead to a decrease in sugar & confectionary export diversification by 0.0004 per cent. This effect however was not statistically significant.

4.3 | Ceramic on export diversification in South Africa

The estimation result for all the observed variables on ceramic export diversification on the other hand is different from sugar & confectionary export diversification. The result in Table 4 showed that when the effect of all the variables under consideration in South Africa are held constant, a per cent increase in the differences in the value of the immediate previous and current year ED_CER made the current year ED_CER to only decrease by β = -5.3710 in South Africa, this effect was statistically significant at 1%. Also, the result showed that a per cent increase in the number of European Union product standards document had a positive effect (P = 0.638) on the ability of South Africa to diversify its export portfolio to the EU countries. This implied that a one per cent increase in the EU product standard results into β = 0.0142 per cent increase in ceramic export diversification. The result indicated that the effect of EU product standard on South Africa's ceramic export diversification was not statistically significant.

The result also showed that the EU standards that are harmonized with ISO standards have a positive effect (P = 0.962) on ceramic export diversification. That is, a one percent increase in EU_ISO will result into an increase in the diversification of South Africa's ceramic export portfolio by (β = 0.0012) per cent. Though this effect is not statistically significant, it confirmed to Nham *et.al* (2023) that explored the nonlinear relationship between digitalization and export value, which state that harmonized standards enhance export diversification while non-harmonized standards reduce export diversification. The estimated result also showed that the ability of the home country (South Africa) to diversify its ceramic export was positively and significantly affected by its GDP (P = 0.064), that is a one percent increase in the home country (South Africa) GDP led to an increase in export basket of ceramic commodity thereby enhancing export diversification in the South Africa's ceramic sector. A one per cent increase in home country GDP led to 0.1051 percent increase in ceramic export diversification of South Africa with a statistical significance of 10%.

The relationship between South Africa's ceramic export diversification and foreign importing countries GDP was negative but significant; this indicates that a one percent increase in foreign countries GPD led to a decrease in South Africa's ceramic export diversification by β= 0.0605 percent with a statistical significance of 1%. This implied that as foreign countries GDP increase, import of ceramic commodity tends to reduces thereby leading to a reduction in ceramic

commodity export portfolio of the home country (South Africa). The analysis of the model also demonstrated that distance between the home (South Africa) and foreign countries had a positive relationship with ceramic export diversification. The farther away the countries are from each other, the larger the export basket.

The distance between the home country (South Africa) and the foreign countries positively affects the home country's ceramic export diversification by 0.4872% with a statistical significance of 1%. Common official language and South Africa's ceramic export diversification has an inverse relationship; the effect of common official language on ceramic export diversification is β = 0.1224 percent and has a statistical significance of 1%. The relationship between colony and ceramic export diversification in South Africa was positive. Though colony affect South Africa ED_CER by 0.0298, the effect was not statistically significant. Time to export (TTE) has a positive effect on ceramic export diversification, hence as time of export increase by a day, South Africa's ceramic export diversification increase by β= 0.0082 percent; but this effect of not statistically significant.

Table 4 | Estimation results of Gravity model Generalized Least Square Regression of Ceramic on exports Diversification for South Africa

	Ceramic on export diversification		
Variables	**Estimated coefficients**	**Standard Error**	**P-value**
Constant	-5.3710***	1.9484	0.006
Lneu	0.0142	0.0302	0.638
lneu_iso	0.0012	0.0255	0.962
Lngdph	0.1051*	0.0568	0.064
Lngdpf	-0.605***	0.0069	0.000
Lndist	0.4872***	0.1299	0.000
Lang	-0.1224***	0.0362	0.001
Colony	0.0298	0.0371	0.421
Tte	0.0082	0.0071	0.247
Wald chi-square	113.07***		0.000
Log likelihood	123.2373		
Number of observations	210		

Source: Authors Computation (2024)
* ** *** *indicate significance at 10%, 5% and 1% critical level respectively*

5 | Conclusions

This study analyzed the effect of product standards on export diversification in the sugar & confectionary and ceramic sectors. The study used bilateral trade relations between South Africa and 21 European Union countries. The data used covered the period of 2011 to 2022 which was sourced from WIT-TRAINS, WDI, EUSDB CEPII and author's calculation. The methodology employed was Generalized Least Square (GLS) Model. Specifically, the model estimated the effect of EU product standards (EU), harmonized EU product standard (EU_ISO), Gross Domestic

Product (GDP) {home and foreign}, Gravity variables (distance, language and colony) on sugar & confectionary and ceramic exports diversification (ED_SUC and ED_CER) and time to export (TTE).

The study concludes that EU standards positively affect both sugar & confectionary and ceramic exports diversification in South Africa. The EU_ISO (i.e. harmonized EU standards) positively affect both sugar & confectionary and ceramic exports diversification. These effects of EU and EU_ISO are not statistically significant; this might be that South Africa's export were not be driven by standards requirements. The study also concludes that, distance has a significant positive effect on both sugar & confectionary and ceramic exports diversification for South Africa. This might be due to the fact that countries tend to export larger basket of commodities to longer distance rather than to shorter distance. However, the effect of distance on ED_CER was stronger than its effect on ED_SUC.

Language has a significant negative effect on ceramic export diversification while its negative effect on sugar & confectionary export diversification was not statistically significant. The study also concludes that colony positively affects both South Africa's sugar & confectionary and ceramic exports diversification but this effect was not statistically significant. The effect of time to export on sugar & confectionary export diversification was negative while its effect on ceramic export diversification was positive. However, TTE effect on both sugar & confectionary and ceramic exports diversification was not significant.

The study thus recommends that the government adopt foreign technologies and attract international investments to foster bilateral cooperation. It also suggests focusing on the development of high-quality sugar, confectionery, and ceramic products to enhance food safety and consumer satisfaction, thereby boosting the global competitiveness of South Africa's sugar, confectionery, and ceramic industries.

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