Empirical Analysis of the AfCFTA in the SADC Region: Evidence using the PPML Estimation Technique

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Abstract

The challenges that small countries in the Southern African Development Community (SADC) face towards the successful implementation of the Africa Continental Free Trade Agreement (AfCFTA) have not been adequately empirically tested to establish if there is scope for mutually beneficial trade among the countries as advocated by AfCFTA's intra-regional trade promotion. This study employs the gravity model of trade theory. The main objective of this paper is to empirically test if there are mutual gains from intra-regional trade for small countries in the SADC region that face several political, legal, economic, and institutional challenges toward the successful implementation of AfCFTA. This study utilised a modified structural gravity model estimated using the Poisson Pseudo-Maximum-Likelihood (PPML) approach. A balanced panel data from a set of select nine SADC countries over the period 2010-2022 is used. The study finds that distance negatively and significantly affects bilateral trade. In addition, overlapping Regional Economic Community (REC) membership positively influences bilateral trade for small landlocked SADC countries and island nations that have a high trade presence in the region. However, after considering agricultural-dependent nations, overlapping REC membership has a trade-reducing impact. Furthermore, poor institutional quality at the destination country was found to reduce bilateral trade negatively and significantly which eventually increased the overall trade costs. The study recommends AfCFTA members diversify their exports and add value to their agriculture products to adequately benefit from the agreement.

Keywords: AfCFTA, African Union, Gravity, SADC, PPML.

1. Introduction

Intra-African trade has been averaging between 12%-14% for the past 20 years which is relatively low compared to Asia's intra-regional trade which has been averaging between 51%-53%. North America averaged between 53%-54% and Europe averaged between 67%-69% over the same period (Parshotam, 2018). To promote economic development and to boost intra-continental trade the Africa Continental Free Trade Area (AfCFTA) was established because of the poor outcomes of free trade in Africa. The challenges that small landlocked countries in SADC face towards the successful implementation of AfCFTA have not been adequately empirically tested to establish if there is scope for mutually beneficial trade among themselves as advocated by AfCFTA on intra-regional trade promotion.

What is known are qualitative studies by Aniche (2020), Odusote and Aduak (2022), Parshotam (2018), and Cofelice (2018) that showed the impact of relationships between poor infrastructure on trade, the impact of distance on intra-regional trade, overlapping RECs impact on trade, and the impact that poor institutions have on trade focusing on Africa at large. Also known are quantitative studies estimated using linear estimation methods covering the whole of Africa up to the year 2018 by Gnimassoun (2019), Grossman and Helpman (1991), Yabu (2014), Marinov (2014), and Bankole, Osei-Bryson, and Brown (2015), who affirm to theories of classical and neo-classical trade and customs theories. These studies found that there were trade benefits if large countries traded with other large countries and small countries only benefited when they traded with large countries. Small countries in SADC have been experiencing regressing intra-trade among themselves contrary to improvements that are expected after implementing AfCFTA. The main objective of this paper is therefore to empirically test if there are mutual gains from intra-regional trade for mainly small countries in the SADC region that face several political, legal, economic, and institutional challenges towards the successful implementation of AfCFTA. Therefore, the novelty of this study

hinges on two contributions. First, there is a need to add to the stock of empirical evidence if there are AfCFTA intra-trade benefits available for smaller nations within the SADC region when they trade among themselves. Secondly, the provision of empirical evidence on using the Poisson Pseudo Maximum Likelihood Estimator (PPML), a non-estimating method that has been used extensively in most bilateral trade flow estimations elsewhere, yet in the SADC region there are limited studies available mostly to the year to the 2018 but not to the year 2022. The study also examines how significantly overlapping REC membership affects intra-regional trade. Further, examining the impact of corruption impacts bilateral trade for small countries from the 16 members of SADC who are signatories of AfCFTA in the period 2010-2022.

The rest of the paper is structured as follows; section 2 is an illustration of the stylised trade facts for SADC member states. Section 3.1 is a review of the theoretical literature which is followed by the empirical literature in section 3.2. Afterward, section 4 is the materials and methods. Furthermore, section 5 focuses on the discussion of results. Lastly, section 6 is the conclusion.

2. Stylized SADC trade facts

Small nations have shown a trend of having a high concentration of exports in their GDP as shown in Figure 1 below. Specifically, Seychelles experienced over 90% of exports as a percent of GDP during the 2010-2022 period. Furthermore, Mauritius, Botswana, Angola, and Eswatini had percentages of over 50% over the same period. Most SADC countries generally show high degrees of trade openness (Khobai & Moyo, 2021). The findings seem to suggest that South Africa, Comoros, Malawi, and Tanzania are the least open economies in SADC within the period 2010-2022.
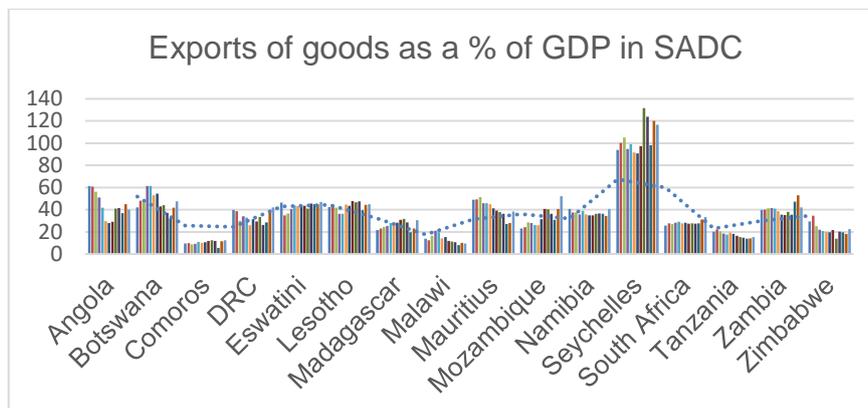
Source: Own compilation from IMF database
Figure 1. Exports as a percentage of GDP, 2010-2022

From Figure 2, South Africa accounted for 60% of total exports within SADC, followed by Namibia which had 10% of total exports to the SADC region. Most small SADC nations' exports combined contributed to less than 10% of the exports of the SADC region during the period 2010-2019.
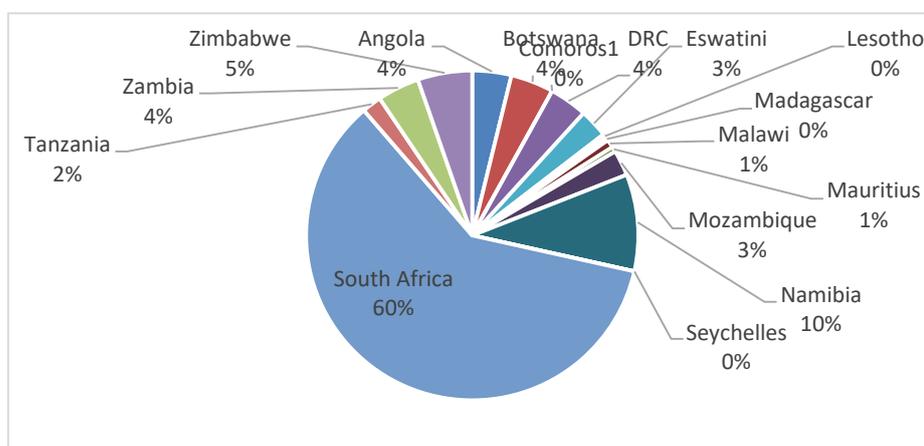
Source: Own compilation from SADC Statistical Bulletin (2021)
Figure 2. Share of exports in the SADC region, (2014-2019)

Figure 3 shows that the leading SADC trading partners have been the Asian Pacific Economic Cooperation (APEC) which accounted for 45% of exports from SADC. The main destination of SADC exports of petroleum oils, coal, platinum, precious metals, and diamonds is China. Intra-SADC exports are mainly in electricity, agricultural products, some textile products, and manufacturing equipment mostly from South Africa to the rest of the SADC region. However, intra-SADC trade remained low at around 10% from 2014-2019.
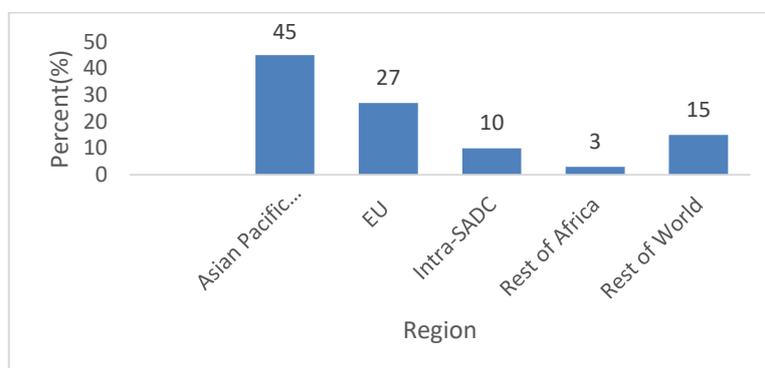
Source: Own compilation from SADC Statistics Bulletin (2021)
Figure 3. Direction of SADC exports

3. Literature Review

3.1. Theoretical Literature Review

The main theory that was used in this study is the gravity model of trade which was first formally used by Tinbergen (1962) and Linnermann (1966). Also, classical contributions by Adam Smith's (1776) theory of Absolute Advantage considered the importance of distance in influencing the direction of trade (Elmslie, 2018). Furthermore, Elmslie (2018), noted that Adam Smith found that national borders reduced trade flows with distance found to be an observable variable. Also, David Ricardo (1817) made contributions to the model using the comparative advantage theory through the understanding that differences in comparative advantages between countries were more important in explaining trade patterns under a free trade situation than the distance between countries.

The gravity model also borrows from the economic integration literature. Specifically, the Static Analysis (SA) theory by Viner (1951) also contributed to the theoretical literature on the gravity model. Dynamic Analysis (DA) by Balassa (1962) and Cooper and Massell (1965) also offered another angle to the gravity model. However, SA and DA have been empirically condemned for being more applicable to developed countries than developing countries given they focused mainly on North-North or North-South trade benefits but not South-South trade benefits or South-North trade benefits. As such, this has led to the emergence of alternative economic integration theories like the Training ground theory which Mude (2020), offered an alternative understanding of the gravity model. Furthermore, the Package Approach to Economic Integration by Balassa and Stoutjedij (1975) and the Dependence theory provided a more applicable understanding of the challenges and prospects that AfCFTA may encounter towards its successful implementation.

A theoretical link exists between free trade and economic integration theory. Following extended contributions by Kozłowski (2011) to the International Product Life Cycle version by Vernon(1966), in the context of AfCFTA, Article 3 objectives focus on boosting the industrialisation bases of member states through the promotion of intra-industry trade. This can be linked to the Training Ground Theory, where Inotai (1991), found positive welfare gains arising in small countries when they temporarily protected infant industries during the transitional training phase which most AfCFTA members are experiencing as phase 2 negotiations are proceeding.

3.2. Empirical Literature Review

Studies by Babu, Abala, and Mbithi (2022), Pasara and Dunga (2020a), Kagochi and Durmaz (2018) and Bakouan and Ouedraogo (2022a), were all based on Sub-Saharan Africa from 1995 to 2018 and found distance to be negatively and statistically significant to bilateral trade. Specifically, the study by Kagochi and Durmaz (2018), was carried out on 46 Sub-Saharan countries from 1995 to 2011 using a Pooled OLS. They found distance to be negatively significant on intra-regional trade at the 1% level. In most of these studies, mostly linear estimating techniques were applied to bilateral trade involving Africa and the rest of the world limited to the year 2018 yet a gap exists using non-linear estimating techniques in the SADC region up to 2022. The study by Bakouan and Ouedraogo (2022b) used PPML on the East African Community (EAC) with total exports of the EAC region as the dependable variable, a departure from bilateral exports that were used in both Pasara and Dunga (2020a) and Kagochi and Durmaz (2018) studies.

Chin, Yong, and Yew (2015), did a study using a spatial panel model to assess the impact of overlapping REC membership on bilateral trade on ASEAN 5 countries   trade with China over a period 1993-2009. Despite the ASEAN 5 countries belonging to some other RECs than the Asian Economic Community (AEC), the trade openness coefficient was found to be statistically positively influencing bilateral trade with China. Belonging to overlapping RECs transformed competition to complementation between the AEC region, which further expanded bilateral trade with China.

Bankole et al. (2015), showed that good institutional quality (IQ) has a positive and statistically significant influence on intra-Africa trade. Also, Babu et al. (2022), found that the control of corruption index had a positive and statistically significant effect on trade growth within the SADC and ECOWAS region. Also, Le, Kim, and Lee (2016), used the Generalised Method of Moments(GMM) on 26 Asia-Pacific countries and found good governance and quality institutions promoted trade and financial development of developing countries. These findings were consistent with earlier findings by Longo and Sekkat (2004) who applied a principal component analysis using an extended gravity model on 41 African countries in the period 1988-1997.

4. Material and Methods

4.1 Materials

The panel data is from a balanced set of 9 SADC countries over the period 2010-2022. This study utilised annual secondary data that was obtained from various sources. Notably, bilateral trade data was obtained from UN COMTRADE, IMF, and WDI for IQ indexes as presented in Table 1 as follows.

Table 1. Data sources and descriptions

Variable Dependent	Symbol	Variable definition	Data source
The real value of bilateral exports	X_{ijt}	This captures the real value of exports from country i to country j in US$ millions	COMTRADE (2010-2022)
Independent 1)Real GDP	Y_{it};Y_{jt}	Real GDP for country i in US$ millions; Real GDP for country j in US$ millions	IMF (2010-2022)
2)Population	POP_{it}; POP_{jt}	Population in millions for exporting country i; Population in millions for importing country j	IMF (2010-2022)
3)Common border dummy variable	$Bord_{ij}$	1 if exporter country i and importer country j share common border. 0 if exporter and importer country do not share a border	Own Calculation
4)Dummy variable for multiple REC membership	$MREC_j$	1= SADC exporter or importer member belonging to more than two RECS (SACU or COMESA) 0=SADC membership only for either exporter or importer	Own Calculation
5)Dummy variable for Landlocked	$land_j$	1 if the exporter or importer is landlocked. 0 if the exporter or importer country is not landlocked.	Own Calculation
6) Corruption	$Inst_{it}$; $Inst_{jt}$	Corruption perception index for exporting country [1= low to 100=high]	WDI (2010-2022)
7)Distance	$Dist_{ij}$	Measures distance in kilometres between SADC capital cities	Google Maps and distance calculator
	β_0;$\beta_1 - \beta_{14}$	Intercept of the regression line; Slope coefficients of the explanatory variables.	
	ε_{ij}	The error term captures the unobserved variables.	

Source: Own compilation

Expected signs: $\beta_1 > 0$, $\beta_2 > 0$, $\beta_3 < 0$, $\beta_4 > 0$, $\beta_5 < 0$, $\beta_6 > 0$, $\beta_7 < 0$, $\beta_8 < 0$, $\beta_9 > 0$ and $\beta_{10} < 0$

4.2 Methods

The gravity model used by Tinbergen's 1962 theory is based on Isaac Newton's (1687) law of Gravity which considers the relationship between mass and distance. The assumption is that a country's bi-lateral trade is directly related to its GDP and the volume of trade is inversely proportionate to the distance between the countries (Maruf, Saha, Baten, & Akter, 2020). The relationship is shown in equation (1), as follows.

$$TV_{ijt} = \frac{AY_{it}^{\alpha} Y_{jt}^{\beta}}{D_{ij}^{\omega}} \tag{1}$$

Where TV_{ijt} is the value of trade between country i and country j. A represents a constant term. Y_i is GDP for a country i and Y_j is GDP for a country j. D_{ij} is the distance between the country i and country j. α, β, ω, are parameters to be estimated

Equation (1) is log- lineralised to give a base structural gravity model (2) as shown below:

$$lnTV_{ijt} = LnA + \alpha lnY_{it} + \beta lnY_{jt} - \omega ln\,D_{ij} + \varepsilon_{ij} \tag{2}$$

4.2.1 Model specification and estimation

This study utilised a modified structural gravity model by Anderson and Van Wincoop (2003) estimated using the Poisson Pseudo-Maximum-Likelihood (PPML) approach that was developed by Silva and Tenreyro (2006) that has been used in studies by Fofack, Dzene, and Hussein (2021), Olney (2022), Alhassan and Payaslioglu (2020), Osabuohien, Efobi, Odebiyi, Fayomi, and Salami (2019) as shown in equation (3) below. According to Felbermayr and Yotov (2021), firstly, this approach is more comprehensive in solving problems of heteroscedasticity and zero trade flows which are common in micro panels in the empirical gravity model. Secondly, they argued that they needed to stay as close to the original specifications of Davis and Weinstein (2002). The third reason highlighted was that by explicitly accounting for the size versus multilateral resistance this helped in resolving the mystery of excess trade balances. Lastly, this provided a yardstick of theoretical comparing theory constituent indexes. The base structural gravity model in equation (2) is modified to the estimated equation (3) as follows.

$$X_{ijt} = \beta_0 + \beta_1 lnY_{it} + \beta_2 lnY_{jt} + \beta_3 lnPOP_{it} + \beta_4 lnPOP_{jt} + \beta_5 ln\,Dist_{ij} + \beta_6 MRec_j + \beta_7 lnInst_{it}$$
$$+ \beta_8 lnInst_{jt} + \beta_9 Bord_{ij} + \beta_{10} Land_{ij} + \varepsilon_{ij} \tag{3}$$

The dependent variable is given by the real value of exports(X_{ijt}) between the exporting country i and importing country j. The independent variables are the natural logarithm of the real GDP (Y_{it}) for the exporting country i and GDP (Y_{jt}) for importing country j, (POP_{it}) is the population for the exporting country i and (POP_{jt}) is the population for the importing country j. Furthermore, a dummy variable for multiple REC membership for the exporting and importing country is shown by $(MRec_j)$. Also, there is a dummy variable for common shared border between the two countries shown by ($Bord_{ij}$). There is also a dummy variable for showing if an exporting and importing country are landlocked represented by $(land_j)$. The control variables in the panel data model are the Institutional Quality Index (IQ), represented by corruption perception index for the exporting country shown by $(Inst_{it})$ and for the importing country $(Inst_{jt})$. $Dist_{ij}$ is the bilateral distance between country i capital city and country j capital city and ε_{ij} is the error term. Equation (3) can be written in a simplified form as equation (4) in non- linear format.

$$X_{ijt} = exp(\mathbf{Z_{ijt}}\beta_1 + \mathbf{T_{ij}}\beta_2) + \varepsilon_{ij} \tag{4}$$

Where $\mathbf{Z}_{ijt}$ is a vector of standard gravity variables made of the following time-variant variables (real GDP for country i and country j and the Population of the country i and country j). Vector $\mathbf{T_{ij}}$ captures the time invariants that allow for asymmetric trade costs (Bilateral distance, landlockadeness, the institutional quality indicator shown by the corruption perception index, and membership of multiple RECs. However, the specification model (4) considers the real value of exports that are used in PPLM models using the integer count method.

According to Burger, Van Oort, and Linders (2009), the PPML uses estimates of X_{ijt} instead of lnX_{ijt} to avoid the problem of underestimation of the large trade flows and total volumes. Also, Babu et al. (2022), argued that PPML by using maximum likelihood techniques adopts estimates to the actual data that makes an identity between

the sum of input values with predicted values. PPML has some advantages that were mentioned by Shahriar, Qian, Kea, and Abdullahi (2019), that includes, firstly, it deals with zero trade flow problems. Secondly, it deals with problems of unbiased estimates in the presence of heteroscedasticity. Thirdly, all observations are weighted equally, and lastly, the mean is always equal. According to Prehn, Brümmer, and Glauben (2016), the major drawback of using the PPML is the dependable variable bias problem.

5. Results and Discussion

5.1. Descriptive Statistics

A summary of descriptive statistics for the landlocked SADC countries is presented in Table 2. From the table, Zambia has the highest GDP of all the 5 SADC landlocked countries in the sample and had the highest mean bilateral exports into the SADC region of 17.60, whilst Eswatini recorded the lowest GDP within the period 2010-2022. The dummy variable for sharing a common border shows that of the 5 landlocked countries, Eswatini and Malawi share fewer common borders whereas Zambia shares more land borders with the 5 SADC countries. The influence of multiple REC membership and being landlocked has similar equal results for all 5 countries at 0.88 for the dummy variable for multiple REC memberships ($MREC_j$) and 0.5 for the landlocked dummy variable ($Land_j$). A summary of descriptive statistics for the landlocked SADC countries is presented in Table 2. From the table, Zambia has the highest GDP of all the 5 SADC landlocked countries in the sample and had the highest mean bilateral exports into the SADC region of 17.60, whilst Eswatini recorded the lowest GDP within the period 2010-2022. The dummy variable for sharing a common border shows that of the 5 landlocked countries, Eswatini and Malawi share fewer common borders whereas Zambia shares more land borders with the 5 SADC countries. The influence of multiple REC membership and being landlocked has similar equal results for all 5 countries at 0.88 for the dummy variable for multiple REC memberships ($MREC_j$) and 0.5 for the landlocked dummy variable ($Land_j$).

Table 2. Summary of descriptive statistics for SADC landlocked countries

Mean	Botswana	Eswatini	Malawi	Zambia	Zimbabwe
lnX_{ijt}	16.16	17.05	15.19	17.60	16.54
lnY_{it}	2.74	1.48	2.28	3.17	3.09
lnY_{jt}	2.96	3.12	3.02	2.91	2.92
$lnPOP_{it}$	0.86	0.86	2.92	2.81	2.64
$lnPOP_{jt}$	2.11	2.21	1.85	1.87	1.88
lnD_{ij}	7.06	6.91	7.38	7.23	7.07
$MREC_j$	0.88	0.88	0.88	0.88	0.88
$lnInst_{it}$	0.03	0.17	0.23	0.22	0.62
$lnInst_{jt}$	0.81	0.85	0.85	0.85	0.39
$Bord_j$	0.5	0.25	0.25	0.63	0.5
$Land_j$	0.5	0.5	0.5	0.5	0.5

Source: Processed with E-Views 13

Table 3 Descriptive Statistics for Mozambique, Namibia, and Mauritius

Mean	Mozambique	Namibia	Mauritius
lnX_{it}	16.44	16.91	13.97
lnY_{it}	2.70	2.49	2.52
lnY_{jt}	2.97	2.99	2.99
$lnPOP_{it}$	3.33	0.84	0.23
$lnPOP_{jt}$	1.80	2.11	2.19
lnD_{ij}	6.99	7.56	8.07
$MREC_j$	1	0.88	0.88
$lnInst_{it}$	3.29	4.17	4.17
$lnInst_{jt}$	3.67	3.56	3.65
$Bord_j$	0.63	0.38	0
$Land_j$	0.63	0.63	0.63

Source: Processed with E-Views 13

Table 3 gives a summary of the mean values of SADC countries with a coastline and an Island. From the table, Mauritius registered the lowest GDP within the study period and had the lowest population of the group of SADC countries with a coastline and an island. Furthermore, Mauritius is the furthest from all SADC countries in terms of distance and does not share any border with any SADC country.

5.2. Estimation Results

The sections that follow provide an analysis of balanced panel results for SADC landlocked countries, SADC countries with a coastline, and SADC island countries in addressing this study's empirical objectives. Firstly, the study tests the impact of distance between countries on intra-regional trade in SADC. Secondly, it tests the impact of overlapping REC membership on bilateral trade within the SADC. Thirdly, there is an examination of the impact of corruption on bilateral trade in the SADC region.

Table 4. Panel data PPML results for 5 SADC landlocked countries.
Dependable Variable: Bilateral exports (X_{ij}) from host country (*i*) to partner country (*j*).

	Host Country (*i*)				
Variables	**Botswana**	**Eswatini**	**Malawi**	**Zambia**	**Zimbabwe**
Real GDP for country i (Y_{it})	0.838 (1.630)	1.405 (1.377)	0.6711 (0.591)	1.121*** (0.335)	-0.009 (0.247)
Real GDP for country j (Y_{jt})	-1.196*** (0.446)	0.653** (0.276)	0.823* (0.454)	0.273*** (0.079)	0.863 (0.591)
Population country i (POP_{it})	-3.691 (3.454)	1.900 (1.867)	-4.211*** (0.800)	-2.105*** (0.462)	2.390* (1.246)
Population country j (POP_{jt})	1.012*** (0.334)	0.2100* (0.125)	0.462 (0.537)	0.575*** (0.129)	0.279 (0.564)
Distance ($Dist_{ij}$)	-1.589*** (0.608)	-1.146*** (0.216)	-0.220 (0.787)	-0.243 (0.590)	0.503 (1.060)
Corruption ($Inst_{it}$)	1.167 (4.469)	-0.546 (0.562)	-0.755* (0.431)	0.709*** (0.241)	-0.210* (0.110)
Corruption ($Inst_{jt}$)	-0.169 (0.140)	-0.208* (0.107)	-0.494** (0.229)	-0.165 (0.134)	-0.703* (0.388)
Common border ($Bord_{ij}$)	3.731*** (0.217)	-0.686 (0.981)	0.262 (0.483)	0.587** (0.299)	2.040** (0.969)
REC ($MREC_j$)	3.693*** (0.737)	0.675 (0.874)	-1.976** (0.926)	2.066*** (0.405)	-0.460 (1.674)
Landlockadess ($land_j$)	-3.042*** (0.454)	-1.331*** (0.282)	1.449*** (0.489)	-0.6933** (0.335	-0.423 (0.602)
Constant	21.950 (21.294)	23.48*** (4.161)	30.17*** (7.420)	16.28 (4.418)	7.04 (0.602)
R^2	0.8878	0.9518	0.8324	0.9184	0.9779

Robust standard errors are shown in brackets and levels of significance at 10% (*), 5% (**), and 1% (***)
Source: Processed with E-Views 13

The PPML results from Table 4 show a positive and mostly insignificant relationship between GDP for most of SADC's landlocked host countries with bilateral exports. These results imply that domestic income has an insignificant impact on a host nation's exports, which agrees with findings by Turkson, Oduro, Baffour, and Quartey (2023), who found that local demand has little impact on exports from the host nation. However, results from most SADC landlocked nations suggested a significant and positive impact of foreign GDP on host nation exports at the 1% level of significance, a result that concurs with the theoretical and empirical gravity model of trade and also confirmed by empirical findings by Pasara and Dunga (2020b), who found that the GDP of importing nations in the ECOWAS region influenced bilateral trade significantly.

The PPML results also indicate that the population of the importing landlocked SADC nations has a generally positive and significant impact on the bilateral exports from the host nation at 1% significance. By implication, countries with larger populations have a bigger capacity to absorb more exports from the host nation despite the exporting nation's population size. On the other hand, the population of the exporting nation had a generally negative and significant impact on the exports from the host nation. These results were supported by findings by Eric, Sama, and Cletus (2020), who found that the population of the importing country had a positive impact on the bilateral exports from the CEMAC group.

Table 5. Panel data PPML results for 2 SADC coastline countries and 1 island nation.
Dependable Variable: Bilateral exports (X_{ij}) from host country *(i)* to partner country *(j)*

	Host country *(i)*		
Variables	**Mozambique**	**Namibia**	**Mauritius**
Real GDP for country i	0.767***	-1.218	-0.842*
(Y_{it})	(0.258)	(0.976)	(0.477)
Real GDP for country j (Y_{jt})	0.415*	1.239	1.673***
	(0.200)	(0.887)	(0.148)
Population for country i	1.243***	1.223	65.306***
(POP_{it})	(0.454)	(1.325)	(11.258)
Population for country j	0.535*	-1.193*	-1.152***
(POP_{jt})	(0.252)	(0.580)	(0.215)
Distance between countries	-0.642***	0.080	-11.359
($Dist_{ij}$)	(0.244)	(1.114)	(1.620)
Corruption perception index	-1.100	3.307	-1.950*
for exporting country	(0.165)	(6.011)	(1.129)
($Inst_{it}$)			
Corruption perception index	-0.501***	-1.416*	-0.338***
for importing country	(0.08)	(0.590)	(0.109)
($Inst_{jt}$)			
Common border dummy	0.332	5.225***	0
variable ($Bord_{ij}$)	(0.602)	(1.451)	
Dummy variable for	-	-3.908***	-1.709***
multiple REC membership		(2.184)	(0.545)
($MREC_j$)			
Dummy variable for	-0.80*	0.032	-2.773***
Landlockadeness ($land_j$)	(0.361)	(1.564)	(0.544)
Constant	15.640***	10.226	100.476***
	(2.70)	(25.096)	(13.833)
R^2	0.9634	0.8506	0.9820

Robust standard errors are shown in brackets and levels of significance at 10% (*), 5% (**), and 1% (***)
Source: Processed with E-Views 13

Table 5 presents the PPML results for SADC countries with a coastline (Mozambique and Namibia) and the SADC island nation of Mauritius. The PPML results for SADC countries with a coastline suggest that for Mozambique, a 7.67% increase in GDP led to an export increase of 10% and was significant at the 1% level of significance. However, results from Namibia indicate that an increase in GDP has a negative but insignificant impact on exports. By implication, these results suggest that for a small country like Namibia in terms of population and GDP, an increase in Namibia's GDP led to more imports from South Africa than exports. These findings confirm to findings by Kagochi and Durmaz (2018), who in their study of inter-regional trade in SSA found that for small countries, a negative relationship exists between exports and GDP due to increased consumer choices and increased incomes which enhanced imports rather than exports. Also, for host SADC island country Mauritius indicates that there is a significant negative relationship between GDP for Mauritius and exports to the SADC region at the 10% level. This implies that Mauritius generally imports more than it exports to the SADC region. However, when considering the GDP of Mauritius's SADC trading partners, bilateral exports to the SADC region

respond positively to the GDP of Mauritius's SADC trading partners at the 1% level of significance. This implies that an increase in SADC trading partners' GDP leads to an improvement in exports from Mauritius. These results are consistent with findings by Babu et al. (2022), who found a positive and statistically significant coefficient for GDP for EAC trading partners using PPML.

5.3. Discussion of results

Contextual analysis of the distance influence on bilateral trade for the 5 landlocked SADC countries shows that distance has a negative and significant influence on bilateral exports for landlocked SADC countries. For instance, results for the host country Botswana, suggest that the further countries are by 158.9% from Botswana in terms of distance results to a 100% fall in bilateral exports from Botswana and this result is negative and significant at the 1% level of significance. These results imply that Botswana tends to trade more with countries that are closer to it than countries that are far from it. Furthermore, these results are in line with empirical findings by Eric et al. (2020), who found distance to be negative and significant using PPML on an Augmented gravity model in the CEMAC block. Furthermore, Table 5 above results suggested that for Mozambique, a 7.67% increase in GDP led to an export increase of 10% and was significant at the 1% level in agreement with findings by Babu et al. (2022), who found that the GDP of the exporting country tended to enhance bilateral exports. Also, the result for Mauritius implied that a 10% increase in distance resulted in a fall in exports by 11.4%, these findings agreed with findings by Kagochi and Durmaz (2018).

In general, for landlocked SADC countries, the proxy for belonging to more than one REC (SADC and COMESA) had a positive and significant impact on bilateral trade for countries that are net exporters rather than importers in the region. Specifically, belonging to multiple RECs for Malawi tends to significantly reduce bilateral trade at the 1% level of significance. These results agree with the findings by Ferreira, Steenkamp, and Rossouw (2022), who found that for small agricultural-dependent nations, multiple REC membership negatively impacts bilateral trade. The negative result does not imply trade diversion for Malawi, but rather there was limited trade it had with other SADC nations and exported less of its agriculturally based exports at 1% of the total exports to the SADC region. Also, the findings show that belonging to multiple RECs tends to convert regional competition into regional complementation as alluded to by Chin et al. (2015), who found having multiple REC memberships for ASEAN 5 countries enhanced bilateral trade with China.

Despite, Namibia having a coastline, the empirical PPML results indicate that belonging to multiple REC membership has a negative impact on bilateral exports at the 1% level of significance. These findings agree with the results by Pasara and Dunga (2020a), who found that multiple REC membership had a significant negative impact on small SADC countries. However, the empirical results found that multiple REC membership has a positive and significant impact on bilateral exports from Mauritius to the SADC region at the 1% level of significance.

Findings from this study show that for SADC host countries with relatively high corruption levels, bilateral trade is significantly discouraged. Specifically, results from Eswatini, Malawi, and Zimbabwe found a negative and significant relationship between higher levels of corruption and bilateral trade at the 1% level of significance. High corruption indexes implied low IQ, and this increases the costs associated with cross-border trading leading to reduced bilateral trade. These findings assert empirical findings by Babu et al. (2022), who found that countries with a low control on corruption negatively impacted exports from the host countries. Furthermore, results from Namibia and South Africa as host countries showed that corruption at the destination country negatively and significantly discouraged bilateral trade. These study findings agreed with the findings by Njinkeu and Fosso (2006), that the institutional quality of a destination country had a negative and significant effect on intra-Africa trade. Also, results from Mauritius found that there was a negative and significant relationship between high corruption levels and bilateral trade at the 1% level of significance in agreement with findings by Bakouan and Ouedraogo (2022b), who found a negative and statistically significant relationship between host nation corruption and its bilateral exports.

5.4. Diagnostic Testing for Heteroscedasticity, and Model Specification

To avoid the presentation of spurious results, a Breusch-Pagan test was conducted to test for heteroscedasticity and the Ramsey-reset test was conducted for model specification as follows:
Heteroscedasticity test using Breusch- Pagan (BP)Test
H_0: Panel data is constant (homoscedasticity)
H_1: Panel data is not constant (heteroscedasticity)

Table 6. Breusch- Pagan Test results

Landlocked SADC countries	Botswana	Eswatini	Malawi	Zambia	Zimbabwe
BP Statistic	1.11	7.17	4.42	0.08	0.55
p-value	0.2927	0.0074	0.0356	0.7830	0.4591

Island and Coastal SADC Countries	Mozambique	Namibia	Mauritius
BP Statistic	5.92	12.43	0.12
p-value	0.0150	0.0004	0.7274

Source: Processed with E-Views 13

From Table 6, the p-values for Botswana, Zambia, Zimbabwe, and Mauritius are all > 0.05. This implies that H_0 is not rejected at the 5% level showing the absence of heteroscedasticity in those panels. However, the p-values for Eswatini, Malawi, Mozambique, and Namibia had p-values which are < 0.05 showing panels that are not homoscedastic. Despite the presence of heteroscedasticity in some of the panels Shahriar et al. (2019), maintain that unbiased estimates can still be obtained from PPML results even in the presence of heteroscedasticity.

Ramsey Reset test: Model specification
H_0: The model has no omitted variables (correctly specified)
H_1: The model has some omitted variables (wrongly specified)

Table 7. Ramsey Reset Test results

Landlocked SADC countries	Botswana	Eswatini	Malawi	Zambia	Zimbabwe
F (3,90)	0.05	0.60	2.74	0.76	14.97
Prob>F	0.9861	0.6195	0.05	0.5198	0.000

Coastal and Island SADC countries	Mozambique	Namibia	Mauritius
F(3,90)	8.96	1.81	0.71
Prob>F	0.8425	0.1508	0.5477

Source: Processed with E-Views 13

The Ramsey reset results are presented in Table 7 and indicate that most models are correctly specified given p-values>0.05. At the 5% level, there is no sufficient evidence to reject H_0, implying that most models are correctly specified. However, results from Zimbabwe have a p-value< 0.05 which may suggest that there are some omitted variables in the panel with Zimbabwe as a host country. Also, this may be attributed to Zimbabwe primarily importing more from the SADC region than it exports to the region (Ngoma, 2020).

5.5 Robustness Check

Following recommendations by Sellner (2019) and Head and Mayer (2014), PPML results can be tested for robustness using a Gamma PPML and POLS when faced with small panel samples. Furthermore, the Negative Binomial model offers an alternative to PPML when handling small panels that exhibit over-dispersed data. For this study, there was an investigation of replacing the variables for GDP for both the exporting and importing countries (lnY_{it} and lnY_{jt}), with GDP growth rates for both the exporting and importing countries (YGR_{it} and YGR_{jt}) respectively had any changes on the expected results. This approach indicated how well the independent variables were predicting bilateral exports of small host countries within the SADC countries when trading amongst themselves.

For instance, from Table 8, results from Malawi as a host country trading with other SADC countries from PPML, Negative Binomial, and Gamma PPML indicate different outcomes when variables are changed. Specifically, a negative impact of the GDP for the host country i (lnY_{it}) on bilateral exports was found from a Gamma PPML which is contrary to an expected positive impact that was registered from a PPML model. Also, replacing the GDP with GDP growth rates had negative impacts on bilateral exports from both the Negative Binomial model and Gamma PPML in tandem with expected results. On the other hand, the POLS results for most variables are similar to Gamma PPML results, except for the distance variable (lnD_{ij}) for the POLS model that conforms to the theoretical expectation of an inverse relationship between distance and bilateral trade. By implication, the empirical results may suggest that the GDP growth rate is not a good variable for this data as it failed to conform to theoretical and empirical expectations on all the models tested.

Table 8. Robustness check of Malawi PPML results

	PPML	Negative Binomial	PPML	Gamma PPML	POLS
lnY_{it}	0.886 (0.638)	-	-	-0.124 (0.931)	-0.338 (1.209)
lnY_{jt}	0.633 (0.472)	-	-	1.642*** (0.412)	2.642*** (0.576)
YGR_{it}	-	-1.133* (0.072)	-0.053*** (0.000)	-	
YGR_{jt}	-	0.036* (0.021)	0.016*** (6.390)	-	
$lnPOP_{it}$	-4.18*** (1.071)	-2.941** (1.378)	-3.389*** (0.000)	-4.389*** (1.250)	-1.559 (1.733)
$lnPOP_{jt}$	-0.434 (0.822)	-1.225** (0.545)	0.156*** (0.000)	-0.015*** (0.349)	-2.380*** (0.694)
lnD_{ij}	-2.486* (1.475)	-7.380*** (1.835)	-2.460*** (0.001)	2.764*** (0.820)	-4.579** (2.164)
$lnInst_{it}$	-1.30*** (0.484)	-0.575 (0.445)	-1.066*** (0.001)	-0.097 (0.588)	0.003 (0.721)
$lnInst_{jt}$	-0.434** (0.208)	0.470 (0.348)	-1.146*** (0.000)	-1.836*** (0.427)	-0.836 (0.519)
$Bord_{j}$	0.257 (0.440)	-1.304* (0.761)	-0.306*** (0.000)	3.120*** (0.795)	1.231 (1.106)
$MREC_{j}$	-3.970 (1.576)	-6.911*** (1.536)	-3.231*** (0.001)	-	-7.691*** (1.668)
$Land_{j}$	0.900 (0.610)	-1.006 (0.668)	0.709*** (0.001)	2.737*** (0.568)	1.077 (0.933)
Constant	51.77*** (12.858)	87.712*** (14.222)	49.99*** (0.007)	8.433 (6.794)	59.252 (16.981)
R^2	0.8749	0.5771	0.8720	0.5860	0.8264

Source: Processed with E-Views 13

6. Conclussion

From the study, it was found that distance negatively and significantly affects bilateral trade. Also, overlapping REC membership positively influences bilateral trade for small landlocked SADC countries and island nations that have a high trade presence in the region. But, for agricultural-dependent nations, overlapping REC membership has a trade-reducing impact. Furthermore, corruption at the destination country was found to reduce bilateral trade negatively and significantly which eventually increased the overall trade costs.

What AfCFTA seeks to achieve in the form of increased bilateral trade in Africa through free trade may be challenging considering some sticking points that have not been negotiated yet in its protocols. Specifically, the issue of who bears the compensating costs for member states that stand to lose when free trade is implemented has not been clarified yet it needs urgent attention given the SADC region is home to small open economies that rely heavily on export revenues to fund their budgets. Also, should small economies continue to export primary or semi-finished products and agricultural products, there may be minimal realisable benefits from AfCFTA. The added benefits of a common border or having a coastline and being geographically closer to a trading partner can only be translated to increased trade if SADC nations increase value addition to their exports with an emphasis on selling finished products rather than primary products. Otherwise, the situation at present where neighbouring countries have insignificant trade between themselves may continue to prevail.

Ironically, Africa is being encouraged to open its markets and the free movement of goods and services by AfCFTA, yet the developed countries who partly funded the setting up of the AfCFTA secretariat are increasingly engaging in protectionist trade wars. The win-win trade outcomes that AfCFTA promises can only be realised if

some sticking points within the agreement are addressed together with dealing with some of the regional trade-related socio-economic and political challenges.

Acknowledgments

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