

Environmental Impact of Trade Sector Growth: Evidence from Tanzania

Mosses E. Lufuke

Abstract—This paper attempted to investigate whether there is Granger-causality running from trade to environment as evidenced in the changing climatic condition and land degradation. Using Tanzania as the reference, VAR-Granger-causality test was employed to rationalize the conundrum of causal-effect relationship between trade and environment. The changing climatic condition, as the proxy of both nitrous oxide emissions (in thousand metric tons of CO₂ equivalent) and land degradation measured by the size of arable land were tested against trade using both exports and imports variables. The result indicated that neither of the trade variables Granger-cause the variability on gas emissions and arable land size. This suggests the possibility that all trade concerns in relation to environment to have been internalized in domestic policies to offset any likely negative consequence.

Keywords—Trade, growth, impact, environment.

I. INTRODUCTION

AFTER establishment of the World Trade Organization (WTO) in 1994, the entire world has been realizing massive flows of tradable goods and services across borders. In responding to the growth of this trade sector, Tanzania has also complimented trade liberalization policy of WTO in the course of trying to significantly benefit from world trade trends. The country has allowed Foreign Direct Investments (FDIs) inflows in some service's sub-sectors like banking, insurance, transport, hotel and tourism along with partial and fully liberalization in goods sub-sectors like agriculture and manufacturing. This economic transformation has resulted in the increase of trade volumes in almost all sectors of the economy. Statistics from tourism [1] showed that the country has experienced an annual rate increase of 10% in the tourism industry since 1995, with earnings amounting to US\$ 1,159.8 million in 2009. Reference [2] revealed that investment in the mining sector in Tanzania has received a boom in both mineral exploration and mining activities, with its contribution to the merchandise exports totaling to 8%. Moreover, [3] stressed that the increase of mining sector investment has realized the share of the sector to GDP hoist to an average of 61.4% over 15 years from 1995 to 2010. The overall trade volume of the country has therefore grown by 126% in 10 years after the establishment of WTO [4]. However, apart from the good performance of the world trade activities, there has been a growing pattern of global environmental changes particularly from the climatic perspective, which called for the establishment of the Committee on Trade and Environment

(CTE) in 1994 by the WTO to identify the relationship between trade measures and the environment in order to promote sustainable development. With the indications of growing performances of trade, coupled by the concern that might be posing to the country's environment, there is a clear necessity to evaluate the nexus between the two. In a large part of Tanzania, particularly in towns, there has been reported an increase of temperature as a result of toxic gas emission. The data from World Bank shows the increase of 0.1 metric tons per capita of carbon dioxide emission in Tanzania from 2002 to 2007. Likewise, some parts of the country have been experiencing an increase in annual rainfall, while precipitation continues to decline in others. The central, western, southwestern, southern, and eastern parts of the country, for example, are currently acknowledging a decrease in rainfall of 10% to 15%, while the north coastal region reports an increase of 0-20% in the short rains and a decrease of 0-10% in the long rains. In the unimodal region, rainfall has decreased between 0% and 25% in central regions during October, November, and December, but increased by 15% in March, April, and May [5]. Generally, the current climatic condition in the country is no longer predictable such that its uneven distribution has been largely evidenced, with the situation being complicated by environmental pollution/degradation particularly in biodiversity destruction.

As Tanzania's economic base depends on the use of natural resources, rain-fed agriculture and biomass for household energy, its economy becomes highly susceptible to the adverse impacts of climate change and to extreme weather events. Severe and regular droughts in the past eight years, for example, have prompted the recent devastating power crisis and food shortage, thus causing GDP growth to reach an average of 6.8% rather than the targeted of 6.9% in 2005. The data showed further that the agricultural sector (which is the core economic stay of the country) grew by only 5.2% compared to 5.8% growth in 2004 and this was again attributed to the prolonged drought in 2005/2006 [6]. This pattern of environmental change in climatic framework is thus poised to undermine national efforts to attain the Sustainable Development Goals (SDGs), while reduction of poverty remains to be an uphill task to achieve. Therefore, all forms of climatic disasters in Tanzania such as floods and droughts which manifest into fundamental capital losses are indeed of great concern in the country.

II. LITERATURE REVIEW

Environmentalists have been actively drawing attention on the extent to which the world worn out fast as a result of

human activities. However over the years, attention has been on other human economic activities such as agriculture, industry and mining [3], [7]-[10]. With trade nowadays regarded as an important engine for growth, the discussion seems to have slightly shifted to reflect both the correlation and causality between the two variables, which are trade and environment.

A. The Linkage between Trade and Environment

According to United Nations Environmental Programme [11] and International Institute of Sustainable Development (IISD), there are four ways through which trade affect environment. The effects can be summed to product, technology, scale and structure. Coined better by [12], the first effect exerted by products happens when the tradable goods in particular harm the environment or even development initiatives. The effect however can be counter-argued to have a positive role to play in address the cases concerning environmental degradation in the sense that it steers the expansion of more innovative goods or technologies that have less environmental impact—for example, solar power technology or more fuel-efficient automobiles—than those currently used). While on the negative side of the argument, trade can facilitate international movement of goods that, from an environmental perspective, would best never be traded. The technological effect is viewed on the way in which trade liberalization affects technology transfer and the production processes used to make traded goods [13]. Foreign producers may transfer technologies abroad when a trade measure or agreement results in a more open market and a business climate more conducive to investment. The concept of scale effect is explained in the sense that trade and trade liberalization can expand the level of economic activity possible by making that activity more efficient. This expansion—essentially creating additional wealth—can have positive and negative effects on the environment and development. In this circumstance where trade creates wealth two types of environmental benefits may follow. (i) The first benefit emerges because of the reduced demand of inputs from natural resources by the then efficient firms thus producing less polluting waste. (ii) The second case happens when the wealth generated from efficiency makes it possible for people to demand more environmental and safety products. However, increased economic activities and wealth creation can negatively harm the environment in a two-fold scenario. In the first scenario, most economic activity damages the environment, whether in extracting raw materials, harvesting renewable resources, or in creating waste and pollution. This implies that increasing the scales of economic activities tend to increase the levels of environmental damage; unless regulations are in place to ensure that the additional activities cause no harm - an unlikely scenario. The subject behind the second scenario stresses that, not all pollutions react inversely to the wealth creation, rather the opposite. The reference is made to the level of all greenhouse gases emissions in developed versus developing countries, that the former group does more emission than the latter regardless of its higher

wealth. And last is the structural effect of which the association has been made with some trade theories like absolute and comparative advantage by Adam Smith and David Ricardo, respectively, as the two pioneered countries' specializations. Reference [14] described trade liberalization as a source to changes in the composition of a country's economy, causing it to produce more of the goods it makes well or has in abundance, to trade for those it does not. On the optimistic side, if the composition of the economy changes so that less polluting sectors have a bigger share of the pie, then trade has resulted in environmental improvements (at least at the national level; the polluting firms may have simply moved to a different country). With regard to development, the question will be whether the sector has any links to the domestic economy, increased employment prospects, or otherwise enhanced potential for creating income equity, for example, the demand of organically produced coffee in Mexico. Moreover, the same liberalization tends to be coupled by reduction or elimination of trade barriers of different forms that otherwise would have an impact to the economic development through worsening of allocative efficiency. On the pessimistic face, if the goods that a country makes well are based on natural resources, or are pollution-intensive, then trade liberalization would increase the share of such industries in the national economy.

B. Empirical Review

The studies that have attempted to disclose the nexus between trade and environment in Tanzania and other related countries in Sub-Saharan Africa have either been limited to the specific sectors, such as mining and agriculture, or have applied a qualitative approach which is unable to establish the causality of the variables. For instance, [3] analyzed the environmental impact of FDI in the mining sector in Sub-Saharan Africa. The study concluded that FDI in the mining sector in some cases lead to improved environmental management practices as companies tend to introduce new technology; thus, refurbishing existing installations, which in consequences result in better environmental performance. With its qualitative approach, the study failed to establish the extent to which this technological adaptation has made environmental better or at least equal to the world of counterfactual. Another qualitative study by [8], based on desktop studies and discussion with relevant stakeholders having an impact on trade matters, reviewed the trade issues for management of Tanzania's coastal forests. With the main concern on the impacts of flora and fauna trade on the environment, it was indicated that coastal forests of Tanzania mainland experience serious degradation deforestation being caused by uncontrolled trade on flora and fauna. Furthermore, analysis of foreign trade and the environment in Tanzania by [7], in which simple descriptive investigation was taken into consideration, revealed tariff structure in Tanzania's major trading partners as an unquestionable cause of environmental degradation leading to climatic changes. That the analysis on tariff structures in at least six major countries that form Tanzania's trading partners (that is UK, West Germany, Italy,

Netherlands, United States of America and Japan) showed that the tariff structures in those countries actually favored the production (in Tanzania) of environmentally degrading products. These included agricultural and forest based products like tobacco, wood and cork, forestry and others. The only different methodological approach was established in the study by [9], which analyzed how changes in trade policy as brought about by the Doha Development Round in the WTO affect the environment in countries producing oilseeds, and how these effects might be addressed in advance by policymakers in those countries. The study described the WTO negotiation's likely results and its effects on production and trade in soy, palm oil and rapeseed, the major oilseed commodities. It also assessed the effects of biodiesel policies and described the major trade and environmental policies at work in the producing countries, and assessed the likelihood of change to national environments should the Doha results occur. Meanwhile it examined the distortion of trade policy measures as brought by WTO negotiations, while emphasis was given to the structural effect in agricultural production from one commodity to other as a response to policy changes in favor of biodiesel production. In all these targets, matrix approach was used to derive the environmental sustainability implications of changes in scale and location of agricultural production that will accompany agricultural trade reform. The study concluded that the oilseed sector will continue to be an important driver for environmental changes taking place in palm oil and soy producing countries, particularly those where good management practices and environmental law enforcement ability are challenged by the rapid pace of development spurred by high oilseed prices. As pinpointed before, these studies failed to nail down the causality relationship between trade and environment in Tanzania; the area which become the centre herein throughout.

III. MODEL ESTIMATION AND DATA

Model Estimation: Even though impact measurement on environment is deemed to be a wider subject, this article has paid attention to the impact on two elements. Firstly, the impact on nitrous oxide emissions as indicated by CO₂. These are emissions from agricultural biomass burning, industrial activities, and livestock management; activities that results into production and therefore trade. Secondly, is the impact on arable land (AL), which is land under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or for pasture, land under market or kitchen gardens, and that which is temporarily fallow. These two variables (CO₂ and AL) were assessed whether are Granger-caused by several trade variables (inward FDI flows, exports-X, imports-M, GDP per capita-Y and population density-PD) as coined by [16] using (1):

$$f(C_i) = \sum_{i=1}^5 \partial_i C_{it} \quad (1)$$

where, ∂_i are the coefficients and C_i are the five independent variables (FDI, X, M, Y and PD). The interest of this study requires the right-hand side of the model to be occupied by

CO₂ and AL; however, since Granger-causality test allows assessment in two way directions then each variable is granted to seize it.

Data: The World Bank collection of development indicators was used to compile series on nitrous oxide emissions (in thousand metric tons of CO₂ equivalent), arable land (in percentage of land area) and total population. Inward FDI flows, exports, imports (both in USD at current prices in million) and USD at constant prices (2005) per capita were collected from UNCTAD database. In order to establish PD, the total population was then divided by the country size, of which was obtained from the Tanzanian Ministry of Lands, Housing and Human Settlements.

IV. EMPIRICAL RESULTS

According to [15], non stationary variables might result into models yielding higher R² even if the series are independent to each other and/or portraying significance of variables that are realistically otherwise. In that respect, Augmented Dickey-Fuller test was instituted to all variables. With equations of intercept, trend and intercept as well as none, the test requires the confirmation on the absence of unit root to be justified by all three equations. Table I presents the summary of the Augmented Dickey-Fuller test.

TABLE I
UNIT ROOT RESULTS

| Variables | $\Delta Z_t = \phi_0 + \delta Z_{t-1} + \varepsilon_t$ | $\Delta Z_t = \phi_0 + \phi_1 t + \delta Z_{t-1} + \varepsilon_t$ | $\Delta Z_t = \delta Z_{t-1} + \varepsilon_t$ |
|----------------------------|--|---|---|
| AL | 2.2852(-2.9332) | 0.7479(-3.5208) | 2.9814(-1.9489)** |
| CO ₂ | -4.8729(-2.9332)** | -4.8147(-3.5208)** | -0.5688(-1.9491) |
| FDI | 5.1546(-2.9511)** | 4.0580(-3.5485)** | 5.1477(-1.9510)** |
| M | 5.2596(-2.9369)** | 3.8251(-3.5266)** | 5.3566(-1.9493)** |
| PD | 2.2969(-2.9411) | 2.2230(-3.5331) | 2.3334(-1.9499)** |
| X | 8.0246(-2.9350)** | 6.2149(-3.5236)** | 7.4694(-1.9491)** |
| Y | 1.8319(-2.9350) | 1.3680(-3.5208) | 1.3998(-1.9493) |
| 1 st Difference | | | |
| AL | -4.5531(-2.9350)** | -5.0241(-3.5236)** | -0.1706(-1.9499) |
| CO ₂ | -11.6289(-2.9350)** | -11.5060(-3.5236)** | -11.7804(-1.9491)** |
| PD | 1.1515(-2.9411) | -0.9920(-3.5331) | 1.9966(-1.9499)** |
| Y | -2.0383(-2.9369) | -3.1140(-3.5485) | -1.6471(-1.9493) |
| 2 nd Difference | | | |
| AL | -7.6864(-2.9411)** | -7.6852(-3.5331)** | -7.6682(-1.9499)** |
| PD | -1.6922(-2.9411) | -2.2825(-3.5331) | -0.6665(-1.9499) |
| Y | -8.9490(-2.9369)** | -8.8936(-3.5266)** | -9.0741(-1.9493)** |
| 3 rd Difference | | | |
| PD | -1.6922(-2.9411) | -2.2825(-3.5331) | -0.6665(-1.9499) |
| 4 th Difference | | | |
| PD | -5.3424(-2.9411)** | -5.2720(-3.5331)** | -5.3800(-1.9499)** |

Note: Critical values are in brackets; * * means statistically significance at 5%

The result of the unit root test shows that, at level inward FDI flows, imports and exports were all stationary, as indicated in the three equations of intercept, trend and intercept as well as none. On the other hand, CO₂ became stationary at the first difference, arable land and GDP per

capita after the second difference, while population density after differencing at the fourth stage. Moreover, in determining the BLUE estimates heteroskedasticity, serial correlation and normality tests were performed. Using LM-test and White-test, the variables noted to be free from both autocorrelation and heteroskedasticity respectively. On other hand, Jarque-Bera test statistic of 23.020 and p-value of 0.0276 were enough to reject the null hypothesis at 5%. Individual variables' Jarque-Bera analyses indicated non-normality cases on exports, imports and FDI. Therefore, while ordinary logarithm transformation was applied to the exports and imports variables, log-modulus transformation (that is, $\log FDI_t = [\text{Sign}(FDI_t) * \log|FDI_t| + 1]$) as suggested by [17] was used in transforming the inward FDI flows which contained some non positive values. Following these time series variable's testing, the main VAR-Granger causality test was performed, as shown in Table II.

TABLE II
VAR-GRANGER CAUSALITY RESULTS

| | D(CO ₂) | Log (X) | DDDD(P D) | Log (FDI) | DD(Y) | Log(M) |
|---------------------|---------------------|--------------------------|-------------------|-------------------|-------------------|-------------------|
| D(CO ₂) | 1.3812 [0.501] | 1.9695 [0.373] | 1.2732 [0.529] | 0.3418 [0.842] | 2.2688 [0.321] | |
| Log(X) | 1.7173 [0.423] | 0.2463 [0.884] | 1.7825 [0.410] | 0.7859 [0.675] | 2.7250 [0.256] | |
| DDDD(P D) | 1.0892 [0.058] | 3.5515 [0.169] | 0.0268 [0.986] | 0.3502 [0.839] | 0.3328 [0.846] | |
| Log (FDI) | 1.8511 [0.396] | 8.9135** [0.011] | 2.6164 [0.270] | 3.8406 [0.146] | 0.3735 [0.829] | |
| DD (Y) | 0.1426 [0.931] | 6.6193** [0.036] | 0.2514 [0.881] | 1.9800 [0.373] | 0.2449 [0.884] | |
| LogM | 0.9666 [0.616] | | | 0.6982 [0.705] | 0.3459 [0.841] | |
| All | 7.1703 [0.709] | 26.3349* * [0.003] | 7.1477 [0.711] | 8.8785 [0.543] | 4.4011 [0.927] | 6.4459 [0.776] |
| | DD (AL) | Log(X) | DDDD(P D) | Log (FDI) | DD(Y) | Log(M) |
| DD(AL) | 1.0755 [0.584] | 0.0404 [0.980] | 0.2347 [0.889] | 0.6418 [0.725] | 2.1445 [0.342] | |
| Log(X) | 2.4643 [0.291] | 0.3669 [0.832] | 1.3254 [0.515] | 0.7112 [0.700] | 2.8291 [0.243] | |
| DDDD (PD) | 0.1436 [0.930] | 4.4093 [0.110] | 0.1078 [0.947] | 0.1584 [0.923] | 0.3690 [0.831] | |
| Log (FDI) | 1.0725 [0.584] | 9.2107** [0.010] | 1.5969 [0.450] | 3.7895 [0.150] | 0.1314 [0.936] | |
| DD(Y) | 1.4538 [0.483] | 7.3948** [0.024] | 0.3383 [0.844] | 1.3398 [0.511] | 0.5842 [0.789] | |
| LogM | 1.5624 [0.457] | 4.438 [0.108] | 1.5330 [0.464] | 0.5239 [0.769] | 0.2374 [0.907] | |
| All | 5.5693 [0.850] | 25.7287* * [0.004] | 4.8339 [0.902] | 7.5275 [0.674] | 4.7511 [0.907] | 6.3019 [0.789] |

Note: Numbers in parentheses are the p-values; ** means statistically significance at 5%

The result of VAR-Granger causality indicates clear attestation on causality running from inward FDI flows and GDP per capita to the country's exports. It however, denotes lack of statistical evidence for any of the exports, imports and inward FDI flows to the nitrous oxide emissions. The same can be noticed that neither of exports, imports nor inward FDI flows seems to Granger cause changes in arable land. Meanwhile, for the overall models of causalities representing

directions of variable's combinations, only one having exports as dependent variable [that is, $\log(X_t) = \partial_1 D(CO_{2t}) + \partial_2 D^4(PD_t) + \partial_3 \log(FDI_t) + \partial_4 D^2(Y_t) + \partial_5 \log(M_t) + \epsilon_t$] was revealed to be statistically significant. Therefore, even though previous literature such as [16] indicated that there exist co-integration between both CO₂ and arable land on the trade variables, still such relationships fail to be evidenced in causality form.

V. CONCLUSIONS AND POLICY IMPLICATIONS

There have been diverging concerns on the way economists and environmentalists argue on issues relating to trade. While economic arguments are on whether to liberalize or restrict trade as the means to promote growth, environmentalists on other hand associate these changing human surroundings with global trade growth. The assertion from the latter group is established on an agenda that the two (trade and environmental degradation) have positive linkage. On that basis, and the fact that (at least if it had been the case) degraded environment tends to backfire on the welfare of both trade advocates and the neutrals, the main environmentalists' argument has been on the failure to realize market and therefore economic inefficiencies due to the market failures (both in form of externalities and information asymmetry) posed by unregulated trade.

In this study, VAR-Granger causality technique was used to analyze whether trade as the proxies of exports and imports has an impact to the changing environmental concerns in terms of nitrous oxide emissions and arable land. Although past studies on other countries displayed the existence of co-integration between the two variables, the results in this study indicated that neither of the trade variables appeared to have the impact on environment. Therefore, since co-integration technique only shows the long-run relationship, the results from this study clearly illustrate the possibility that all the concerns on environment as attributed by trade are already internalized, and that are no longer challenges to the welfare of society.

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