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The Impact of Trade Openness on Economic Growth: Empirical Evidence from Madagascar

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Abstract

The purpose of this research is to determine the impact of trade openness on economic growth; nevertheless, the study of the trade openness and economic growth nexus in Madagascar is still ongoing. As a result, the link between trade openness and economic growth has been intensively researched, with conflicting and inconclusive results. This study uses the Vector Error Correlation Model techniques for the period 1993 to 2020. Specifically, the empirical estimated results are sound evidence that there exists a long-run cointegration among the variables. Our empirical findings further depict that trade openness has a negative effect on economic growth in Madagascar. Moreover, this study demonstrates a positive and significant complementary relationship between inflation, FDI net inflow, and Labor force participation in strengthening economic growth. The study concluded with the recommendation that policymakers should develop and execute trade laws that are aimed at regulating various sources of import and export in the country.

Keywords

Madagascar, Trade Openness, GDP, VECM

1. Introduction

In the context of today's globalization, the influence of trade openness on economic growth is a subject of great interest in the life of the global economy. Trade openness has consistently contributed to economic growth in both developed and developing nations, albeit to varying degrees. In fact, many international organizations are encouraging countries to move their borders and to engage in exchanges with others. Countries are now emphasizing new strategies to align their domestic economies with the world economy through open trade through various channels. This makes exchange at the heart of relations between

people and between countries. As some raw materials and products are impossible to obtain from self-country, it is essential for each country to trade around the world. The unequal natural resources and skills distribution, therefore, encourages international trade. With this perspective, a large number of developing countries have embraced the idea that they should increase the opening of their economies by increasing and diversifying their exports. These contexts have led each country to adopt new trade policies. As a result, trade openness has become a trend in the modern economy. Frankel and Romer (1999) confirm that exogenous cross-country changes in international trade are strongly related to each country's per capita GDP. The nexus between economic growth and trade openness has been indecisive and theoretically controvertible. It is widely believed that trade boosts the economy. Recent developments have demonstrated that trade openness does not necessarily have a growth-promoting influence on a country's economy. The integration into global trade is facilitated by trade, which is a source of innovation and boosts the return on foreign direct investment. Grossman and Helpman (1991b) argue that trade openness aids technological progress and productivity by increasing the transfer of new technologies and that the level of trade openness affects these advantages. Trade openness encourages the economy to increase production, leading to increasing returns and specialized economies on the scale (Bond et al., 2005). The growth of international commerce can also help to improve economic growth by fostering technology dissemination and knowledge through FDI or direct import of high-tech items (Almeida & Fernandes, 2008). Trade openness minimizes resource misallocation in the short run, whereas in the long run, it facilitates the transfer of technological advancement, according to Ohlan (2018). Limited research has concentrated on the influence of trade openness on Madagascar's economic growth at the national level, according to a previous study showing trade openness and economic growth. Feenstra and Kee (2008) established a model that allows for the integration of export-related diversity to total factor productivity across nations and over time using a GDP function. They looked studied exports from a group of 48 countries to the United States from 1980 to 2000 to see if there was a link. Zahonogo (2017) conducted a cross-sectional analysis in Sub-Saharan Africa from 1980 to 2012 to assess the influence of trade openness on economic growth in a set of 42 African nations. Moyo and Khobai (2018) examine the association between trade openness and economic development in 11 SADC countries from 1990 to 2016. Huchet-Bourdon et al. (2018) studied the relationship between trade openness and economic development for an unbalanced panel of 169 countries in the period 1988 to 2014. This trend reflects the realities of Sub-Saharan African countries, including Madagascar.

Thus, this study aims to see the dynamic relationship between trade openness and economic growth in Madagascar using the VECM model for the period between 1993 and 2020. Historically, since the independence of Madagascar in 1960, several reforms have been adopted by the various followed governments. Certainly, for this study, the reforms will be highlighted concerning the com-

mercial aspect, especially worldwide. To improve its trade openness, Madagascar became a member of the WTO on 17 November 1995.

Likewise, this study extends the literature on economic growth and trade openness in two directions. First, this paper utilizes the integrated variables for economic growth and trade openness to recognize the dynamic link of these variables; they should be considered in a combination model. Second, this study examines the economic growth and trade openness relationship in Madagascar, the fourth biggest island in the world and with a difficult economic situation. Finally, this study investigates the link between economic growth and trade openness in Madagascar countries by taking into consideration the previous research in the same method as any other sub-Saharan African nation; the results of this paper are crucial to developing future trade policy in Madagascar countries.

Our empirical application draws on Vector error correlation Model (VECM) on data over the period 1993 to 2020. We utilize a VECM approach that enables the short- and long-run estimation of the impact of trade openness on economic growth. As per Akadiri et al. (2020), all openness measures are closely linked to economic growth. Therefore, all openness measures can be endogenous to economic growth. Consisting the previous investigation with the same approach deal with African nations. The current investigation utilizes trade-based measures of trade openness such as GDP, import and export as a percentage of GDP, the net inflow of FDI as a share of GDP, Labor force participation rate and inflation as the Consumer Price Index reflecting the percentage change of a basket of Goods.

Hence, the advantages of trade liberalization and openness are cumulative. Depending on the degree of market openness, the countries may benefit or lose individually. The impact of trade policy on GDP growth has been pondered in many studies using cross-country data settings utilizing developed, emerging and developing economies. While most research focuses on African trade openness, separate studies using times series data analysis on African island economies like Madagascar are rare.

Therefore, this study basically contributes to the ongoing research in two ways: First, the research incorporated new time series from 1993 to 2020 that were not included in previous studies on the economy of Madagascar. The period from 1993 to 2020 coincided with the COVID-19 global pandemic crisis, which may have influenced the empirical findings. Second, rather than utilizing the often used restricted definition of openness, this article employed a variety of trade openness measurements, which helped to ensure that the results were robust. Thus, this study not only extended the existing literature but also increased the evidence quality.

The following is how the rest of the study is organized: Section 2 summarizes the review literature on trade openness and economic growth, Section 3 presents the empirical model, source of data used and methodology, and Section 4 reports the analysis and results of this study. Finally, Section 5 concludes the study.

2. Literature Review

2.1. Trade Openness and Economic Growth Theoretical Relationship

The relationship between economic growth and trade openness is still debated in research on economic development and growth. Traditional trade theory asserts that countries can achieve growth gains through trade openness through specialization, investment innovation, efficient resource allocation, and product development. In the development literature, the importance of trade policy in economic development has long been a point of contention. Trade openness and economic growth have a complicated and confusing relationship, according to theoretical growth studies. If a country needs to trade with another, it should develop items in which it has a comparative advantage, according to the concept of comparative advantage. It focuses on industries with advanced element equipment and the ability to mass create items. As a result, manufacturing and exports in the sector will increase, boosting overall economic growth. Other economists have developed this phrase further. Liberalization, as per Krueger (1978) and Bhagwati (1978), stimulates specialization in industries with economies of scale, resulting in higher efficiency and productivity over time.

According to neoclassical growth theory, the openness of trade stimulates efficiency of resource allocation, stimulates capital formation and enables higher quality economic growth. According to New Growth Theory, trade openness enhances economic growth by improving feature production and accelerating technological development (Romer, 1986). In recent years, academics have looked into the relationship between trade openness and economic growth.

New endogenous growth models describe the beneficial link between open commerce and economic growth as a result of the international diffusion of creative technology (Grossman & Helpman, 1991a; Romer, 1994; Coe & Helpman, 1995; Grossman & Helpman, 1991b). To grow quicker than less open countries, highly open countries can take benefit of technologies made in developed countries. According to Edwards (1993), the cost of copying has an impact on the relationship between trade growth and the cost of copying. Poor countries tend to expand and converge faster when the cost of replicating innovation is lower than in developed countries.

Liu et al. (1997) show a two-way causal link between China's economic growth and trade liberalization. Jin (2000) investigated the relationship between trade liberalization and economic growth in East Asian countries and found little evidence of trade liberalization's long-term influence. In his other research, Jin (2004) revealed that trade openness boosts economic growth in China's eastern coastal regions. Conversely, trade liberalization is having a negative impact on China's island areas' GDP development. According to Lee et al. (2004), trade openness boosts economic growth. Hye and Lau (2015) examine the relationship between India's trade opening and economic growth from 1971 to 2009 using the ARDL approach. They discovered that while trade openness boosted economic growth

in the short term, it had a detrimental impact in the long run. In addition, the Granger causality test reveals that in the short and long run, trade openness and economic growth have a unidirectional relationship.

Additionally, scholarly research on economic growth focuses on the relationship between trade policy and growth rather than the relationship between trade volume and growth (Yanikkaya, 2003). As a result, according to Yanikkaya (2003), the relationship between trade barriers and growth does not always lead to the impact of changes in trade volume on economic growth. The phrases "trade volumes" and "trade limits" are closely intertwined despite their differences. Furthermore, a number of other elements that influence a country's external sectors, such as size, spatial considerations, and wealth, can significantly impact the relationship between economic growth and these sectors (Rodriguez & Rodrik, 2001). Nonetheless, scholars are currently confronted with a serious dilemma due to a lack of a precise definition of what "trade liberalization" or "trade openness" means. As a result, the concept of openness has grown significantly over time, moving from one extreme to the other. Nevertheless, some counterarguments argue that trade openness undermines economic growth. That will be the case if a country specializes in areas where R & D is not its main activity (Almeida & Fernandes, 2008). In addition, product combinations in the retail industry influence growth (Haussmann et al., 2007; Kali, Méndez, & Reyes, 2007). Whether a country benefits from international trade is determined by how easy it is to learn foreign technology and adapt to the local environment. According to Idris (2016), trade openness is one of the key drivers of economic growth. According to Keho (2017), Trade openness has a positive short- and long-term impact on economic growth. Trade openness and financial creation work together to grow a resilient and resilient economy. According to Huchet-Bourdon (2018), trade openness supports long-term economic growth.

2.2. Trade Openness and Economic Growth: Empirical Evidence

There has been a growing research body investigating the link between trade and economic growth on the empirical side. In every way and country, the data in this book is mixed and contradictory. Academics have employed trade openness indices to examine economic growth in a variety of ways, including assessments of trade barriers and distortions. The numerous methods for measuring openness are all linked to the rate of economic expansion. Most previous studies analyzed the long-term relationship between economic growth and trade openness using the successive integration methods of (Engle & Granger 1987). However, this research is neither right nor accurate in the face of transaction costs and price transmission asymmetries (Balke & Fomby, 1997). They critique all previous analyses that imply asymmetric adjustment toward a long-term equilibrium between trade liberalization and economic advancement (1997). Besides, empirical research suffers from a lack of rigorous methodology. The recently established and extremely resilient threshold cointegration model often assumes

asymmetric rather than symmetric fit to long-term equilibrium time series data analysis. Balke and Fomby (1997) presented the threshold cointegration technique, which states that when the divergence from the long-run equilibrium exceeds a specific threshold level, adjustments in relation to long-run equality hold. Instead of addressing symmetric adjustments, the study examines asymmetric adjustments between India's trade liberalization and economic development employing the TAR and MTAR model. The TAR and MTAR methods enable unevenly variable adjustments through recovering to long-term equilibrium after a small shock (Enders & Granger, 1998; Enders & Siklos, 2001).

Hassan (2005) looked at the relationship between trade openness and economic growth in Bangladesh from 1994 to 2003 in the study. In Bangladesh, the analysis found a long-term balance between trade openness and economic growth and the one-way relationship between the two growths. Meanwhile, Adhikary (2011) discovered that trade had a negative impact on Bangladesh's economic growth from 1986 to 2008, but that the impact was diminished after that. Other Asian studies on the impact of trade openness on economic growth, such as those from Bangladesh, have produced mixed results. For example, Hye and Lau (2015) examined the relationship between India's start-up and economic growth from 1979 to 2009 using the Composite Trade Start Index. The findings show that starting a firm has a short-term positive impact on economic growth but has a long-term negative impact. In another study, Klasra (2011) looked at the long-term relationship between trade openness and economic growth between Pakistan and Turkey from 1975 to 2004. In Pakistan, however, there was a good long-term relationship between trade openness and economic growth; however, this was not the case in Turkey.

Similarly, the data for Sub-Saharan African nations are divided. Deme (2002) is in favor of Nigeria's trade expansion concept. Chang and Ying (2008) confirmed the positive impact of trade growth and air freight as an example of the countries represented by the United Nations Economic Commission for Africa (ECA). There was no significant long-term interaction between objects looked at in 16 countries in Sub-Saharan Africa and in most cases (Gries, Craft, & Meierrieks, 2009). They also show that economic growth drives trade openness in Senegal, Mauritius, Ethiopia, Kenya, Sierra Leone, Togo, and Gabon, but Rwanda, Nigeria, Cameroon, and Ivory Coast, have a feedback causal link. On the other hand, Ghana, Gambia, Madagascar, Burundi, and South Africa had no direct association between trade and growth. Vlastou (2010) finds that trade openness negatively influences economic growth in a sample of 34 African nations. He also claims that there is a link between openness and growth. Tekin (2012) shows no substantial correlation between trade openness, foreign aid, and real per capita GDP in examining 27 African least developed nations. According to Asfaw (2014) findings, free trade is a key factor in both economic growth and investment through his study on the sample of 47 countries in Sub-Saharan Africa about the influence of trade liberalization on economic growth.

Furthermore, Trade policies, which include moderately weighted tariffs and efficient exchange rates, also contribute to economic success. Menyah, Nazlioglu, and Wolde-Rufael (2014) study the relationship between trade liberalization, financial development, and economic growth in 21 sub-Saharan African nations. The notion of exchanged growth has very intermittent evidence. The trade growth idea only applies to Sierra Leone, Benin, and South Africa.

Dufrenot, Mignon, and Tsangarides (2010) used Quantile regression to assess links to trade growth in 75 developing countries. Their results show that openness has a greater influence on economic growth in less developed nations than in more developed nations. Low-growth economies can be found on every continent, although the majority is found in African countries (Ivory Coast, Benin, Zambia, and Madagascar) and Latin America. To see if the trade-income link differs in economic development, Kim, Lin, and Suen (2011) utilize flexible variable threshold regressions. Their findings suggest that trade openness helps high-income countries with capital accumulation, financial development, and economic development. In low-income countries, though, the impact is negative and significant. The trade liberalization benefits rich countries' economic development and real income while harming poor countries. Likewise, the real impact of trade is influenced by the amount of inflation financial development, and Trade openness has a negative impact on growth in financially developed countries, but it does not have an impact on financially developing countries.

Malefane (2020) used four distinct proxies to assess the influence of trade openness on economic growth in South Africa, comprising imports and exports to GDP ratios, imports to GDP ratios, exports to GDP ratios, and a combination index. While trade openness has a largely positive influence on economic growth in South Africa, when country size and geography are properly considered, the impact is minimal, according to the study.

3. Data and Methodology

3.1. Variable Description and Data Sources

To explore the main goal by studying trade openness's impact on economic growth, this study employs the annual time series of Madagascar from 1993 to 2020 taken from the World Bank, World Development Indicators (WDI). The time period was selected depending on the availability of data. All of the data series in the variable datasets are from World Bank Indicators (World Bank, 2020).

The following variables are measured in the model. This study used economic growth proxied by GDP growth as the dependent variable in the growth equation. The trade openness index was derived using a regression equation based on export and import, according to the revised version of the standards Frankel and Romer (1999).

The independent variables are FDI (net inflow of foreign direct investment as a percentage of GDP) and trade (total trade as a percentage of GDP), Labor force participation rate and inflation. The export plus import as a proportion of GDP

is a proxy for trade openness, GDP is a proxy for economic growth, and FDI is net inflows (percent of GDP). The study calculated GDP growth (annual percent), foreign direct investment, inflation as Consumer price Index reflecting the percentage change of a basket of Goods, and Labor as labor force participation rate. The vector error-correction model is used to investigate the asymmetric long-run adjustment among the variables (Table 1).

Table 1. Lists of the variables used in the model.

Variable	Description
GDP	GDP growth (annual %)
TRO	import plus export as a percentage of GDP
FDI	Net inflow of foreign direct investment as a share of GDP
LAB	Labor force participation rates
INF	Consumer price Index reflecting the percentage change of a basket of Goods

Source: Author.

3.2. Empirical Model Specification and Estimation Techniques

Early empirical formulations attempted to study the causal link between trade and GDP growth by including imports and exports in the gross domestic product function. An empirical model based on Ohlan (2018) was employed to analyze the impact of India's trade opening and economic growth. Under Ohlan (2018) original specifications, gross domestic product is backed up by trade openness (the ratio of GDP financial development, capital accumulation, and economic development. imports to exports). The augmented production function, including GDP growth, trade openness, inflation, FDI and Labor is expressed as the following model:

$$GDP_t = f\left(\text{trade openness}, \text{FDI}, \text{labor}, \text{inflation}\right) \tag{1}$$

The model is specified as follows to analyze the relationship between the variables:

$$\begin{aligned}\Delta GDP_t = {} & \alpha_0 + \alpha_1 E_{t-1} + \sum_{i=1}^{n} \alpha_{2i}\left(1-L\right)\Delta GDP_{t-1} + \sum_{i=1}^{n} \alpha_{3i}\left(1-L\right)\Delta TRO_{t-1} \\ & + \sum_{i=1}^{n} \alpha_{3i}\left(1-L\right)\Delta FDI_{t-1} + \sum_{i=1}^{n} \alpha_{4i}\left(1-L\right)\Delta LAB_{t-1} \\ & + \sum_{i=1}^{n} \alpha_{5i}\left(1-L\right)\Delta INF_{t-1} + \varepsilon_{1t}\end{aligned} \tag{2}$$

where L represents the lag operator, Δ is the difference operator, $E_{t\text{-}1}$ is the error term, ε_t is white noise. Indeed, the first step in this analysis is to look at the time series' stationarity tests, which are required for each cointegration test in order to avoid misleading regressions. Then, before looking at causation between variables, we'll see if there are any cointegration linkages.

3.3. Estimation Procedure

To measure the effect of trade openness on economic growth in Madagascar, this study employed three conventional econometrics steps to assess. First, this research utilizes the unit root test to confirm whether the data contains a unit root. In the second testing step, this study looked at the linear and non-linear cointegration between trade openness and economic growth in Madagascar. To discover the long-run relationship between variables, we apply the ARDL bound test. Finally, we investigated the asymmetric long-run adjustment between the variables using the vector error-correction model (VECM). The next sections go over the three most common econometric procedures.

3.3.1. Unit Root Test

As a first step toward obtaining stationarity, the study estimated the unit root test using the most applicable ADF test. A researcher in this situation is determining whether variables are integrated in the same order. This is one of the most widely utilized tests among researchers. The study used the following statement to conduct the ADF test:

$$\Delta Y_t = \alpha + \beta t \; yY_{t-1} + x\sum_{i=1}^{m} \gamma_i \Delta Y_{t-I} + \varepsilon_t \tag{3}$$

where ΔY is the first difference of series Y variable which is to be tested, t is the time trend with coefficient β; parameters are denoted by y and x, ε_t represents the stochastic error term.

3.3.2. Johansen Co-Integration Test

This study used Johansen Juselius' maximum likelihood cointegration method to see if the variables were cointegrated after completing the unit root test as well as attaining the same order of integration. Here, we'll look at whether there's a long-run equilibrium link between the variables and why it's important to avoid using spurious regression. When the model verifies cointegration, VECM will be used, and a lack of cointegration will result in a constrained VAR model. The cointegration of Johansen-Juselius is as follows:

$$\Delta Y_t = \sum_{i=1}^{p-1} \gamma_i \Delta Y_{t-I} + \Pi Y_{t-I} + \phi t \tag{4}$$

where ΔY_t is the vector (GDP, FDI, TRO, LAB, INF) respectively, t is a vector of residuals, and Δ denotes the difference operator. With the estimated parameters γ_i and, the VECM model help to figure out for short and long-run adjustments to changes in ΔY_t.

3.3.3. Vector Error Correction Model

The existence of cointegration is the reason for using the VECM in this investigation. Due to the cointegration of the variables, the VECM was chosen over the VAR. If the study finds that a set of variables has one or more cointegration vectors, VECM (Vector Error-Correcting Model) is a good estimation method.

It adjusts to changes in variables throughout time as well as deviations from equilibrium. The most common formula of the VECM model is:

$$\Delta Y_t = \alpha_1 + \sum_{i=1}^{p} \theta_{1i} \Delta Y_{t-1} + \sum_{i=1}^{p} \omega_{1i} \Delta X_{t-1} + \sum_{i=1}^{n} \psi_{1i} \Delta Z_{t-1} + \varepsilon_{1t} \tag{5}$$

$$\Delta X_t = \alpha_2 + \sum_{i=1}^{p} \theta_{2i} \Delta Y_{t-1} + \sum_{i=1}^{p} \omega_{2i} \Delta X_{t-1} + \sum_{i=1}^{n} \psi_{2i} \Delta Z_{t-1} + \varepsilon_{2t} \tag{6}$$

The regression equation form for the VECM model used is specified as follows:

$$\begin{aligned} \Delta GDP_t = {} & \alpha_1 + \sum_{i=1}^{p} \theta_{1i} \Delta GDP_{t-1} + \sum_{i=1}^{p} \omega_1 \Delta TRO_{t-1} + \sum_{i=1}^{n} \psi_{1i} \Delta FDI_{t-1} \\ & + \sum_{i=1}^{n} \xi_{1i} \Delta LAB_{t-1} + \sum_{i=1}^{n} \beta_{1i} \Delta INF_{t-1} + \varepsilon_{1t} \end{aligned} \tag{7}$$

$$\begin{aligned} \Delta TRO_t = {} & \alpha_2 + \sum_{i=1}^{p} \theta_{2i} \Delta GDP_{t-1} + \sum_{i=1}^{p} \omega_{2i} \Delta TRO_{t-1} + \sum_{i=1}^{n} \psi_{2i} \Delta FDI_{t-1} \\ & + \sum_{i=1}^{n} \xi_{2i} \Delta LAB_{t-1} + \sum_{i=1}^{n} \beta_{2i} \Delta INF_{t-1} + \varepsilon_{2t} \end{aligned} \tag{8}$$

VECM cointegration rank indicates the number of cointegrating vectors. Two linearly independent non-stationary variable combinations with a rank of two, for example, will be stationary. If the ECM factor is negative and significant, it suggests that the dependent and independent variables' short-term fluctuation leads to a stable long-term association.

4. Analyses and Result

4.1. Descriptive Statistics

A brief summary of the descriptive statistics is presented in Table 2. With respect to our findings, the most important series refers to the actual deviation from the mean value of the variables proposed in the study.

Table 2. Descriptive statistics.

Variables	GDP	TRO	FDI	LAB	INF
Mean	8.01e+09	51.09105	3.377694	86.89000	79.24323
Median	6.38e+09	53.13246	2.344600	86.62000	66.30946
Maximum	1.42e+10	74.35736	13.44854	89.05000	192.0590
Minimum	3.25e+09	32.86589	0.162627	83.45000	8.852579
Std.Dev.	3.82e+09	11.93303	3.553824	1.067117	56.52500
Skewness	0.267445	−0.074578	1.227009	−0.391407	0.528515
Kurtosis	1.438077	1.776467	3.712933	5.378224	2.045164
Jarque-Bera	3.407140	1.899100	8.163094	7.835934	2.536280
probability	0.182033	0.386915	0.016881	0.019881	0.281354

Source: author's computation.

Table 2 presents the variables' descriptive statistics. To be more specific, the value of the standard deviation for the response variable (GDP) is equal to 8.01×10^9 with standard deviation of 3.82×10^9. Furthermore, the same statistics for trade openness (TRO), foreign direct investment (FDI), Labor force participation (LAB) and inflation (INF) are respectively obtained as 51.09105 (11.93303), 3.377694 (3.553824), 86.89000 (1.067117) and 79.24323 (56.52500), where those in parenthesis represents the corresponding standard deviations. Further, Table 1 gives the value on Skewness, kurtosis, as well as Jarque-Bera tests which helps to verify whether the series with the employed data follows the normal distribution. It's also important to note that the Jarque–Bera statistic's probability values indicate that our variables are regularly distributed.

4.2. Unit Root Test

To conduct the cointegration analysis, first, we should test the existence of a unit root in variables under study. The unit root test is employed to check the stationarity. In order to avoid misleading regressions, a check for stationarity must be performed before any treatment of the time series. As a result, the Augmented Dickey-Fuller test must be used to establish the order of integration of the time series (ADF). The result shows that there is a unit root test in some variants while some are stationary at level 2. We get the following findings, which are presented in Table 3.

Table 3. Unit root test.

Null Hypothesis: GDP CURRENT US$_ has a unit root			
Exogenous: Constant, Linear Trend			
Lag Length: 0 (Automatic—based on SIC, maxlag = 7)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		−2.490194	0.3301
Test critical values:	1% level	−4.309824	
	5% level	−3.574244	
	10% level	−3.221728	

Null Hypothesis: INF has a unit root			
Exogenous: Constant, Linear Trend			
Lag Length: 0 (Automatic—based on SIC, maxlag = 7)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		−0.353499	0.9847
Test critical values:	1% level	−4.309824	
	5% level	−3.574244	
	10% level	−3.221728	

Null Hypothesis: FDI NET INFLOWS has a unit root			
Exogenous: Constant, Linear Trend			
Lag Length: 1 (Automatic—based on SIC, maxlag=7)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		−1.936518	0.6091
Test critical values:	1% level	−4.323979	
	5% level	−3.580623	
	10% level	−3.225334	

Null Hypothesis: LABOR_FORCE_PARTICIPATION has a unit root	
Exogenous: Constant, Linear Trend	
Lag Length: 4 (Automatic—based on SIC, maxlag = 7)	
	t-Statistic
Augmented Dickey-Fuller test statistic	2.976715

Null Hypothesis: TRADE has a unit root		
Exogenous: Constant, Linear Trend		
Lag Length: 0 (Automatic—based on SIC, maxlag = 7)		
	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	−2.284964	0.4284

*, ** and *** denote statistical significance levels at 1%, 5% and 10% respectively. Source: author's computation.

The results show that there is a unit root in all variants except GDP growth. So, the study moves to the cointegration test to see if there is a long-term relationship in the series. In this study, the Johansson cointegration test is used to checkthe relevance.

Table 4. (a). Unrestricted cointegration rank test (Trace). (b) Unrestricted cointegration rank test (Maximum Eigenvalue).

(a)

Hypothesized		Trace	0.05	
No. of CE (s)	Eigenvalue	Statistic	Critical Value	Prob.**
None*	0.713709	92.93899	69.81889	0.0003
At most 1*	0.606349	57.91805	47.85613	0.0043
At most 2*	0.585632	31.81388	29.79707	0.0289
At most 3	0.212755	7.145829	15.49471	0.5608
At most 4	0.015866	0.447803	3.841466	0.5034

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level. *denotes rejection of the hypothesis at the 0.05 level. **MacKinnon, Haug, & Michelis (1999) *p*-values. Source: author's computation.

(b)

Hypothesized		Max-Eigen	0.05	
No. of CE (s)	Eigenvalue	Statistic	Critical Value	Prob.**
None*	0.713709	35.02095	33.87687	0.0364
At most 1	0.606349	26.10417	27.58434	0.0764
At most 2*	0.585632	24.66805	21.13162	0.0152
At most 3	0.212755	6.698026	14.26460	0.5254
At most 4	0.015866	0.447803	3.841466	0.5034

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level. *denotes rejection of the hypothesis at the 0.05 level. ** MacKinnon, Haug, & Michelis (1999) *p*-values. Source: author's computation.

Table 4(a) shows presented the result for trace for none* show that probability is less than 5%, i.e. 0.03%, which convinced us to reject the null hypothesis that there is no cointegration. In Table 4(b), the result from Eigenvalue for none* also shows that probability is less than 5%, i.e. 3.64%, which leads the study to reject the null hypothesis. Therefore, both cointegration results confirm that there is a long-term relationship between the variables.

4.3. ARDL Bound Test

The ARDL Bound test is a cointegration approach devised by Pesaran et al. (2001) to the existence of long-term relationships between variables. This process, still a relatively new method, offers many advantages over traditional cointegration testing. To begin, the method is applied regardless of whether the series is I(0) or I(1). Furthermore, ARDL bound test is used to assess the long-run relationship among variables.

Table 5. Long-run test.

Test Statistic	Value	k
F-statistic	8.867011	4
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06

Source: author's computation.

Table 5 shows that the F-value for the test is 8.867011, which is greater than the upper bound value for 1%, 2.5%, 5% and 10%. So there is a long-run relationship. Due to the long-run relationships between variables, the investigation

moves to VECM. The results are as below.

4.4. Vector Error Correction Model

The existence of cointegrating vectors between variables shows that they have a long-term relationship, allowing the VEC model to be employed. In VECM estimation, structural short and long-run linkages are shown (Doğru, 2013). The long-run cointegrating and short-run coefficients matrix make up the VECM. The results are presented in **Table 6**, respectively.

Table 6. VECM estimation results.

Cointegrating Eq:			CointEq1		
	GDP(−1)		1		
	INF(−1)		−75812057		
			−1.50E+07		
			[−4.89919]		
	FDI(−1)		8.34E+08		
			−2.50E+08		
			[3.32762]		
	LAB(−1)		−3.23E+09		
			−8.00E+08		
			[−4.05424]		
	TRO(−1)		38122556		
			−7.00E+07		
			[0.54531]		
	C		2.74E+11		
Error Correction:	D(GDP)	D(CPI)	D(FDI)	D(LAB)	D(TRO)
CointEq1	−0.596706	8.87E−10	−1.01E−09	−1.36E−10	−2.53E−09
	(0.19400)	(8.6E−10)	(4.0E−10)	(1.4E−10)	(1.8E−09)
	[−3.07583]	[1.03776]	[−2.50948]	[−0.96073]	[−1.39688]
D(GDP(−1))	0.023406	−4.10E−10	1.19E−09	7.85E−11	1.98E−09
	(0.17893)	(7.9E−10)	(3.7E−10)	(1.3E−10)	(1.7E−09)
	[0.13081]	[−0.52037]	[3.19864]	[0.59980]	[1.18740]
D(INF(−1))	1.02E+08	0.598717	−0.053559	−0.028424	−0.909850
	(3.8E+07)	(0.16698)	(0.07873)	(0.02771)	(0.35366)
	[2.68048]	[3.58559]	[−0.68027]	[−1.02558]	[−2.57265]
D(FDI(−1))	1.70E+08	0.129744	0.405840	0.132338	1.705367
	(9.0E+07)	(0.39711)	(0.18724)	(0.06591)	(0.84108)
	[1.89090]	[0.32672]	[2.16749]	[2.00781]	[2.02760]

Continued

D(LAB(−1))	8.29E+08	−0.929381	−0.579219	0.428918	−8.792415
	(5.0E+08)	(2.22570)	(1.04944)	(0.36942)	(4.71405)
	[1.64243]	[−0.41757]	[−0.55193]	[1.16106]	[−1.86515]
D(TRO(−1))	−6169783.	0.005292	0.077995	0.011610	−0.172523
	(2.1E+07)	(0.09361)	(0.04414)	(0.01554)	(0.19826)
	[−0.29052]	[0.05654]	[1.76714]	[0.74724]	[−0.87019]
C	−2.81E+08	2.865044	−0.154153	0.022760	5.412533
	(2.6E+08)	(1.16719)	(0.55034)	(0.19373)	(2.47212)
	[−1.05935]	[2.45464]	[−0.28010]	[0.11748]	[2.18943]

Note: Values in the brackets represent the t-statistics. Source: author's computation.

Table 6 presents the VECM estimation result. The Error Correction Term of the model has a coefficient of −0.596, indicating that the system corrects the imbalance from the previous period at a rate of about 59.6% annually. This also means that almost 59.6 percent of long-run equilibrium deviations are smoothed out in one year. Consistent with previous expectations, the error correction term coefficient sign is significant and negative, suggesting a long-run causal link between openness, GDP, FDI, labor force participation, and inflation.

The relationship between GDP and inflation is significant, but the coefficient appears to be big, based on the estimated findings of the cointegration equation (long-run relationship). A 1% increase in GDP is connected with a 75,812,057 decrease in inflation. This is the same for labor force participation, with a 3.23 percent decrease in GDP. On the other hand, the results for FDI (8.34) and trade (38,122,556) indicate that one percent increase in FDI and Trade is associated with a 3.23 percent and 38,122,556 percent increase in GDP, respectively.

Therefore, the cointegration equation shows that there is a significant effect of INF, FDI net inflow, and Labor force participation on GDP. Trade has an insignificant effect on GDP. The results of the Error Correction Model show that the cointegration equation error term has a significant effect on the system, and the correction rate is 59.6%. It means that the system moves to long-run equilibrium while GDP is the dependent variable. In the aspect of short-run analysis, the results show that INF with lag-1 has a significant effect on GDP with the value of 1.02E+08, with a t-statistic of 2.68, while they are in no significant effect of GDP, FDI net inflow, labor force participation, and trade in the short-run on GDP of Madagascar. Our result agrees with Vlastou (2010), Were (2015) and Lawal et al. (2016), who presented that trade openness has a negative or negligible impact on economic growth. But contradicts with Keho (2017), Moyo and Khobai (2018), Akadiri et al. (2020), Malefane (2020) reported a positive and significant effect of trade openness on economic growth.

4.5. Robust Least Squares

The robust regression analysis for Madagascar trade openness is summarized in

Table 7. Robust Regression Analysis in the presence of outliers and influential data, Huber M Estimation and Bi-Square M-Estimation produce better results to OLS.

Table 7. Robust least squares analysis.

Variable	Coefficient	Std. Error	z-Statistic	Prob.
INF	75,105,705	3,230,785	23.24689	0.0000
FDI_	5,059,078	58,002,456	0.087222	0.9305
LAB	7.72E+08	1.59E+08	4.856172	0.0000
TRO	−54523943	16744262	−3.256276	0.0011
C	−6.23E+10	1.37E+10	−4.535437	0.0000
Robust Statistics				
R-squared	0.823835	Adjusted R-squared		0.795648
Rw-squared	0.986833	Adjust Rw-squared		0.986833
Akaike info criterion	37.76330	Schwarz criterion		47.50896
Deviance	7.57E+18	Scale		4.98E+08
Rn-squared statistic	1323.483	Prob (Rn-squared stat.)		0.000000
Non-robust Statistics				
Mean dependent var	8.01E+09	S.D. dependent var		3.82E+09
S.E. of regression	7.33E+08	Sum squared resid		1.34E+19

Method: M-estimation M settings: weight = Bisquare, tuning = 4.685, scale = MAD (median centered). Huber Type I Standard Errors & Covariance.

Table 7 shows the results of a robust regression analysis with GDP as the dependent variable. When we look at the coefficient estimations, we can find that with the M-estimator coefficient determined with equivalent precision, all the robust regression results showed that the M-estimator yields a substantially larger negative impact of trade on GDP −54523943, with the M-estimator coefficient estimated with similar precision 16,744,262. The trade coefficient estimates' sensitivity to robust estimation is consistent with the diagnostic, implying that the observation had high leverage for the trade-GDP connection.

Moreover, while controlling for the other covariates, LAB and INF were significant at the $p < 0.01$ level, whereas FDI was non-significant at the $p < 0.10$ level on GDP. This study agrees with the findings of Lebari and Udoadugo (2022), who conducted a Robust Regression Analysis Study for Data with Outliers at Some Significance Levels and discovered that the M-estimation was the best model among Bi-square M-estimation. Thus, The R-squared and Rw-squared goodness-of-fit and adjusted measures are displayed at the bottom of the output, indicating that the model accounts for 82 - 98 percent of the variation in the constant-only model. The p-value of 0.00 and the statistic of 1323.483 imply that the null hypothesis that all non-intercept coefficients are equal to zero is strongly

rejected. Finally, the output displays the deviation value, information criterion, and estimated scale.

5. Conclusion and Recommendation

5.1. Conclusion

Madagascar is one of the fastest-growing developing economies in Sub-Saharan Africa, with a trading strategy that promotes, among other things, trade expansion and export diversity. This study aims to learn more about the empirical study of Madagascar's dynamic relationship between trade openness and economic growth, which is based on five important variables. The trade policy is also included in the analysis to account for Madagascar's trade policy changes. Following the termination of import substitution industrialization in 2001, export stimulation was implemented as a strategy for the country's industrialization.

Several scholars working in the field of international trade have been debating the influence of trade openness on economic development or growth without reaching a conclusion. Different econometric methods have been used in various research, but the empirical conclusions are still equivocal. Some research has found that trade openness boosts economic growth, whereas others have found the opposite.

Thus, this research aims to demonstrate how economic growth adjusts to respond to the changes in trade openness. It provides a clear indication that Madagascar's economic growth reacts unevenly to changes in trade liberalization throughout the period 1993-2020. The study reached the conclusion that there exist cointegration among variant under consideration, but ECM shows that there does not exist a significant short-run effect on variables on GDP except inflation. The effect of INF on GDP could be due to inflation's effect on the economy, as Madagascar could print too much money, which could just have a nominal effect on GDP. The insignificance of the short-run relationship could be due to political turmoil in Madagascar, as there has been military intervention in Madagascar last decades. So, political and non-economical factors influence Madagascar's economy more than pure economic and financial factors.

Therefore, the trade sector could not be criticized for Madagascar's overall poor economic performance. Indeed, the wide liberalization of Madagascar's external trade without considering the country's economic realities may have worsened the country's recent economic downturn. The import-dependent sector, which is exposed to the impact of the trade developments, seems unable to withstand the shocks caused by market disruptions. Moreover, based on the findings of this paper, this study concluded with the advice that policymakers create and execute trade laws targeted at regulating various sources of import and export in the country.

5.2. Recommendation

According to the finding of the study, trade openness has a negative impact on

Madagascar's economic growth. The country has been importing more than it has been exporting, resulting in ongoing trade imbalances. As a result, in order for Madagascar to have a full advantage from trade liberalization, the research suggests the following:

The government of Madagascar should temper its trade liberalization policies, as the economy appears to be too weak to sustain negative external trade shocks. Above all, appropriate political, fiscal, and monetary policies should be implemented to mitigate the detrimental impacts of exposing the economy to foreign pressures.

Furthermore, improved transportation and communication infrastructure are required to promote trade. Current infrastructure is insufficient and underdeveloped in comparison. Road and railway rehabilitation are critical in order to lower transportation and trading costs throughout delivery. Trade will grow significantly as a result of free trade and improved infrastructure, driving stronger economic growth.

Additionally, the government should enhance the agriculture sector, which employs almost 80% of the country's overall population. Agriculture is Madagascar's economy's foundation, yet the industry is in bad shape. In order to be market-oriented, farm sectors must be modernized and commercialized. Incentives in terms of agriculture infrastructure might be provided to the rural people to add value to the agricultural products produced. Farmers should be provided greater market access in order to increase their revenue.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Appendix

The graphical visualization of data: