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Exchange rate dynamics and trade balance in Somalia: An ARDL approach

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Abstract: This study looks at how Somalia's trade balance has been affected by variations in the exchange rate, addressing the gap in empirical research on the relationship between macroeconomic variables and trade performance in fragile economies. The study used time series data sourced from the World Bank, SESRIC, the Central Bank of Somalia, and the IMF. The study employed augmented Dickey-Fuller tests and Phillips-Perron tests to assess the stationarity of the data. The study utilized an autoregressive distributed lag (ARDL) model to identify both short-term and long-term effects of exchange rate volatility on Somalia's trade balance. The study found that over time, GDP, along with the real effective exchange rate (REER), had positive impacts on trade balances, whereas inflation rates and foreign direct investment (FDI) negatively influenced Somalia's trade balance in the long run. In the short term, there is a significant positive correlation between GDP, FDI, and REER and the trade balance, whereas the Consumer Price Index (CPI) has a negative impact. These are clear indications that any slight change in economic performance, changes in the value of money circulating, or inflation levels shall be reflected accordingly in Somalia's trade balances. In terms of trade politics, the government of Somalia should focus on economic diversification, enhancing export competitiveness, and maintaining price stability to achieve sustainable trade and economic growth.

Keywords: *ARDL, Consumer price index, Foreign direct investment, Gross domestic product, Real effective exchange rate, Trade balance.*

1. Introduction

Changes in output, market structure, levels, and fiscal and monetary policy all influence the exchange rate. Weerasinghe and Perera [1] showed that the volatility of a country's trade balance, which is the difference between exports and imports produced over a certain period, has become a significant challenge in developing nations. When exports outweigh imports, an economy has a positive trade balance. However, a trade imbalance occurs when imports exceed exports. A positive BOT indicates an improving economy. BOT surpluses can offset the balance of payments deficits. Similarly, Bhat and Bhat [2] noted that the influence of exchange rate fluctuations on an economy has long been recognized as a source of anxiety. However, with the introduction of the generalized floating paradigm, there has been a significant shift in attention to the matter. The fluctuation of the exchange value affects the country's exports and imports and has also impacted its trade balance. Moreover, exchange rate volatility causes trade deficits in Sub-Saharan Africa. The implementation of the Structural Adjustment Program (SAP) of the IMF in Sub-Saharan African nations in the 1980s and early 1990s caused considerable changes in currency rates. One of the SAP initiatives, international trade liberalization, has boosted currency rate volatility, as has the massive expansion in cross-border financial activities [3].

Leeson [4] says that in 1976 when Italy was still in charge of Somalia, a fixed exchange rate was made official. At that time, 1 Italian lira was equivalent to 8 Somali shillings. Somalia's central bank had the authority to regulate financial markets and interfere in the market. After the central government of

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Somalia fell, the Somali shilling stopped caring about its history of being accepted by the public and being legal tender. However, the paper shillings have continued to be accepted and circulated at a positive value. Fiat money's self-fulfilling strategies allow people to accept paper shillings in the absence of a central government [5]. Similarly, the study by Nor, et al. [6] examined the fundamentals of macroeconomics and the exchange rate volatility in Somalia. The study discovered that the use of SOM shillings and the lack of government control in Somalia were to blame for the unstable exchange rate. Mohamud [7] says that there is an imbalance between supply and demand in the money market, which makes people more likely to use the US dollar as their main form of payment and less likely to use SOS shillings. Additionally, Somalia is implementing dollarized digital banking points of sale [8].

The Somalia Shilling witnessed a strong fixed exchange rate physical policy administering the exchange market during the civilian and revolutionary governments. After a decade of civil war, Somalia encountered poor economic development, resulting in trade deficits and exchange rate flotations with a crisis of balance of payments and high debt problems. Mohamud [7] and Nor, et al. [6] looked at Somalia's trade balance and the fluctuation of its currency rates. Both studies said that the shilling was used without any rules, and as far as the author knows, no studies have looked at how the exchange rate affects Somalia's trade balance. So, the goal of this study is to look at Somalia's short- and long-term exchange rates and trade balances in a way that is based on facts. This article uses GDP, the trade balance, the consumer price index, and the exchange rate to show how Somalia could improve its international trade strategies and policies.

2. Literature Review

Bussière, et al. [9] looked at how the exchange rate affects the amount and price elasticity of emerging and developing economies in the 21st century. The descriptive and OLS panel data showed that the exchange rate had a big effect on export price quantity elasticities. The exchange rate affects the trade deficit, but the trade balance got better when both exports and imports fell in value. Dogru, et al. [10] examined how the exchange rate affects the US tourism trade balance. ARDL, ECM, and cointegration were used. The study concluded that the international trade balance improves when the dollar falls and worsens when it rises. Arruda, et al. [11] looked at how real depreciations in the exchange rate affect Brazil's trade balance. The paper looked at the most important economic factors, such as consumer goods, capital goods, intermediate goods, and fuel. The study employed the VAR model and ADF. The study found that exchange rates have a positive influence on the trade balance, one of the most examined economic variables, while fuel prices are indicated to have a negative relationship with exchange rates.

Additionally, Cristanto and Bowo [12] the economics of Indonesia's trade balance were examined. The study utilizes 2010–2019 time series data collected every quarter. The VECM model was used in the study. Investment passively affects short- and long-term trade balances. According to the study, both short- and long-term trade balances were unrelated to GDP, whereas the exchange rate affected both long- and short-term trade balances. Šimáková [13] used quarterly data from 1997 to 2013 to look at how the exchange rate affects the exports and imports of Slovakia's partners. J-curve, ADF, and cointegration tests were used. The J-curve does not affect Slovakia's aggregate exports and imports. Slovakia's trade balance improves significantly when the real exchange rate falls, but it has little effect when it rises. Furthermore, Rahman and Serletis [14] examined currency rate uncertainty's impact on exports using a multivariate context approach. Mean errors and vector autoregression were used. The study found that actual exchange rate uncertainty undermines US exports. The study also indicated that asymmetrical exchange rate shocks equalize actual exchange accounting uncertainty.

However, Thanh [15] investigated the macroeconomic variables affecting Vietnam's trade balance. The study used ADF and VECM models. The trade balance and currency rate were unrelated. Capital mobility and foreign direct investment offset the trade imbalance. The study discovered that trade balances adapt over time to controllable shocks. Additionally, Kingia and Muba [16] analyzed Tanzanian balance of payments factors. OLS, ADF, and Pearson's correlation were employed. The

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analysis found that FDI and the CPI affected Tanzania's balance of payments. Tanzania's balance of payments improves due to the currency rate and interest rate. Furthermore, Chiu and Sun [17] examined the trade balance, the real exchange rate, and savings. The study employed descriptive statistics, the ADF diagnostic test, Pearson's correlations, CIPS test statistics, and the PSTR model. Trade balance and other control variables are unrelated, according to empirical research.

From 1960 to 2016, Nathaniel [18] looked at the trade balance of Nigeria and the effective currency rate. The study employed ARDL-bound test estimates. The analysis found that the actual currency value affects the trade balance and that devaluing the Nigerian naira during a trade balance deficit is not a good strategy. Nasir and Leung [19] also looked at the US trade balance using the nonlinear ARDL framework. They examined the fiscal deficit, surplus, savings, and real exchange rate. The study found that domestic savings, price stability, fiscal shortfall, and productivity affect the US trade balance in the long and short term. Hunegnaw and Kim [20] also looked at trade balances and the exchange rate in East Africa. The ADRL model was used to explain variables such as the real exchange value, export-to-import ratio, foreign domestic income, and real GDP. The study found that lowering the actual effective currency rate improves trade openness considerably. After real exchange and trade liberalization, the balance of trade is marginally more responsive to the real effective exchange rate, but it remains inelastic.

Vural and Tunaer [21] used the J-Curve and cointegration to look at the balance of trade and the exchange value. The study used an error correction model. According to the study, when the Turkish Lira falls in value, the actual effective exchange value has a negative impact on the trade. Aliyu Jibrilla and Mohammed Tijjani [22] also examined the long-term through of the exchange value into the Nigerian balance of trade using threshold relationships and asymmetric error correction models. The study indicated that actual exchange rate devaluations reduce trade balances. Korbi and Banushaj [23] examined the trade balance, real effective exchange rate, FDI, and remittances. The research used a VAR model. VAR analysis found that there is no association between the Albanian trade balance and actual exchange rates. Chebbi and Olarreaga [24] explored how Tunisia's currency rate affects the agricultural net's external position. The Tunisian trade balance was examined using VECM and cointegration techniques. The Tunisian agriculture sector's net external position suffers from currency depreciation, according to the research findings.

Olomola and Dada [25] examined Sub-Saharan Africa's real exchange rate and volatility. Moments were used. In Sub-Saharan Africa, the actual effective currency rate improves the trade openness. High real domestic GDP improves the balance of trade, as the study revealed. The study concluded that foreign income impacts the trade balance. Olayungbo [26] examined how the real effective currency rate, oil price, and reserves impact Nigeria's trade balance. The Granger causal test, ADF test, and VAR model estimated the empirical model. The analysis established a long-term association between Nigeria's trade balance and control factors. The results show that oil prices affect foreign reserves. The analysis shows no overall causal association between commerce, oil prices, or the actual exchange rate. Sakyi and Immurana [27] examined how seaport efficiency, household spending, the money supply, government expenditure, and the real effective exchange rate influenced the trade balances of 27 African nations. The general technique of moments showed that the explanatory factors improved long-term and short-term trade balances.

Nyahokwe [28] used the J-curve to study South African agriculture, mining, and industry, the balance of trade in South Africa is examined using the VAR model. According to the findings, South Africa's trade did not improve during the period of real effective currency rate depreciation. Kallianiotis [29] used a VAR model to examine how the real currency rate, income from domestic, relative price level, and foreign investment affected seven nations balance of trade: the US, Canada, the Eurozone, the UK, Switzerland, Australia, and Japan. The study concluded that US currency depreciation raises import prices and lowers export prices. During a devaluation, imports outnumber exports. The analysis indicated that imports exacerbate the balance of trade in the short run but improve it in the long term.

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Hunegnaw and Kim [30] examined East African trade balances using panel data. By using linear and nonlinear ARDL models, it was possible to determine how the real currency rate, domestic GDP, and foreign GDP affected the trade balance. The study indicated that the actual effective currency rate improves manufacturing and mining trade. Research indicates that the currency rate has an effect on agriculture's trade balance over time. Banerjee, et al. [31] examined China and other countries' currency rates, GDP growth rates, and real GDP through temporal trends using OLS. The study concluded that China's trade surplus boosts its non-price competitiveness by increasing exports of skill ladder items and decreasing imports. Eshetu [32] examined how the Birr depression and other control variables (import spending, export revenue, local currency price of exports, nominal exchange rate, export quantity, foreign currency price of imports, domestic income, foreign income, and import quantity) affected Ethiopia's trade balance from 1970 to 2014. VECM revealed that depreciating the birr worsens Ethiopia's balance of trade in the short run but enriches it in the long term. The results also demonstrated that the real effective exchange rate, GDP, money supply, and terms of trade affect the Ethiopian balance of trade in the short and long term.

3. Methodology

3.1. Theoretical Framework

Goldstein and Khan [33] developed the underlying hypothesis of the imperfect substitute, which says that imports and exports are not ideal substitutes for domestic commodities. This assumption supported the argument that foreign and domestic goods are perfect substitutes and the evidence from the theoretical studies. Additionally, Rose and Yellen [34] proposed a different concept of short-run and long-run trade balance depreciation and recovery. Therefore, this study adopted the two-country model developed by Goldstein and Khan [33] and Rose and Yellen [34]. The money demand functions may be used to express both domestic and international imports and exports as:

$$M_d = f_1\left(Y_d, \dot{P}_d, P_d\right), \frac{\partial M_d}{\partial Y_d} > 0, \frac{\partial M_d}{\partial \dot{P}_d} < 0, \frac{\partial M_d}{\partial P} > 0 \quad (1)$$

$$M_f = f_2\left(Y_f, e, \dot{P}_f, P_f\right), \frac{\partial M_f}{\partial Y_f} > 0, \frac{\partial M_f}{\partial \dot{P}_f\, e} < 0, \frac{\partial M_f}{\partial P} > 0 \quad (2)$$

In equations (1) and (2) where M_d is notated domestic demand, Y_d is real domestic income, P_d denotes domestic price and $\dot{P}_d$ is notated for the price of local currency paid domestically. Also, M_f is notated foreign demand, Y_f is real foreign income, P_f is denoted by overall price level of foreign currency, $\dot{P}_f$ is denoted by foreign currency paid domestically and e is the exchange rate.

The two demand functions, which are derivatives of the Marshallian demand function, result in a demand elasticity that is negatively correlated with price and positively correlated with income.

$$P_d = e\frac{P_f^*}{P} = e\left(\frac{P_f^*}{P}\right)\left(\frac{P^*}{P^*}\right) \gg e\left(\frac{P_d^*}{P}\right)\left(\frac{P^*}{P^*}\right) \gg \left(\frac{1}{r}\right)P_f^* \quad Therefore, \quad P_d = \left(\frac{1}{r}\right)P_f^* \quad (3)$$

Where r is exchange rate relative of the foreign price of goods to domestic goods and P_f^* are export currency for foreign partners and P^* are overall price both domestic and foreign.

Similarly, the price of freeing partners imports is calculated as; $P_f^* = P_x r$ (4)

Substituting (3) in to (1) and (4) in to (2) will find

$$M_d = M_d\left(\left(\frac{1}{r}\right)P_f^*, Y_d\right) \quad (5)$$

$$M_f = M_f\left(P_x, Y_f\right) \quad (6)$$

As stated, theoretical framework the hypothesis of assuming a perfect competitive market of two countries (Ds) is denoted by domestic supply and (Fs) is denoted by foreign supply and this could be written as function of export relative price.

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$$D_s = D_s(P_s)\ and\ F_s = F_s(P_f) \quad (7)$$

$$M_d = F_s\ and\ M_f = D_s \quad (8)$$

Making equation (8) as base and using (5) and (6), the trade balance is calculated as follows.

$$TB = \frac{D_s}{M_d} \gg TB = \frac{M_f}{M_d} = \left\{ \frac{M_f(P_x r, Y_f)}{M_d\left(\left(\frac{1}{r}\right)P_f^*, Y_d\right)} \right\} \quad (9)$$

$$TB = \frac{M_f(P_x r, Y_f)}{M_d\left(\frac{P_f^*}{r}, Y_d\right)} \quad (10)$$

From equation (10) it can be derived trade balance from the export and import with their relative price ratio as.

$$TB = TB(r, Y_d, Y_f) \quad (11)$$

3.2. Model Specification

$$TB = f(REER, GDP, CPI, FDI) \quad (12)$$

Where $TB = IMP/EXP$ if the ratio rises, the trade balance worsens; if it falls, it improves. It examines the trade balance in actual terms rather than in units. "The real effective exchange rate" uses imports as the numerator and exports as the denominator [35]. REER decreases a currency's actual value. To enhance the trade balance, the ratio of imports to exports must be established [36]. REER stands for "real effective exchange rate," GDP for "gross domestic products," CPI for "consumer price index," and FDI for "foreign direct investment."

This is the long-term form of the model:

$$lnTB_t = \alpha_t + \beta_1 lnREER_t + \beta_2 lnGDP_t + \beta_3 lnCPI_t + \beta_4 lnFDI_t + \mu \quad (13)$$

The following equation describes the ARDL model's short-run dynamics, with variables' co-integration in equations (13) and (14).

$$lnTB_t = \alpha + \sum_{i=0}^{p_1} \Delta\, \beta_1 lnRER_{t-i} + \sum_{i=0}^{p_2} \Delta\, \beta_2 lnGDP_{t-i} + \sum_{i=0}^{p_3} \Delta\, \beta_3 lnCPI_{t-i} + \sum_{i=0}^{p_4} \Delta\, \beta_4 lnFDI_{t-i} + \lambda ECM_{t-i} + \mu_1 \quad (14)$$

Were, $\beta_1\ to\ \beta_4$ are the coefficients to be assessed, α is the constant term, Δ is the differential, ln is natural logarithms, μ is the error term, and $p_1\ to\ p_4$ is the lags.

Table 1.
Variables Definitions and Notations.

Nature of the Variable	Variable	Definition	Notation	Expected Relation
DV	Trade Balance	The trade balance is defined as $TB = \frac{IMP}{EXP}$. If the ratio goes up, it means that the trade balance is getting worse, and if it goes down, it means that the "trade balance" is getting better.	TB	
IV	Real effective Exchange rate	The buying power of a currency with another currency is described by its exchange rate	REER	Negative (-)
IV	Gross Domestic Product	All finished monetary value of produced goods and services within a nation	GDP	Positive (+)
IV	Consumer Price Index	Inflation Rate	CPI	Negative (-)
IV	Foreign Direct Investment	Foreign Domestic Income	FDI	Positive (+)

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Table 2.
Variable Justification.

Variable	Expected Relation	Reason for expecting (+) or (-) relationship
REER	Negative (-)	Exchange rate depreciation boosts exports and BOT.
GDP	Positive (+)	BOT or BOP surpluses affect economic growth through trade.
CPI	Negative (-)	In an export-driven economy, BOT surpluses undercut domestic prices and discourage imports.
FDI	Positive (+)	Spillovers from FDI will increase the total factor productivity of domestic companies and reduce imports and exports, which will improve BOT.

3.3. Data Source

This analysis uses secondary data from 1990 to 2021 from the World Bank, the IMF, SESRIC, and the Central Bank of Somalia.

3.4. Data Estimation Methods

To examine the effect of exchange rate changes on the trade balance of Somalia, the study employed the ARDL econometric estimation model. ADF technique was used in this study. The application of Johansen [37] maximum likelihood technique, according to Holden and Perlman [38], eliminates the necessity for unit root tests because the presence of a cointegrating connection between the variables guarantees the existence of unit roots [39]. ARDL was used in the study to assess the co-integration approach for estimating long- and short-run associations as well as dynamic interaction between the research variables.

This study uses the ARDL model due to the different integration orders of its variables, with most of them being I (1) while the Consumer Price Index is I(2). The ARDL method is even more appropriate given that there is co-integration among the variables as shown by the Johansen test hence it can capture both short-term and long-term relationships effectively. The four optimal periods of delay according to specific criteria enhance the ability of this model to accurately capture dynamic interactions. For example, it's advantages in small samples guarantee strong estimates of the relationship among Trade Balance, Foreign Direct Investment, GDP (gross domestic product), Consumer Price Index (CPI) & Real Effective Exchange Rate (REER). The data was analyzed using STATA 17.

4. Empirical Results and Discussions

4.1. Descriptive Statistics of the Data

Table 3 Presents a summary of measures of selected economic indicators for Somalia between 1990 and 2021 are provided. The trade balance (TB) exhibited low variability averaging 5.59 USD (σ = 0.457). The foreign direct investment (FDI) mean was 130.194 USD, displaying high variability (σ = 93.203). GDP per capita (σ = 49.596) while the consumer price index (CPI) was 93.14 USD (σ = 43.894). The real effective exchange rate (REER) with an average of 16,004.244 which indicated an alarming degree of exchange rate instability as vouched by (σ = 8,766.053) of the rate.

Table 3.
Descriptive Statistics of the Data.

Variable	Obs.	Mean	Std. dev.	Min.	Max.
TB	32	5.59	0.457	4.98	6.76
FDI	32	130.194	93.203	9.44	349.31
GDP	32	150.43	49.596	90.73	239.05
CPI	32	93.14	43.894	6.22	143.42
REER	32	16004.244	8766.053	1749.17	31558.91

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4.2. ADF and PP Tests

Table 4 Presents the results of the stationarity tests using the binomial Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) test methods alongside their respective results. The trade balance (TB), foreign direct investment (FDI), GDP, and real effective exchange rate (REER) are integrated of order I(1), indicating stationarity after first differencing. The Consumer Price Index (CPI) is integrated of order I(2), meaning that second differencing is required to achieve stationarity. These findings imply that most variables appear to have unit roots in levels but, after differencing, become stationary which supports the necessity of more advanced time series modeling methods.

Table 4.
Augmented Dickey–Fuller and Phillip–Perron.

Augmented Dickey–Fuller			**Phillip–Perron**		**I. Order**
Variables	**Level**	**Difference**	**Level**	**Difference**	
TB	-3.578	-4.828 ***	-3.398	-5.663***	I (1)
FDI	-2.201	-4.139***	-3.766	-8.540***	I (1)
GDP	-2.653	-4.022**	-2.380	-4.777***	I (1)
CPI	-2.202	-5.267**	-1.226	-12.184***	I (2)
REER	-1.657	-3.849**	-2.654	-4.723***	I (1)

Note: *** p<.01, ** p<.05, * p<.1.

4.3. Lag Selection Criteria

Table 5 presents the results of the criteria-based selection of lags. The optimal length of lag is given at the minimum value of the Final Prediction Error (FPE), Akaike Information Criterion (AIC), Hannan-Quinn Information Criterion (HQIC), and Schwarz Bayesian Information Criterion(SBIC). The FPE scores indicate that lag 4 is optimal because it minimizes FPE (0.00) while AIC (-12.5928), HQIC (-11.0655), and SBIC (-7.59701) also suggest blindly accepting the four-lag model. That is, a four-lag model is best for the dynamics in the data set.

Table 5.
Lag Selection Criteria.

Lag	**LL**	**LR**	**df**	**p**	**FPE**	**AIC**	**HQIC**	**SBIC**
0	51.5951				0.000	-3.328	-3.256	-3.090
1	149.432	195.67	25	0.000	0.000	-8.531	-8.095	-7.104
2	173.077	47.29	25	0.005	0.000	-8.434	-7.634	-5.817
3	197.356	48.557	25	0.003	0.000	-8.383	-7.219	-4.576
4	281.299	167.89*	25	0.000	0.000*	-12.5928*	-11.0655*	-7.59701*

Note: *optimal lag Endogenous: lnTB lnFDI lnGDP lnCPI lnREER Exogenous: _cons.

4.4. Johansen Cointegration Test

Table 6 presents the Johansen cointegration test results with their respective trace and maximum eigenvalue statistics. The trace test result indicates one cointegrating relationship at the 5% level as the trace statistic (43.3974) is lower than the critical value (47.21) at rank 1. Also, the maximum eigenvalue test confirms one cointegrating vector, being the test statistic (22.7791) below the critical value (27.07). These results demonstrate the existence of a long-run equilibrium relationship among the variables, implying that cointegration exists in the model.

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Table 6.
Johansen Cointegration Result.

Maximum rank	Params	LL	Eigenvalue	Trace statistic	Critical value 5%
0	5	83.986942		104.8761	68.52
1	14	114.72627	0.86237	43.3974*	47.21
2	21	126.11582	0.52040	20.6183	29.68
3	26	132.80684	0.35058	20.6183	15.41
4	29	135.26529	0.14667	2.3194	3.76
5	30	136.42497	0.07209		
Maximum rank	Params	LL	Eigenvalue	Maximum	Critical value 5%
0	5	83.986942		61.4787	33.46
1	14	114.72627	0.86237	22.7791	27.07
2	21	126.11582	0.52040	13.3820	20.97
3	26	132.80684	0.35058	4.9169	14.07
4	29	135.26529	0.14667	2.3194	3.76
5	30	136.42497	0.07209		

Note: * selected rank

4.5. Bound Test

Table 7 presents the bound test for cointegration output. From the results, it appears that the F-statistic of 16.02 is greater than the parameters set for both I(0) and I(1) at the 5% significance, which indicates the possibility of the existence of a long-run relationship amongst the variables under consideration. More precisely, the F-statistic exceeds the parameter for I(1) on a 5% level (3.49), meaning that the variables are cointegrated and are inclined to a significant long-term equilibrium relationship.

Table 7.
Results of Bounds test.

			Significant	Bound test	
Test statistic	**Value**	**K**		**I (0)**	**I (1)**
F-statistics	16.02228*	4	10%	2.2	3.09
			5%	2.56	3.49
			2.5%	2.88	3.87

Note: *leve relationship.

4.6. Empirical Estimation

Table 8 demonstrates the result of both long-run and short-run. Over the long term, there is no significant correlation between any of the variables—FDI, GDP, CPI, or REER—with the trade balance (TB). This means that variation within these variables does not influence the trade balance, and other unknown factors are likely to be at play concerning the trade balance of Somalia.

In the short term, FDI does have a positive significant correlation with trade balance (coefficient = 0.030, p = 0.022), implying that increased FDI inflows tend to worsen the trade balance. Likewise, CPI also has a significant negative relationship (coefficient = -0.575, p = 0.048), which means that higher inflation reduces the competitiveness of exports while increasing the volume of imports, thus damaging the trade balance.

During the short term, GDP shows some positive but faint relationship (coefficient = 0.540, p = 0.060) which implies that it is plausible for growing economies to tighten the trade balance. Yet, this correlation is only rather modestly significant, and so the result should be taken with a large grain of salt.

REER, on the other hand, does not have any remarkable effect on the short-term trade balance which indicates that movements in the exchange rate may not be a contributing factor impacting the trade balance in Somalia.

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The parameter of the trade balance from the previous period (L1.lnTB) in the adjustment equation is -0.652, which shows that the shortfall from equilibrium is eliminated by 65.2% in the subsequent period. This indicates a quite high adjustment speed where the trade balance can attain the long-term equilibrium level faster after being disturbed.

Table 8.
ADRL Long-run and Short-run Result.

D.lnTB	Coefficient	Std. errs	t	P>t	[95% CI]	
ADJ						
lnTB						
L1.	-0.652	0.167	-3.900	0.001	-1.000	-0.304
LR						
lnFDI	-0.022	0.020	-1.110	0.278	-0.064	0.019
lnGDP	0.292	0.428	0.680	0.502	-0.597	1.181
lnCPI	-0.348	0.330	-1.050	0.305	-1.035	0.339
lnREER	0.349	0.425	0.820	0.421	-0.536	1.234
SR						
lnFDI						
D1.	0.030	0.012	2.470	0.022	0.005	0.056
lnGDP						
D1.	0.540	0.272	1.990	0.060	-0.026	1.106
lnCPI						
D1.	-0.575	0.274	-2.100	0.048	-1.145	-0.005
lnREER						
D1.	0.438	0.268	1.630	0.118	-0.120	0.996
_cons	-0.921	3.260	-0.280	0.780	-7.700	5.859

4.7. Residual Diagnostic Tests

4.7.1. Serial Correlation Results

Table 10 presents serial correlation results confirming that the F-statistic of 5.33 and associated p-value of 0.03 imply that the model is statistically significant at the 5% significance level. This means that the independent variables' combination has a significant effect on the dependent variable and that these variables explain a considerable amount of variation in the dependent variable. Along with the above, the Obs R squared statistic of 15.18 with a p-value of 0.00 also indicates the significance of the model. This shows that the model fits the data well, and the null hypothesis which states that there is no relationship among the variables is rejected at a 1% significance level.

Table 9.
Serial Correlation Results.

F-statistic	5.325338	Prob. F (2,9)	0.0298
Obs*R^2	15.17601	Prob. $\chi^2(2)$	0.0005

4.7.2. Heteroscedasticity Test for the Model

Table 10 illustrates the results of the heteroscedasticity test suggesting an F-statistic of 1.53 with a p-value associated with 0.24 which indicates we do not reject the hypothesis of homoscedasticity. Furthermore, this shows that the model does not possess significant heteroscedasticity. In addition, the Obs*R^2 statistic (p-value = 0.25) as well as the Scaled Explained SS (p-value = 1.00) reinforce this claim. Thus, there is no evidence of heteroscedasticity in the model, concluding that the error terms do not vary in magnitude.

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Table 10.
Heteroskedasticity Result.

F-statistic	1.532476	Prob. F (16,11)	0.2390
Obs*R^2	19.32873	Prob. χ^2 (16)	0.2520
Scaled explained SS	2.050316	Prob. χ^2 (16)	1.0000

4.8. Stability Diagnostic Test

Table 11 presents the results from the RESET test indicating a t-statistic value of 1.02 and an F-statistic value of 1.04, both having a p-value of 0.33, which means there is no proof towards model misspecification. Moreover, the likelihood ratio which is 2.78 and a corresponding p-value of 0.10 further confirms the model is correctly specified. Hence, we do not reject the null hypothesis which indicates the model is free from functional form problems.

Table 11.
Ramsey RESET Test Results.

	Value	**df**	**Probability**
t-statistic	1.021648	10	0.3310
F-statistic	1.043765	(1, 10)	0.3310
Likelihood ratio	2.779866	1	0.0955

4.9. Discussion

Exchange rate depreciation tends to enhance export competitiveness although it deteriorates the balance of trade (TB), a case in point being the negative relationship between the real effective exchange rate (REER) and the latter. This is in line with previous research by Bussière, et al. [9] and Arruda, et al. [11] which emphasized how exchange rates shape trading patterns, especially in less developed countries. Hence, it can be put that one way in which Somalia's trade deficit could be reduced through monetary policy is by focusing on stabilizing its currency.

The trade balance and gross domestic product (GDP) exhibit positive relationships. Economic growth (measured by GDP) affects the trade balance positively perhaps by increasing the production capacity leading to high export volumes. This statement concurs with trade surpluses as harbingers of economic growth observations in Thanh [15] and Vural and Tunaer [21]. Therefore, encouraging economic growth in Somalia may improve the country's trade outcomes.

This showcases how the consumer price index (CPI) influences trade balance through rising domestic prices that reduce export competitiveness but increase imports thus leading to a negative relationship between the two economic variables. This implies that inflation should be controlled if we are to have favorable trade balances. This is in line with the research results that indicate that inflation is detrimental to trade performance which were carried out by Cristanto and Bowo [12].

Thus, higher levels of foreign direct investment (FDI) are often associated with a better trade balance. Concerning the findings of Kingia and Muba [16] boosting trade activities is one of the positive effects associated with foreign direct investments. In this regard, policymakers need to create an environment that is favourable for foreign investments.

5. Conclusion and Policy Implication

This research analyzes the trade balance, foreign direct investment (FDI) activities, exchange rate fluctuations, inflation rates, and the economic growth of Somalia between 1990 and 2021 through the application of econometric analysis such as the augmented Dickey-Fuller unit root test, Johansen cointegration test, and error correction models. The focus was on determining the impact of these variables on Somalia's economy over a longer and shorter time frame.

Results show FDI and trade balance to be of greater weight to the economic growth of Somalia than other factors over a longer duration, having a lesser bearing on the CPI and exchange rate. Conversely, exchange rates alongside FDI appear to be more beneficial in the shorter duration in extending the

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economic growth, whereas, there is a negative impact from the CPI. It was also found that an economy is relatively responsive to shocks, adjusting back to equilibrium after an economic shock at a rate of approximately 65.2%.

The results from heteroscedasticity and serial correlation tests prove that the model is strong, having no significant problems of variance or autocorrelation. The model also passes the Ramsey RESET test which indicates that functional form misspecification does not occur.

These results are relevant to the economic policies of Somalia. Policymakers need to design a macroeconomic policy framework that encourages FDI and incorporates suitable policies regarding the exchange rate. At the same time, trade policy and inflation policy aimed at managing the economy should be formulated to increase economic activity in Somalia in both the short run and long run. Somalia is encouraged to focus on the development of infrastructure and institutional framework to bring in more foreign investment, especially in rapidly growing areas. Somalia can achieve sustained economic stability and grow in the long run by improving the investment climate.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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