An Investigation into The Relationship Between Climate Change and Trade in Zimbabwe

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ABSTRACT

A number of questions has been raised on the existence of the relationship between climate change and trade. Some have asked what the short- and long-term consequences of climate change on trade are while others want to know if the optimal combination of trade and environmental policies harness the benefits of trade while minimizing the environmental costs. Other questions raised were on the effects of trade or trade liberalization on the environment or how the changing natural environment (e.g. climate change) impact or modify trade patterns. A review of this literature reveals that the world needs to know how trade and climate change interact with each other. This study therefore examines the causal relationship between climate change and trade in Zimbabwe as well as the existence of a long- and short-run relationship between the two variables using secondary data for the period 1990-2022. From the results, the impact of climate change on trade volumes in the short run is largely insignificant, but is significant in the long run, all else constant. For Zimbabwe which relies on agriculture exports, trade is negatively impacted as climate change likely affects farm produce. As global emissions rise, that negative trajectory is likely to be observed on trade volumes. It is therefore recommended that more climate resistant farming methods, like the already adopted "Pfumvudza" have to be initiated to ensure consistent. With the world moving towards environmentally friendly goods export diversity is also necessary to cancel out the risk associated with climate variability. There is also need of some form of moral suasion so that businesses invest participate in climate change adaptation.

Keywords: Climate Change, Trade, Zimbabwe, ARDL, Granger Causality

INTRODUCTION

Climate change is a global phenomenon, with global implications especially due to the inevitable establishment of the world being a global village. The world is anchored as one as a result of international trade. However, the prospects for trade and economic development are being affected by climate change all over the world particularly in developing countries. These developing economies are more vulnerable to climate change as compared to developed economies mainly because of low adaptive capacities, limited knowledge on climate change as well as awareness and an over-reliance on climate particularly for most key sectors in such countries [5]. Changes in weather patterns can disrupt supply chains, and damage transport infrastructure that necessitate merchandise trade. The complex and interconnected nature of global value chains implies that disruption in key locations as a result of changes in climate, can have exaggerated effect for a developing economy as well as the global economy at large [30].

Global Climate-Trade Dynamics

Trade is a critical knob to mobilize for the global economy to achieve green, resilient, and inclusive development in the coming years. According to [9], trade can be regarded as a central element of the solution to climate change

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since it has the potential to enhance mitigation as well as adaptation efforts. This is done by means of shifting production to areas with cleaner production techniques which are environmentally friendly and hence changes export comparative advantages, compelling countries to adapt and seize new opportunities. However, trading of goods can also contribute to environmental degradation, through the emissions of greenhouse gases which lead to climate variability [5]. As imports are critical for any country for immediate recovery from a natural disaster, in a world increasingly shaped by climate change, trade will be therefore a crucial mechanism to address food insecurity, support adaptation, and enable recovery from natural disasters [8].

Reference [13] posits that international trade had increased for the past years due to a decline in international transportation costs of commodities. All forms of transport infrastructure be it sea, land based or aviation; are exposed to the effects of climate change. This is witnessed by faster degradation of roads and bridges, and shorter availability of transport routes. Bridges, in particular will be susceptible to damage from sea level rise and changes in long-term flow regimes if authorities do not encourage necessary investments in adaptation [14]. In America, engineers typically design bridges to stomach storms that have a historical probability of occurring only once or twice every 100 years, whilst past climatic patterns may no longer reliably predict future impacts due to climate change to such an extent that extreme weather events like storms, may take place every 50 or even 20 years by the end of the century [15]. According to [14], heat stress and an increased number of freeze thaw cycles may quicken paved roads dilapidation and melting of permafrost thereby shortening the availability of transportation routes through zones of cryotic soil.

Countries that are mostly affected by climate change, e.g. India and Sub-Saharan Africa, experience shrinkage in exports more than Gross Domestic Product [7]. This is mainly caused by increased production costs which make the countries' products expensive on international markets making them less competitive than their counterparts. According to statistical projections, an increase in global temperatures of 2.5°C by 2060 could decrease export volumes by as much as 5 to 6 per cent for countries in South Asia and Sub-Saharan Africa, 3 to 4 per cent for the Middle East, North Africa, and South-East Asia, and 2 per cent in Latin America, compared with less than 1 per cent in Europe and North America[7]. Climate change also affects the prices of agricultural produce. Reference [21] estimated price changes of selected agricultural produce with and without climate change and the results are summarized in Table I below.

Table I World Prices of Selected Crops and Livestock Products (Constant 2000 US$/Metric Ton)

AGRICULTURAL PRODUCTS	2000	2050				
		No climate change	NCAR No CF	CSIRO No CF	NCAR CF effect	CSIRO CF effect
		US$/metric ton			% change from 2050 No CF results	
Rice	190	307	421	406	-17.0	-15.1
Wheat	113	158	334	307	-11.4	-12.5
Maize	95	155	235	240	-11.2	-12.6
Soybeans	206	354	394	404	-60.6	-62.2
Beef	1,925	2,556	3,078	3,073	-1.3	-1.5
Pork	911	1,240	1,457	1,458	-1.3	-1.5
Poultry	1,203	1,621	1,968	1,969	-1.9	-2.1

Source: [21]

Figure 1 below explains price changes anticipated by the models in 2050, compared to the prices of the commodities in year 2000. Even without climate change, the model results show an increase in prices. This can be due to growth in population.

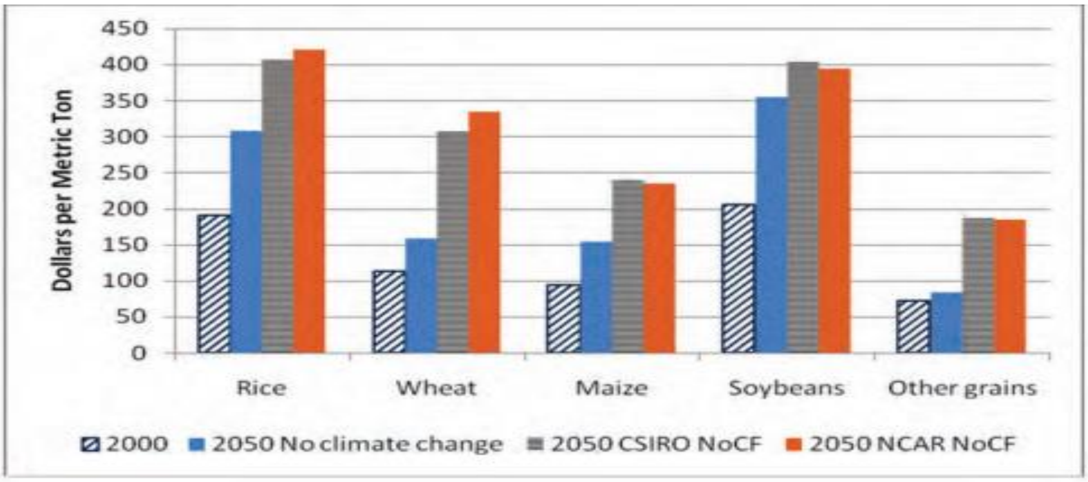

Fig 1 World prices of major grains (2000 US$)

Climate Change and Trade in Zimbabwe

In Zimbabwe, trade is also increasingly being affected by extreme weather-related shocks such as storms, floods, and droughts. Exports and imports are directly affected negatively when trade-related transportation and logistics infrastructure sustains significant damage. Longer-term adverse impacts arise from loss of life and injury of employees and damage to buildings, machinery, and so forth.

These impacts are compounded when exporter contracts are canceled because companies cannot fulfill orders during the crisis and with time discouraging producers to export their products. Food production is hit hard when extreme weather events prevent the planting or harvesting of main crops. Imports are critical to the immediate recovery from a natural disaster such as a flood or a drought. Trade allows imports from unaffected countries to meet the crisis-induced shortage of supply in critical goods and services. Such imports are crucial to avoiding long-term negative development outcomes. During reconstruction, imports provide the equipment, materials, and skills needed to rebuild the capital stock and transportation infrastructure [30].

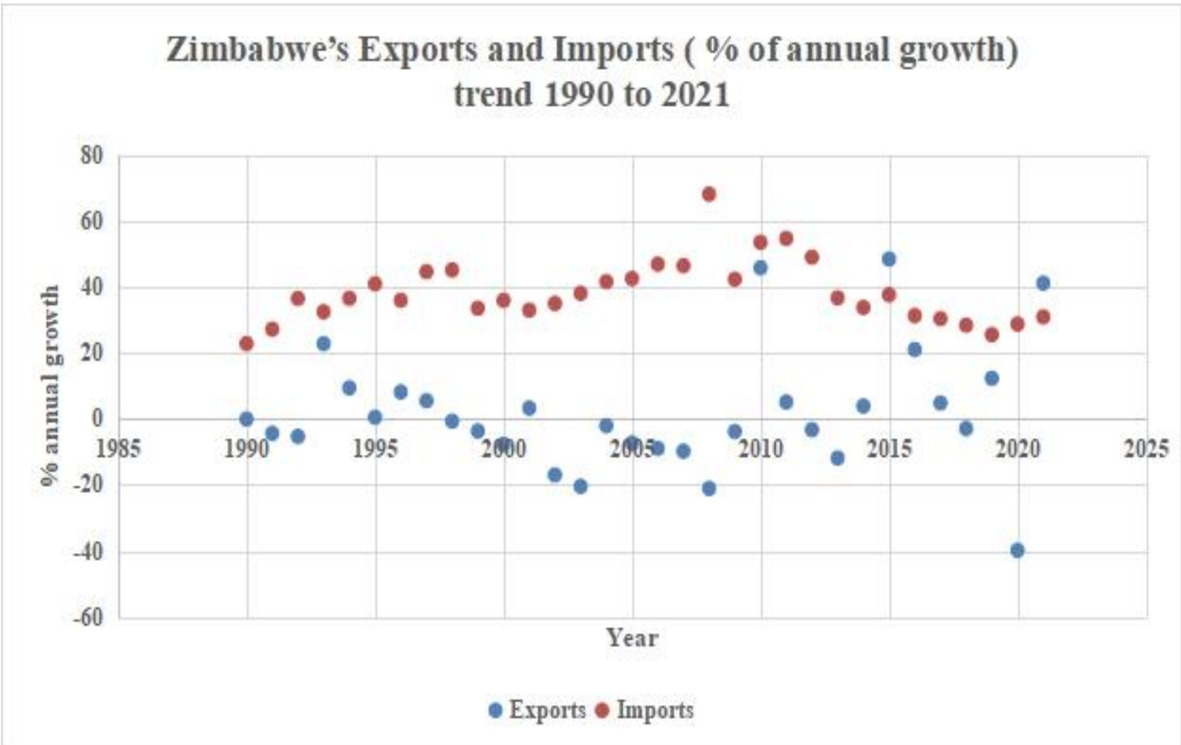

Fig 2

SOURCE: Own tabulation using World Bank Data [31]

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Looking at Figure 2, overall exports continued to decline in both value and volume in the last few decades. Export earnings, for instance, declined by 33.64% from 2018 with earnings pegged at US$5.57 billion in 2019 from a peak of around US$8.94 billion in 2018 to around US$7.21 billion in 2021. The import bill escalated exponentially during the same period, increasing from US$5.57 billion in 2019 to around US$8.77 billion in 2021. A negative balance of trade has been experienced in Zimbabwe since 2002. The percentage growth of aggregate imports have increased over the past three decades, with statistics showing a 22.79% annual growth in 1990, 33.51 % in 2000 a maximum peak of 53.48% in 2008 which escalated due to the global financial crisis and more recently 30.90% growth in imports recorded in 2021 with imports valued at US$8.77 Billion [18]. Zimbabwe sources most of its imported goods from South Africa which is the country's top trading partner with exports and import valued as of 2021 at US$1.883 Billion and US$3 Billion respectively. Imports of fuel are mainly from Singapore valued at US$963 Million in 2021. Merchandise exports have recovered significantly in recent years, reaching a value of US$4 billion in 2018 and an annual growth of 41.12% in 2021. The top exports products being minerals such as gold, Nickel mattes, Ferroalloys and diamonds and agricultural products with raw tobacco valued at (US$863 Million) in 2021 as well as other products such as sugar cane and cotton. The top export destination apart from South Africa includes the United Arab Emirates, China, Mozambique and Belgium [8].

Strong export industries have successfully been developed over the years in the agriculture, mining and tourism sectors, which are the main pillars of the Zimbabwean economy. Exports of agricultural commodities and minerals, (led by gold, nickel, and tobacco) account for nearly 90% of total merchandise exports. Manufacturing retains a relatively large and diversified manufacturing base. Services contribute about 66% to GDP, led by wholesale and retail trade, education services, and tourism. The top export products in Zimbabwe are Gold contributing US$3.51 billion as of 2021. Nickel Mattes (US$1.25 billion), Raw Tobacco (US$863 million), Ferroalloys (US$380 million) and Diamonds (US$235 million). The top five export destination countries are South Africa, United Arab Emirates, China, Mozambique and Belgium. The top imports are Refined petroleum (US$1,08 billion), Pharmaceuticals including vaccines, blood, toxins and cultures amounts to US$261 million, delivery trucks (US$ 206 million), Nitrogenous fertilizers (US$181 million) and Soya bean oil (US$184 million). These products are being imported from countries such as United Arab Emirates, South Africa, China, Singapore and Mozambique [18].

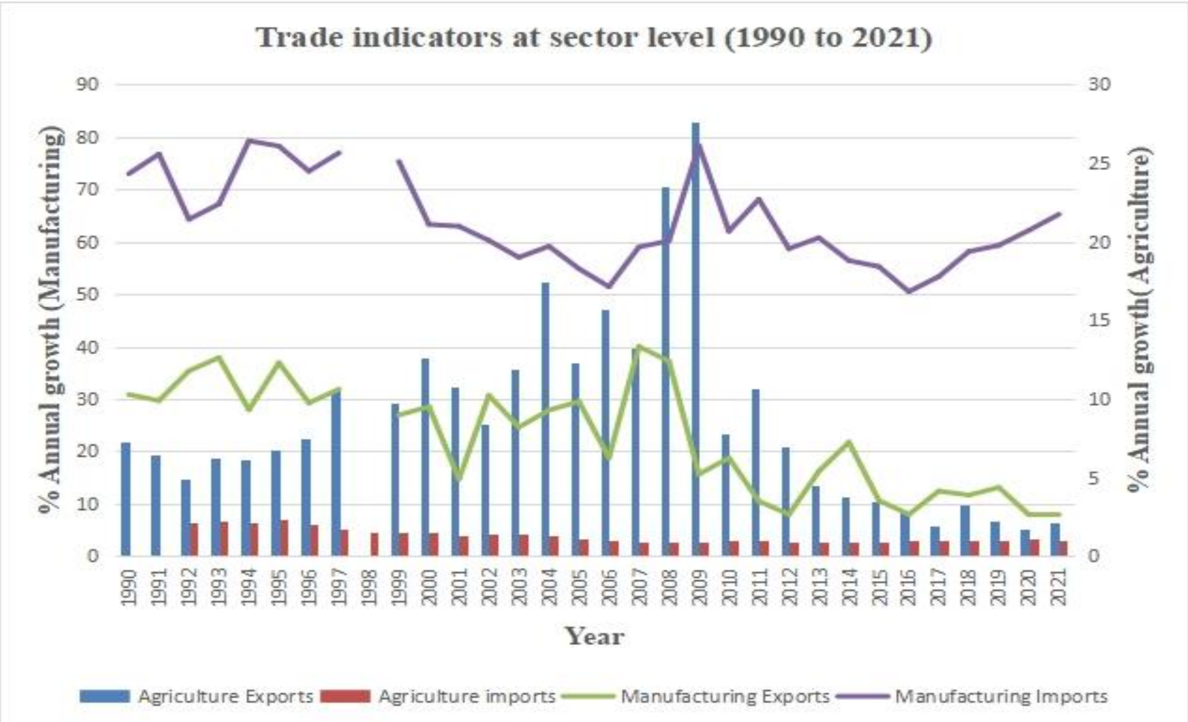

Fig 3 Exports and imports annual growth rates by sector.

SOURCE: Own tabulations using World Bank data [31]

Manufacturing exports dropped from USD 740 million in 2011 to USD 470 million in 2018 recording annual growth rates of 10.5% and 11.65% respectively, on the account of liquidity constraints and the high cost of imported raw materials, and power shortages [8]. Annual export growth in the manufacturing sector have been declining significantly over the years with a record of 28.51% in 2000, 29.5% in 2005, a significant drop to 1.71 % in 2010, 10.64% in 2015 and the lowest record of 7.93% in 2020. Manufacturing imports consist of raw materials and machinery to be used in the production process, from Figure 2 ,there is an a significant increase of imports in Zimbabwe with growth ranging from 63.29% in 2000 and a peak of 78.31% in 2010. Tobacco is the number one agricultural commodity for Zimbabwe (21% of total exports in 2018). Other cash crops considered as top exporters in Zimbabwe include cotton and sugar cane. Agricultural exports have declined significantly, with annual growth of 12.58% recorded in 2000, and the lowest record of 1.74% recorded in 2020.

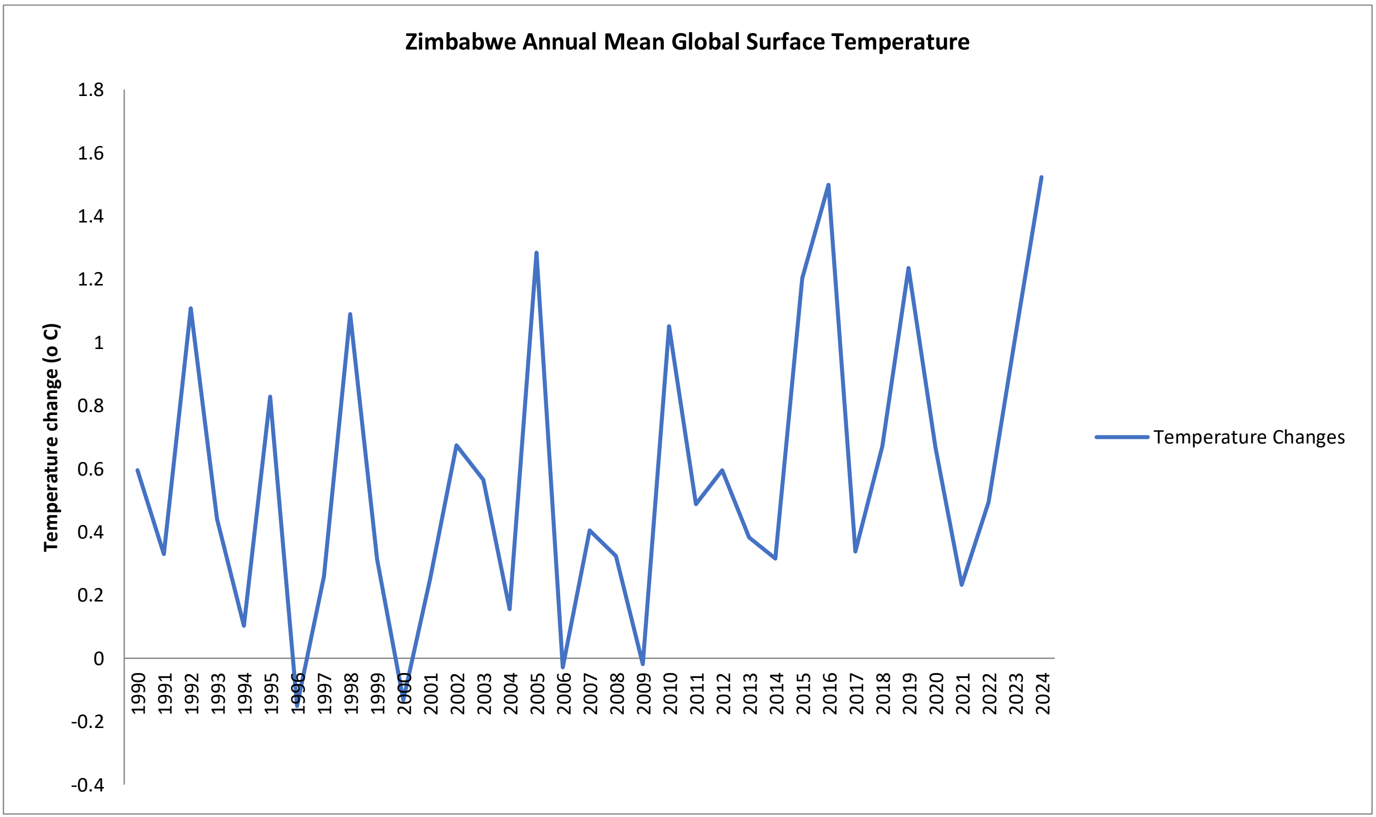

Fig 4

Source: [33]

Figure 4 shows that Zimbabwe's mean global surface temperature has been fluctuating between the years 1990 and 2024. However, the general trend is an increasing one. Basically, the mean temperature has been falling for the periods corresponding to drought years in Zimbabwe, that is, 1992, 2002 and 2012. However, for the years 2022 to 2024, the mean global surface temperature has been increasing.

These statistics are an indication that Zimbabwe has not been spared from the effects of climate change. Statistics presented above have also shown that country's food imports have by far exceeded the exports as climate adverse weather conditions have impacted negatively on agricultural production and hence food security. This study therefore examines the nexus between climate change and international trade taking a case of a developing economy, Zimbabwe. The study also tests the causality between climate change and international trade so as to proffer recommendations and coping strategies that policy-makers can adopt.

RELATED LITERATURE

The relationship between climate change and international trade can be explained using the Partial Equilibrium of [26] or General Equilibrium of [24], which often emphasized on the role of international trade in justifying the use of models of the global economy. However, the models do not specifically analyze the role of international trade in adaptation to climate change. The model of [24] however improved and reached the counterintuitive conclusion that the adjustments facilitated by international trade could have detrimental welfare effects. This result illustrates potential outcomes in a second-best world because climate change leads to increased production in developed countries with high level of agricultural support; thereby aggravating preexisting distortions. According to [2], agricultural policies empirically tend to progress with comparative advantages and market conditions. Agricultural policies are unlikely to stay the same with climate change; hence, our model abstains from representing agricultural policies, despite their prevalence.

These models on international trade and adaptation to climate change all share the assumption that land is uniform within countries, neglecting the role that within-country heterogeneity of climate change effects may play in opening new adaptation possibilities. An additional difficulty is that, when land is uniform, defining crop yields after climate change involves assuming a weighting scheme for the local yield changes. The weighting scheme adopted is usually based on current crop production, which negates the possibility of more favorable yields under climate change elsewhere than where crops are currently produced [9].

The Vent-for-the-surplus theory of trade by Burmese Economist Hla Myint [19] is another hypothesis that stresses how international trade is essential. According to the hypothesis, expanding a global market using global trading helps nations utilize better the previously underused lands & labor resource in order to develop bigger primary product surplus that may become exports. Human resources that aren't used to full capacity offer opportunities in boosting productivity, capacities and gross domestic product. The opening of international markets toward distant agricultural countries, according to this hypothesis, gives chances to exploit formerly underused lands and labor resource to generate greater production for export to overseas markets, rather than reallocating fully employed resources, as classical theory suggests. Under international trade conditions, a rise in the cost of export goods may increase demand for low-skilled workers and is anticipated to result in a major change and positively effect on poverty via increased incomes, employment, or both.

David Ricardo's (1817) theory of comparative advantage is considered a fundamental component of trade theories [25]. Along with the theory of absolute advantage, it is based on the idea that nations participate in worldwide commercial trades to gain from specializing in the manufacturing of low-cost commodities. Countries should assess their factor endowments and allocate resources to generate their best option. By specializing in a product, a country may then participate in international trade with other nations to get items that are inferior in terms of resource usage [4]. According to the law of opportunity cost, countries must focus on manufacturing a product whose cost of not producing is greater than the cost of producing the second option [11].

Even if a country has an absolute advantage in manufacturing both items when compared to another country, Ricardo believes that it must concentrate in manufacturing the goods where it has a comparative advantage in resource utilisation [4]. The hypothesis indicates that international trade would improve national production and job possibilities for unskilled labor in nations with a comparative advantage in exporting items that need unskilled labor.

Adam Smith's [28] contribution to classical theories of trade includes the concept of absolute advantage. Absolute Advantage states that mutually beneficial international trade occurs when countries specialize in producing goods they can manufacture most efficiently. According to [27], international trade allows for specialized production, resulting in economies of scale, higher productivity, and economic growth. Businesses are driven to innovate in order to generate more valuable goods, improved productions and distributional networks, and effective operational processes under international trade, resulting in greater national output [1]. International trade has enabled countries to rise above the limitations of their home markets, leading to an expansion of markets, division of labor, and technological innovations, resulting in increased productivity, economic growth, and poverty reduction.

Studies were carried out on causal relationships between Climate Change and International trade, and other related topics. A similar study was done by [17] who found out that through being engaged in international trade with China, the UK had a reduction in carbon dioxide emissions by 11% in 2004. A combined assessment also showed that the international trade between China and UK resulted in a substantial increase in carbon dioxide emissions in the same one-year period. [21] found out that climate change has major effects on crop production costs and ultimately increases trade costs of such products. Their study also concluded that climate change increases the incidence of food insecurity around the world, whilst international trade helps counteract this effect by availing agricultural goods to areas experiencing productivity declines. A specific reference made by this study is to a study done by [7] who used the OECD's ENV-Linkages model, a dynamic computable general equilibrium model with global coverage and sector-specific international trade flows. From the analysis, the researchers concluded that climate change has direct and indirect effects on international trade. Their findings pointed out that climate change leads to productivity losses and interruptions that have a negative bearing to international trade. This is mainly dominant in Agriculture and mining sectors, as productive activities in these sectors depend on good and viable weather conditions. Storms, floods and violent winds negatively impact production, whilst absurd temperatures, high or low mainly affect production of crops. Disrupted productivity results in interrupted international trade activities [15].

A study carried out by [16] revealed several causal effects of international trade and climate change. Using the economic Global Biosphere Management Model (GLOBIOM)) and crop Environment Policy Integrated Model (EPIC) approach, the study concluded that climate change has the capability to increase agricultural prices and put to risk of hunger to an average of 77 million more people by year 2050. Another study was carried out by [9] using the quantitative general equilibrium trade model inspired from modern Ricardian trade models. The researchers found out that climate change reduces welfare globally by 1.72%, with a lot of heterogeneity as net-food-importing tropical countries lose from the negative productivity shocks and increased global food prices, while countries exporting agricultural products tend to gain thanks to improved terms of trade. [9] concluded that it is international trade that addresses the effects of climate change on crop productivity in countries thereby utilising countries' comparative advantages to the fullest

METHODOLOGY

Model Derivation and Specification

The model used is the gravity model of international trade borrowed from the gravity model of Sir Isaac Newton and has become somewhat of a holygrail of international trade model. The intuition is that GDP of a country and that of its trading partners have a positive impact on the volume of trade, while distance and other control variables (such as population and distance) have a negative impact (as in *Equation3.1)*. A is a normalising constant that captures other factors which affect trade, while$\alpha;\beta;\varphi$are fitting parameters [6].

$$Trade_{A,B} \propto A\frac{GDP_A{}^{\alpha}\times GDP^{\beta}{}_B}{DISTANCE^{\varphi}_{AB}} \quad (3.1)$$

Logging the original gravity model yields *equation* 3.2. The researchers adapted the gravity model to come up with the econometric model (*equation3.2*) which accommodates climate change:

$$lnTrade_{Zim,World} = lnA + \alpha lnGDP_{World} + \beta lnGDP_{Zim} - \varphi\ln(co2_{World}) + e(3.2)$$

Due to lack of availability of bilateral trade data between Zimbabwe and its major trading partners the assessment took the world as the sole trade partner. The researchers use a simple ARDL-ECM model to estimate the short run and long run association of trade and global emissions. The ARDL-ECM will be specified in *equation3.3.* The error correction model is a re-parametrization of the ARDL model

$$\Delta LNEXP_t = \alpha_0 + \sum_{i=1}^{p}\alpha_i\, LNEXPZ_{t-i} + \sum_{i=0}^{q}\beta_1\, LNGDP^{W,Z}{}_{t-i} + \sum_{i=0}^{q}\beta_2\, LNCO2W_{t-i} + \sum_{i=0}^{q}\beta_3\, LNOPENZ_{t-i} + ecm + u_t.$$

Where $ecm = \pi_1 LNEXP_{t-i} + \pi_2 LNGDP^{W,Z}{}_{t-i} + \pi_3 LNCO2W_{t-i} + \pi_4 LNOPENZ_{t-i}(3.3)$

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Table III Variables Expected Signs

Variable	Abbreviation	Expected sign
Exports	LNEXP	Dependent
Global climate change	LNCO2W	-
Trade openness	LNOPENZ	+
GDP-Zimbabwe	LGDPZ	+
GDP-World	LNGDPW	+

Source: Authors own compilation from the review of literature

Data

The quantitative analysis used secondary annual time series data obtained from the World Bank Human Development Indicators database. The sample is 32years from 1990 to 2022. Log transformation is done on all variables to compress the scales in which they are measured [10]. All analysis was done using Eviews 10.

RESULTS

Pre-estimation Diagnostic Test Results

The researchers carried out diagnostic tests to the model and the results are presented in Table IV below

1) Unit Root Tests: Table IV shows the results of the Dickey Fuller unit root tests conducted at the 5% level of significance. The results show that all the variables are integrated of order one meaning they will only be stationary after first differencing. Given the mixed results of the unit root test an ARDL bounds test of cointegration can be used to check the long-term relationships [23]. The results are presented in Table V below.

Table V Bounds Test

Level of significance	Lower bounds	Upper bounds
1%	3.74	5.06
5%	2.86	4.01
10%	2.45	3.52
Computed F-stat = 126.5		k = 4

Source: computations based on data analysed in E-views 10

2) Cointegration Test Results: The computed F-statistic of the bounds test is greater than the values of the upper and lower bounds all levels of significance. The researcher rejects the null hypothesis of "no cointegrating

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relationship" and conclude that there is a long run relationship between the variables. The presence of a such a long-term relationship requires that estimation be done for both the Long Run and Short Run [20].

ARDL-ECM Model

The estimated model is an ARDL (1,4,3,0,4) which was generated using an optimal lag length of 4 selected using the Akaike Information Criterion. R^2 of 0.9, means that the model has higher explanatory power and can explain 99 percent of the variability in trade. The Durbin Watson test statistic is also greater than the R^2 indicating that the model has no autocorrelation.

Table IV Dickey Fuller Test

Variable	**ADF (PValue)**		**Order of Integration**	
	I(0)	**I(1)**	(1)	
Log(Exp)	0.7285	0.0000	(1)	
Log(Co2w)	0.9928	0.0216	(1)	
Log(Openz)	0.0807	0.0000	(1)	
Log(GDPw)	0.8397	0.0007	(1)	
Log(GDPz)	0.7905	0.0000	(1)	

Source: computations based on data analysed in E-views 10

Table VI Short-run Equilibrium

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	26.79032	0.903364	29.65618	0.0000
D(LNCO2W)	-6.922563	0.946527	-7.313643	0.0000
D(LNCO2W(-1))	-0.284117	0.831070	-0.341870	0.7395
D(LNCO2W(-2))	-1.984796	0.838802	-2.366228	0.0395
D(LNCO2W(-3))	1.750211	0.893118	1.959663	0.0785
D(LNOPENZ)	1.131616	0.065198	17.35667	0.0000
D(LNOPENZ(-1))	-0.362264	0.060595	-5.978425	0.0001
D(LNOPENZ(-2))	-0.323282	0.061425	-5.263013	0.0004
D(LNGDPW)	1.640931	0.252322	6.503309	0.0001
D(LNGDPW(-1))	1.266059	0.237949	5.320724	0.0003

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D(LNGDPW(-2))	1.382144	0.259733	5.321397	0.0003
D(LNGDPW(-3))	0.594159	0.197707	3.005249	0.0132
CointEq(-1)*	-0.882334	0.029644	-29.76471	0.0000

Source: computations based on data analysed in E-views 10

Table VI shows the interaction (sign and marginal effects) of trade with the observed dependent variables in the short run. The error correction coefficient (-0.88) is significant, less than one and negative implying that it will take 88 percent of the period for short run errors to be corrected towards long run equilibrium. The current LNOPENZ has an expected positive impact of 1.13percent, ceteris paribus. The lagged values of LNOPENZ, on the other hand, have significant negative impact on LNEXP. The lags for LNCO2W were largely insignificant in the short run, although the current shows a significant negative marginal effect 6.9percent on LNEXP. LNGDPW in the current and all its 3 lags are statistically significant.

Table VII Long-run Coefficients

Source: computations based on data analysed in E-views 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNCO2W	-4.913253	0.534037	-9.200207	0.000
LNOPENZ	1.881703	0.171367	10.98055	0.000
LGDPZ	1.457039	0.067524	21.57822	0.000
LNGDPW	-1.768953	0.162205	-10.90565	0.000

The Long run coefficients are illustrated in table VII. All the variables are statistically significant and have the expected signs, with the exception LNGDPW. LNCO2 has a negative coefficient as expected. A percentage increase LNCO2W will, on average in the long run, lead to a decrease in LNEXP by 4.9, ceteris paribus. LNGDPW unexpectedly will lead to a decrease of 1.77 percent in LNEXP. All else remaining constant in the long run, increases of 1.88 and 1.46 percent will be inflicted upon a percentage increase in LNOPENZ and LNGDPZ respectively.

Table VIII Post-regression Diagnostic test results

Problem	**Test Statistic**	**Pvalue**	**Decision**
Heteroscedasticity	Breusch/Pagan/Godfrey	0.8238	Homoscedastic
Autocorrelation	Breusch/Godfrey LM Test	0.0923	No Autocorrelation
Misspecification	Ramsey Reset	0.6743	No misspecification
Normality	Jarque – Bera	0.9828	Normal distribution

Source: computations based on data analysed in E-views 10

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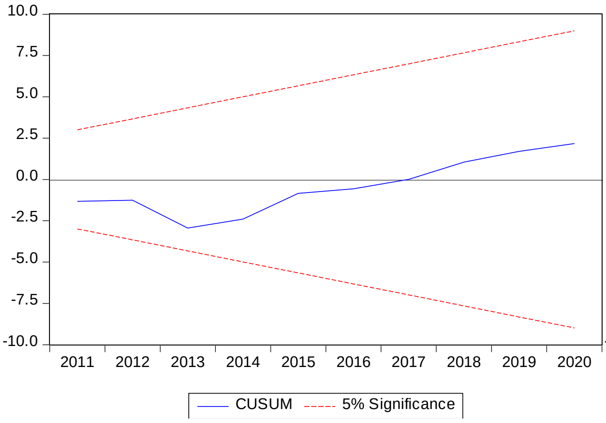
Post-regression Diagnostic Tests

The post-regression diagnostic tests for the model are illustrated in Table VIII. .The null hypothesis of normality cannot be rejected at the 5% level of significance using the Jarque-Bera test statistic which has a probability of 0.983. There is also no problem of Autocorrelation since the Breusch-Godfrey LM test p-value (0.0923) exceeds 0.05. Homoscedasticity is present as the Breusch/Pagan/Godfrey test statistic probability value exceeds 0.05. As verified using the Ramsey Reset test p-value the model is correctly specified and is a good fit, so it can be used to estimate the marginal effects. The stability of the model is also confirmed by the CUSUM and the CUSUM of squares graphs which lie within the 5% level of significance



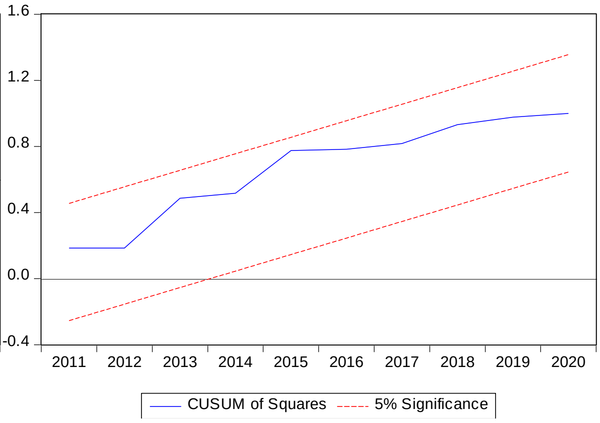


Fig 5 CUSUM and CUSUM of squares

Source: computations based on data analysed in E-views 10

Table IX Optimal Lag Length Selection

Number of lags	0	1	2	3	4
AIC	40.94	36.16*	36.26	36.38	36.38

Pair-wise Granger causality test results

A necessary stage in testing for causality is selecting the optimal lag length [10]. The Akaike Information Criterion is used for optimal lag length selection since it is lower than the Schwarz Information Criterion. The AIC selected an optimal lag length of 1 as shown in Table IX.

Table X Granger Causality test

Null hypothesis	**F(P-Value)**	**Decision**
EXPZ does not Granger Cause CO2W	0.0090	Do not reject null
CO2W does not Granger Cause EXPZ	0.0257	Do not reject null

Source: computations based on data analysed in E-views 10

The results of the pair-wise granger causality are shown in Table X. The probability values of the F statistic are less than 0.05 in both cases, so the null hypotheses are rejected. We conclude that EXPZ granger causes CO2W, and CO2W also granger causes EXPZ. It can be established that there is bilateral causality between CO2W and EXP.

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DISCUSSION OF RESULTS

The study has been able to estimate the impact of climate change on international trade in Zimbabwe. The ARDL based on the gravity model showed the marginal effects in the Short Run and Long Run, while the pair-wise Granger causality pinpointed on the direction of causality. The causality test results show a bilateral relationship between the two variables. The implication is that an increase in trade will highly likely lead to more carbon emissions, while climate change will also have a causal impact on trade. Trade volumes have a largely insignificant negative relationship with global emissions in the short term. In the long run, however, the relationship tends to be very significant and negative. An increase in emissions is associated with a decrease in trade volumes, all else remaining constant. These results are in line with findings by [21] and [7] whose studies posit that climate change has major effects on crop production costs and ultimately increases trade costs of such products. In addition, these studies also pointed out that climate change leads to productivity losses and interruptions that have a negative bearing to international trade. This is mainly dominant in Agriculture and mining sectors, as productive activities in these sectors depend on good and viable weather conditions.

CONCLUSIONS AND RECOMMENDATIONS

A number of questions have been raised on the existence of the relationship between climate change and trade. Some have asked what the short and long term consequences of climate change on trade are while others want to know if the optimal combination of trade and environmental policies harness the benefits of trade while minimizing the environmental costs. Other questions raised were on the effects of trade or trade liberalization on the environment or how the changing natural environment (e.g. climate change) impact or modify trade patterns. A review of this literature reveals that the world needs to know how trade and climate change interact with each other. This study therefore examines the causal relationship between climate change and trade in Zimbabwe as well as the existence of a long- and short-run relationship between the two variables using secondary data for the period 1990-2022. From the results, the impact of climate change on trade volumes in the short run is largely insignificant, but is significant in the long run, all else constant. For Zimbabwe which relies on agriculture exports, trade is negatively impacted as climate change likely affects farm produce. As global emissions rise that negative trajectory is likely to be observed on trade volumes. It is therefore recommended that more climate resistant farming methods, like the already adopted “Pfumvudza” have to be initiated to ensure consistent production flows. With the world moving towards environmentally friendly goods export diversity is also necessary to cancel out the risk associated with climate variability. There is also need for some form of moral suasion so that businesses invest participate in climate change adaptation.

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