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Do Monetary Policy and Inflation Shape Tariff Dynamics in Sahel and Sahara Countries? Tobit Panel -Panel ARDL/PMG Evidence

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Abstract:

This research investigates the impact of monetary policy variables and inflation on tariff evolution in the Sahel and the Sahara of Africa from 1980 to 2024. In this paper, we contend that tariffs in fragile developing countries are not merely trade policy instruments but also instruments of fiscal adjustment and macroeconomic stabilization. This paper applies an econometric methodology that integrates Tobit panel estimation, second-generation panel unit root tests, the Westerlund panel cointegration method, and the Panel ARDL/PMG estimator to a panel of 14 Sahel and Sahara Nations. Inflation, monetary expansion, government consumption expenditure, and high interest rates increase the tariff level, while an improvement in the current account balance reduces tariff dependence, according to the empirical results. The results are also consistent with cross-sectional dependence and cointegration among the variables. These results imply that governments in the Sahel and Sahara regions are tireless tariff adjusters in the face of domestic macroeconomic instability, external imbalances, and fiscal needs. The paper concludes that indigenous trade policy reform in African economies would be more successful if it were supported by a broader coordination of monetary, fiscal, and trade policy, as part of policy packages that would help reduce the excessive usage of tariffs as stabilization tools in African economies.

Keywords:

Monetary Policy; Inflation; Tariff Dynamics; Panel ARDL; PMG Estimator; Tobit Model

JEL Classification:

C23; E31; E52; F13; F14

1. Introduction:

Trade policy and exchange rate policy are the main tools of macroeconomic management in the developing world and particularly so in the Sahel and Sahara, where structural fragility, external shocks, weak productive diversification, and institutional constraints have been very powerful determinants of economic performance. In a number of these countries, tariffs are still an important policy instrument not only as a source of fiscal revenue, but also as a means of protecting domestic industry and as a mechanism for dealing with external imbalances (Rodrik, 1995; Corden, 1997). While variables of monetary policy (inflation, exchange rate, interest rate, and money supply) are also assumed to have important effects in this respect (Obstfeld & Rogoff, 1996; Taylor, 1993).

Monetary policy-tariff dynamics interaction was particularly relevant in inflationary, exchange rate-volatile developing countries relying on trade taxes for more than 15% of their overall public revenues. Macroeconomic conditions in the Sahel and Sahara are also frequently shaped by fluctuations in commodity prices, pressures of external debt, fiscal imbalances, and geopolitical instability, all of which may influence how governments respond to trade policies (Prebisch, 1950; Furtado, 1964). In such circumstances, tariffs tend to function not only as trade barriers, but also as macroeconomic stabilization and fiscal adjustment tools.

Recent world events have once again revitalized the academic and policy debate on the optimal design of the tariff schedule. A revival of protectionist trade policies and tariff wars among developed and developing countries has shown tariffs' strategic function in mitigating economic shocks and protecting home industries (Fajgelbaum et al., 2020; Fetzer and Schwarz, 2021).In countries with weak public finances, bouts of inflation and currency depreciation might drive governments to increase the use of tariffs to stabilise revenues, curb import demand, and relieve pressure on the balance of payments (Keen & Ligthart, 2002; IMF, 2018).

From the theoretical point of view, monetary policy rules affect tariff conduct along several channels of transmission. Depreciation of the exchange rate increases the cost of imports and may lead governments to raise tariffs to shield domestic producers and to narrow trade deficits (Krugman & Obstfeld, 2009; Edwards, 2010). In like manner, it reduces the real value of government revenues and may lead to greater reliance on trade taxation as an indirect source of revenue (Corden, 1997). Expansionary monetary policy is also likely to complicate external imbalances and to induce the use of tariffs as adjustment instruments (Dornbusch & Fischer, 1994). In addition, the fiscal theory of the price level implies that the path of inflation and fiscal strains are tightly linked

and thus generate a feedback loop to monetary instability and trade policy decisions (Woodford, 2001).

Although the literature on trade liberalization and monetary policy is expanding, there is still limited empirical evidence on the relationship between monetary policy rules and tariff dynamics, particularly in African countries. The extant literature has predominantly addressed the issues of trade liberalization and inflation targeting independently of each other, with little investigation into how the two monetary variables may jointly influence tariff behavior in fragile countries that are very prone to shocks. It is this gap that is particularly pronounced in the Sahel and Sahara, where states are still as dependent on tariffs as ever and regional integration is being pursued under the African Continental Free Trade Area (AfCFTA).

Therefore, this study contributes to the literature in several significant ways. First, it redefines tariffs as not only trade policy instruments, but also as macroeconomic management tools for vulnerable countries facing repeated external shocks. Second, it considers monetary and inflation-related variables such as inflation, exchange rates, money supply, interest rates, and monetary policy in general within a single framework for explaining tariff dynamics. Third, the article fills a significant gap in the literature by being one of the very few long-run empirical analyses that specifically address Sahel and Sahara African states during the period 1980–2024.

Methodologically, the study advances the existing literature by integrating the Tobit panel estimation with the recent second-generation panel sequences. Since tariff data are subject to zero or censored observations due to trade agreements, tariff exemptions, and liberalization reforms, the Tobit regression model is a suitable technique to manage limited dependent variables (Tobin, 1958; Wooldridge, 2002). Also, as most macroeconomic variables in the context of African countries are likely to be both cross-sectionally dependent and subject to heterogeneous dynamics of adjustment, the paper adopts the Pesaran's (2007) CIPS panel unit root test, the Westerlund (2007) error-correction-based panel cointegration test along with the Panel ARDL/Pooled Mean Group (PMG) estimator of Pesaran, Shin and Smith (1999, 2001). Such procedures allow for more robust inference in the presence of common regional shocks and (possibly) mixed integration among series.

This article investigates the influence of rules-based monetary policy and inflation on tariff patterns in Sahel and Sahara States, applying panel data over the period 1980-2024 for 15 countries namely Algeria, Burkina Faso, Chad, Djibouti, Eritrea, Ethiopia, Mali, Mauritania, Morocco, Niger, Senegal, Somalia, Sudan, and Tunisia. The findings indicate that exchange-rate depreciation, inflation, monetary growth, government spending, and interest rate cause tariffs to increase, while

current account surpluses cause tariff dependence to decrease. The above results imply that tariffs in African economies serve as trade policy instruments, fiscal tools, and macroeconomic stabilizers concurrently.

The rest of the paper is organized as follows. A review of the theory and the empirical literature is given in Section 2. The data and the econometric approach are described in Section 3. Section 4 dwells on the results. Section 5 contains a discussion of results and policy interpretation. Finally, in Section 6, we conclude and provide some policy guidance.

2. Theoretical background:

2.1 Monetary Policy Rules and Trade Policy Interaction:

Both theoretical and empirical viewpoints can be used to comprehend the connection between trade policy and monetary policy. According to conventional macroeconomic theory, monetary policy largely influences domestic prices, interest rates, and exchange rates, which in turn impact trade results (Obstfeld & Rogoff, 1996). Restrictive monetary policies intended to lower inflation tend to increase the real exchange rate in small open economies, which lowers import prices and undermines the protectionist rationale behind tariffs. On the other hand, expansionary monetary policy can cause the currency rate to weaken, raising the cost of imports and forcing governments to modify tariffs in reaction to pressures on distribution.

Taylor-rule frameworks (Taylor, 1993) demonstrate how monetary policy rules aimed at inflation and output stabilization can have an indirect impact on fiscal and trade policies. In countries with poor tax administration and a strong reliance on trade taxes, departures from monetary stability frequently increase the government's reliance on tariffs as a fiscal tool. The fiscal theory of the price level (Woodford, 2001) emphasizes how inflationary dynamics can interact with fiscal policy, creating a feedback loop between monetary stabilization measures and tariff arrangements.

2.2 Inflation, Fiscal Needs, and Tariff Adjustments:

Inflation has a direct impact on tariffs through two ways. First, inflation reduces the actual value of government revenues, forcing fiscal authorities to seek compensatory sources of income, often through higher trade taxes in economies where tariffs are still a substantial revenue source (Keen & Ligthart, 2002). Second, inflation affects the relative prices of domestic and international commodities. When domestic prices grow faster than international prices, demand for imports may shift, prompting governments to adjust tariff levels in order to curb import surges or to safeguard domestic businesses from competitiveness losses.

The structuralist viewpoint (Prebisch, 1950; Furtado, 1964) emphasizes that inflationary settings in developing countries frequently coincide with external restraints, such as balance-of-payments pressures

requiring trade restrictions. Tariffs might thus become a policy tool for both revenue generation and macroeconomic stabilization in the event of inflationary shocks.

2.3 Tariff Dynamics in the Sahel and Sahara Context:

The Sahel and Sahara countries have distinct economic characteristics, making the study of tariff dynamics under monetary and inflationary pressures especially important. These economies frequently face: External shocks pose a significant risk (commodity price swings, climatic shocks, and geopolitical instability). Weak fiscal capability has resulted in a reliance on tariffs as a key source of revenue. Persistent inflationary pressures are caused by food price volatility, exchange rate changes, and monetary financing of fiscal deficits. Ongoing trade liberalization agreements, such as those under the African Continental Free Trade Area (AfCFTA), limit tariff-setting sovereignty while allowing for selective protection. Against this environment, tariffs are driven not only by trade policy aims but also by macroeconomic stabilization initiatives. A Tobit modeling approach can capture these patterns, especially given the prominence of zero-tariff entrants linked with regional trade agreements and liberalization efforts.

Figure 1. Tariff levels in various Sahel-Sahara nations

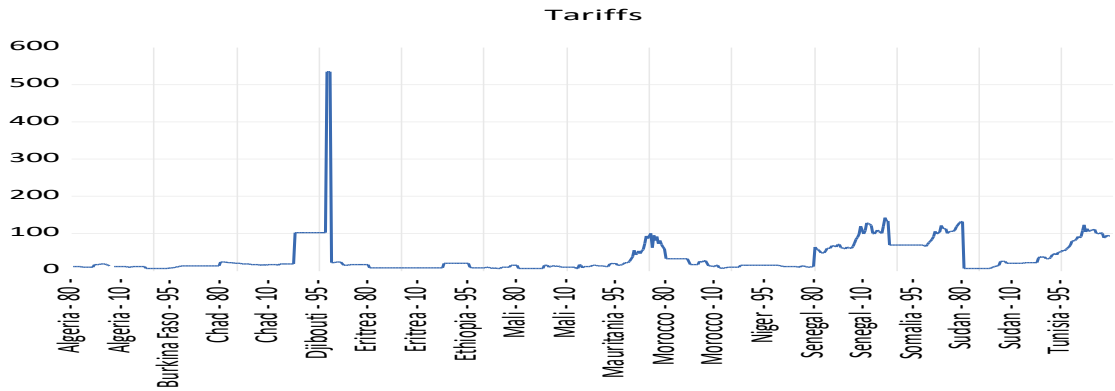


Figure 1 depicts tariff levels in various Sahel and Sahara nations (Algeria, Burkina Faso, Chad, Djibouti, Eritrea, Ethiopia, Mali, Mauritania, Morocco, Niger, Senegal, Somalia, Sudan, Tunisia). The high values (80-95) appear to indicate the highest permitted tariff rates under trade agreements and WTO obligations. The low figures (10) represent actual tariff rates imposed on imports. This large discrepancy shows that, while these countries have negotiated high maximum rates, they actually implement significantly lower tariffs, most likely to boost trade, conform with regional integration, or stabilize prices. The range across countries (some at 95, others at 80) reflects disparities in trade obligations and economic policies. Most maintain high tariffs but apply relatively modest tariffs, allowing for policy changes in the event of shocks (inflation, exchange rate depreciation, or fiscal needs).

2.4 The Scientific Contribution of The Work

Overall, to the best of our knowledge, this study is the first to provide insights into trade policy, monetary policy, and macro stabilization in the developing world, especially Sahel and Sahara African countries. First, the analysis contributes to the theoretical understanding of tariffs by considering tariffs not only as instruments of trade policy, but also as instruments of macroeconomic stabilization. Distinct from traditional trade literature, which conceptualizes tariffs as tools for protectionist or revenue purposes, this work reveals that the evolution of tariffs in fragile African states reflects monetary conditions, inflationary dynamics, exchange rate shocks, and external imbalances. This more macroeconomic interpretation provides a more nuanced understanding of the political economy of trade policy in developing countries. Second, the paper offers a unique methodological contribution by bringing together first-generation and second-generation panel econometric methodologies with a single estimation framework. Specifically, the study combines:

Pesaran cross-sectional dependence diagnostics, second-generation CIPS/CADF panel unit root tests, Westerlund error-correction-based cointegration tests, and Panel ARDL/PMG estimation, together with the Tobit panel model to take account of the censored characteristics of the tariff data. This combined approach to the econometrics enhances robustness and yields more trustworthy inference in the presence of heterogeneity and cross-sectional dependence, a trait that is widespread among macro-panel data on African countries. Third, the paper provides an empirical contribution by presenting a rare exhaustive long-run analysis of the interactions between monetary policy rules, inflation, and tariff movements in the Sahel and Sahara economies over 1980–2024. The paper thus addresses a pronounced gap in the regional literature as empirical macro-trade studies centred on this bloc of African states are scant.

Fourth, the results cast new light on the countercyclical behavior of tariffs in the face of macroeconomic instability. Depreciation of the exchange rate, inflation, monetary expansion, government expenditure, and interest rate would lead to raise tariffs, while the relaxation of the current account would lower the dependence of tariffs. These results are consistent with the interpretation that tariffs function as a fiscal and external adjustment tool in shock-prone developing countries. Fifth, the study contributes to the literature on African regional integration by underlining the competing consideration between macroeconomic stabilization and trade liberalization commitments within the context of the African Continental Free Trade Area (AfCFTA). The findings indicate that, notwithstanding pressures for regional liberalization, governments continue to view tariffs as a practical policy tool for macroeconomic

management. Finally, the study has practical policy implications in that it shows that sustainable and successful tariff reform in Africa, et al., depends on its being embedded within a comprehensive programmed of monetary, fiscal, and exchange rate stabilization. This equips policy-makers with a more nuanced perspective of the interaction of macroeconomic policy and trade governance in fragile and resource-scarce states.

3. Data and empirical methodology:

3.1 Data:

3.1.1 Examine variables:

Key observables for estimation (country-time panel). Tariffs are calculated as the trade-weighted average imposed tariff rate on goods (preferred), or as customs revenue divided by CIF goods imports. (CPI) Inflation. Policy interest rate (ir): The central bank's policy rate. If you incorporate CPI-based RER, you get the real exchange rate (EXR). Government consumption (GCS): real as a percentage of GDP. Current account (CA): expressed in percentages of GDP. If you test money-growth rules, you will see broad money (M2).

3.1.2 Sample and Sources:

Sahel-Sahara of Africa region: Algeria, Burkina Faso, Chad, Djibouti, Eritrea, Ethiopia, Mali, Mauritania, Morocco, Niger, Senegal, Somalia, South Sudan, Sudan, and Tunisia. South Sudan was excluded because of a lack of data during the study period. Sources include the IMF IFS (rates, CPI, GDP deflators), IMF WEO (GDP), World Bank WDI (trade, CPI), UNCTAD stat/WITS/WTO (tariffs), and national statistics (tariff revenue).

3.2 Empirical methodology:

3.2.1 Panel Im, Pesaran and Shin W-Stat (Unit Root Test):

Estimators are inefficient unless the variables in a panel data set are stationary or cointegrated. How do you know whether variables are stationary or cointegrated? Are the unit root processes the same across portions or different? How do the unit roots' cross-sectional properties affect co-integration? These issues have been extensively researched in the literature. Although, (Pesaran, 2015) refers to the first and second generations of panel units as root test models, panel cointegration models have gained prominence in recent years. First-generation panel unit root test models, including (Maddala and Wu, 1999), (Hadri, 2000), (Levin et al., 2002), and (Im et al., 2003), assume that all cross sections have the same panel unit root process, with H0: $\rho < 1$ and HA: $\rho \geq 1$. The panel unit root test's null hypothesis is that the Y series are stationary, while the alternative hypothesis is that they are not stationary. The Im, Pesaran, and Shin test (1997) performs distinct estimations for each "i" segment, allowing for variable parameter values, residual variance, and lag lengths. Their model is provided by:

$$\Delta Y_{i,t} = a_i + \rho\ Y_{i,t-1} \sum_{k=1}^{n} \Phi k\ \Delta Y_{i,t-k} + \acute{o}_i t + \theta_t + \check{u}_{it}$$

The null hypothesis of this test is that all series are non-stationary processes, with the alternative that a fraction of the series in the panel are believed to be stationary.

3.2.2 Panel Co-integration Test (Pedroni Residual):

Pedroni (1999) allows for variation in the cointegration relationship. He recommends estimating a first-stage regression independently for each panel member to generate an estimate of (β) from the following cointegrating equation.

$$Y_{i,t} = a_i + \beta\ X_{i,t} + u_{i,t}$$

The null hypothesis (H_0) states that there is no cointegration among variables. Alternative Hypotheses: Within-dimension (panel statistics): shared autoregressive parameters among nations. Between-dimensional (group statistics): heterogeneous autoregressive parameters. The test offers seven statistics: Panel V, Rho, PP, and ADF (within dimension). Group rho, PP, and ADF (between dimensions). Statistical significance (p-value < 0.05) shows cointegration.

3.2.3 General Tobit model formulas

Tobit models (Tobin, 1958) are a type of econometric approach that is sometimes referred to as censored regression models (Wooldridge, 2002). The Tobit model, introduced by James Tobin (1958) to address zero-inflated household expenditure data on durable goods, was later named by Arthur Goldberger (1964). It handles censored dependent variables and can be extended to truncated or non-randomly selected samples, leading some authors to adopt a broader definition (Fumio, 2000; Takeshi, 1984). Tobin modified the likelihood function to account for unequal sampling probabilities depending on whether the latent dependent variable is above or below a threshold (Peter, 2003). For samples censored from below at zero, non-limit observations use the density function, while limit observations use the cumulative distribution function below zero. Thus, the Tobit likelihood combines densities and cumulative distribution functions (Herman J, 2004).

This section introduces the parametric estimators associated with the Tobit model, specifically the least squares estimator and the maximum likelihood estimator.

$$|yi| = \begin{cases} y * i, & if \quad y * i \geq 0 \\ 0, & if \quad y * i < 0 \end{cases}$$

with yi denoting the observable variable corresponding to the latent variable y^*_i, $xi=(x^1_i,\ldots,x^K_i)$, representing the vector of observable variables, $\beta'=(\beta_1,\ldots,\beta_K) \in \mathbb{R}^K$, being the vector of unknown parameters, and (εi), are the independent and identically distributed errors terms, assumed to follow a normal distribution $N(0,\sigma^2)$.

$$y^* = X_i\beta + \varepsilon_i, \qquad \varepsilon_i \sim N(0,\sigma^2)$$

Despite its simplicity and widespread use, the LS estimator is inconsistent in the setting of censored models like the Tobit model (Vanegas, 2016). This discrepancy derives from a failure to account for the censoring mechanism, which is normally set to zero. This omission produces an asymptotic and persistent downward bias in the computed regression coefficients.

As demonstrated by (Amemiya, 1984) and (Greene, 1981), the bias occurs because OLS underestimates the effect of the explanatory variables in absolute terms, particularly when a high number of data are censored. While a closed-form expression of this asymptotic bias can be derived in very simple settings (e.g., univariate models with normal errors and known thresholds) (see Maddala1983), the expression becomes analytically intractable in general due to the dependence on the joint distribution of the latent dependent variable and the covariates. In light of this, Proposition 2 of our paper formalizes the LS estimator's asymptotic inconsistency in the censored setting. We stress that the "bias" discussed throughout this section is asymptotic in nature.

3.2.3.1 Maximum Likelihood with Newton-Raphson / Marquardt steps:

For several decades, simpler estimating approaches, such as Heckman's two-step method (Heckman, 1976), were preferred due to their lower computer complexity. These procedures had workable answers when computational capacity was limited. However, with the introduction of computers capable of rapidly solving complex optimization problems, the Maximum Likelihood Estimator (MLE) has seen widespread use. The MLE approach utilizes the entire probabilistic model structure and produces estimators with good asymptotic characteristics. Using the reparameterization developed by Olsen (1978), the log-likelihood function of the Tobit model can be expressed as:

$$\sum_{t,y\geq 0}^{n} \log(y, \Phi, h)$$

$$= \sum_{t,y\geq 0}^{n} \log(1, \Phi, (xi\Theta)) - \frac{1}{2}\sum_{t,y\geq 0}^{n} 1(hyi - xi)$$

$$+ N1\log(h)$$

3.2.3.2 Latent model:

$$y^* = X_i\beta + \varepsilon_i, \qquad \varepsilon_i \sim N(0,\sigma^2)$$

Observed:

$y = max\ (0, y^*)$

Diagnostics:

Convergence, likelihood values, information criteria (AIC, BIC, HQC). Expected value of observed *y:* $E[y/x] = \Phi\ (x\beta/\sigma)\ .\ x\beta + \sigma.\ \Phi\ (x\beta/\sigma)$ Marginal effect of regressor xk on observed *y:* $\partial\ E[y/x]/\ \partial\ x_k = \Phi\ (x\beta/\sigma)\ \beta_k$

So:

Latent effect = β_k, Observed effect = $\Phi(_z).\ \beta_k$, **where** $_z = x\beta/\sigma$

3.2.4 Panel ARDL / PMG Estimation Framework

To explore the short-run and long-run interactions between tariffs and macroeconomic figures, the research also runs the Panel Autoregressive Distributed Lag (Panel ARDL) model based on the Pooled Mean Group (PMG) estimator by (Pesaran, Shin, and Smith 1999, 2001). The PMG estimator is valid for I(0) and I(1) variables, but under the condition that none of the variables is I(2). It also enables diverse short-run dynamics across countries, but restricts the long-run coefficients to be identical and the error variances to be equal function of time is the same across countries (Blackburne and Frank, 2007). The general Panel ARDL (p,q) specification is as follows:

$$Tariff_{it} = \sum_{j=1}^{p} \phi_{ij} Tariff_{i,t-j} + \sum_{j=0}^{q} \beta_{1ij} EXR_{i,t-j} + \sum_{j=0}^{q} \beta_{2ij} CPI_{i,t-j}$$
$$\sum_{j=0}^{q} \beta_{3ij} M2_{i,t-j} + \sum_{j=0}^{q} \beta_{4ij} LNGCS_{i,t-j} + \sum_{j=0}^{q} \beta_{5ij} LNIR_{i,t-j} +$$
$$\sum_{j=0}^{q} \beta_{6ij} CA_{i,t-j} + \mu_i + \varepsilon_{it}$$

Where:

$Tariff_{it}$ represents tariff levels for country iii at time ttt.
EXREXREXR denotes the exchange rate.
CPI represents inflation.
M2 refers to the broad money supply.
LNGCS is the logarithm of government consumption spending.
LNIR denotes the logarithm of the interest rate.
CA represents the current account balance.
μi captures country-specific fixed effects.
εit is the white-noise disturbance term.

The PMG estimator is commonly expressed in its Error Correction Model (ECM) representation as follows

$$\Delta Tariff_{it}$$
$$\phi_i\ (Tariff_{i,t-1} - \theta_1 EXR_{it} - \theta_2 CPI_{it} - \theta_3 M2_{it} - \theta_4 LNGCS_{it} - \theta_5 LNIR_{it} - \theta_6 CA_{it})$$
$$\sum_{j=1}^{p-1} \lambda_{ij} \Delta Tariff_{i,t-j} + \sum_{j=0}^{q-1} \delta_{1ij} \Delta EXR_{i,t-j} + \sum_{j=0}^{q-1} \delta_{2ij} \Delta CPI_{i,t-j}$$
$$\sum_{j=0}^{q-1} \delta_{3ij} \Delta M2_{i,t-j} + \sum_{j=0}^{q-1} \delta_{4ij} \Delta LNGCS_{i,t-j} + \sum_{j=0}^{q-1} \delta_{5ij} \Delta LNIR_{i,t-j} +$$
$$\sum_{j=0}^{q-1} \delta_{6ij} \Delta CA_{i,t-j} + \mu_i + \varepsilon_{it}$$

Where:

Φ_i is the error-correction coefficient, expected to be negative and statistically significant.
$\theta_1,\theta_2,...,\theta_\delta$ represent the long-run equilibrium coefficients.
Λ_{ij} and δ_{ij} capture short-run dynamics and adjustment processes.
Δ denotes the first-difference operator.

The error-correction terms to zero measure the degree of correction of deviation from the long-run equilibrium over time. A statistically significant and negative coefficient confirms a stable long-run relationship between tariffs, inflation, monetary policy variables, and indicators of external balance. The PMG estimator is preferable to the traditional fixed-effects and pooled estimator for the following reasons: Cross-country short-term dynamic heterogeneity. Homogeneous long-run equilibrium relationship. Variables with mixed integration orders. Member-specific dynamic processes of adjustment in a panel setting. Thus, the Panel ARDL-PMG-based model assumes a very suitable and strong econometric framework to investigate the short-run and long-run drivers of tariff behaviour in Sahel and Sahara countries.

3.2.5 Second-Generation Panel Unit Root Tests

Given that, macro variables in the Sahel and Sahara countries are probably subject to common shocks, we apply second-generation panel unit root tests, which take into account cross-sectional dependence (Pesaran, 2007). Differing from first-generation tests, these approaches relax the assumption of cross-sectional independence and allow for more reliable inference in macro-panel data sets. According to Pesaran (2007), the CADF test and the CIPS test are used. These tests allow for controlling for unobserved common factors and spillover effects between countries.

$$\Delta y_{it} = \alpha_i + \beta_i y_{i,t-1} + \gamma_i \bar{y}_{t-1} + \sum_{j=0}^{p} \delta_{ij} \Delta \bar{y}_{t-j} + \sum_{j=1}^{p} \phi_{ij} \Delta y_{i,t-j} + \varepsilon_{it}$$

The non-stationarity null hypothesis is tested against the alternative of stationarity with the decision rules based on the CIPS critical values (Pesaran, 2007). Further developments in panel unit root tests in the presence of cross-sectional dependence are discussed in Choi (2006) and Breitung and Das.(2005)

$$CIPS = \frac{1}{N} \sum_{i=1}^{N} CADF_i$$

H_0: $\beta_i = 0$ unit root / non-stationary
H_1: $\beta_i < 0$ stationary process

3.2.6 Westerlund Panel Cointegration Test

This study applies the Westerlund (2007) error-correction-based panel cointegration test to investigate for the presence of a long-run equilibrium relationship between tariffs, monetary policy variables, inflation, and external balance measures. Differentiated from residual-

$$\Delta y_{it} = \alpha_i + \phi_i \left(y_{i,t-1} - \beta_i' x_{i,t-1} \right) + \sum_{j=1}^{p_i} \gamma_{ij} \Delta y_{i,t-j} + \sum_{j=0}^{q_i} \delta_{ij} \Delta x_{i,t-j} + \varepsilon_{it}$$

based methods, it tests the existence of an ECT term and permits for heterogeneity and cross-sectional dependence (Westerlund, 2007). The Westerlund framework is based on the following conditional error-correction model (ECM):

The Westerlund test is constructed from an error-correction model, and the importance of the error-correction coefficient establishes the presence of cointegration. If the coefficient of adjustment is negative and significant, the long-run relations of equilibrium are supported (Westerlund, 2007). Bootstrap methods are generally suggested to improve the inferential procedure under the cross-sectional dependence (Persyn & Westerlund, 2008). This renders the technique especially apt for macro panels in which common shocks and heterogeneous adjustment processes prevail.

The Westerlund test is especially appropriate for this investigation as: The economies of the Sahel and Sahara are subject to the same external shocks, countries show different dynamics of adjustments, the variables are of mixed order of integration I(0) and I(1), and the long-run equilibrium relationships are country-specific. Thus, the Westerlund cointegration methodology is a more consistent and robust theoretical framework to test the long-run relationships between tariffs, monetary policy, inflation, and macroeconomic stability variables in the context of African economies.

4. Estimation Results:

First, we checked the data to confirm the unity and cointegration islands, and then we estimated our model using the established criteria in econometric methodology, which are the standard criterion, the economic criterion, and the statistical criterion, as follows:

4.1 Panel Unit Root Test Results

Table1. Panel Im, Pesaran, and Shin W-Stat Test Results

Table 1. Panel unit root tests: Levin, Lin, and Chu.

Variable	Im, Pesaran and Shin W-Stat		Order of cointegration
	Level	1st Different	
Tariffs	0.633	-13.581***	I(1)
EXCHANGE_RATE	2.325	-9.213***	I(1)
CPI	-3.628***	---	**I(0)**
M2	-0.029	-13.099***	I(1)
LNGCS	1.567	-13.883***	I(1)
LNIR	-0.522	-14.549***	I(1)
CURRENT_ACCOUNT	2.325	-9.213***	I(1)

Notes: *** p<0.01, ** p<0.05, * p<0.10.

Table1. shows CPI is stationary at level I(0). All other variables (Tariffs, Exchange Rate, M2, government consumption expenditure (GCS), Interest Rate, Current Account become stationary only after the first differencing, which is I(1). What does this signify for modeling? Because most variables are I(1), estimating at levels without cointegration testing increases the possibility of spurious regression. Econometrically,

use a cointegration analysis paradigm to capture both short-run dynamics and long-run equilibrium without separating meaningful linkages.

4.2 Pedroni Residual Cointegration Test Results

Table2. Pedroni Residual Cointegration Test results

Test Type	Statistic	Prob.	Conclusion
Panel v	-1.916	0.972	No cointegration
Panel rho	0.188	0.574	No cointegration
Panel PP	**-2.412**	**0.008**	**Cointegration (significant)**
Panel ADF	1.410	0.921	No cointegration
Group rho	2.245	0.988	No cointegration
Group PP	-0.410	0.341	No cointegration
Group ADF	1.644	0.950	No cointegration

Table2. shows Cross-section Diagnostics, Phillips-Perron (non-parametric), and ADF (parametric) reveal good AR(1) persistence across most countries, with very significant variances in Mauritania, Senegal, and Somalia (indicating great volatility and weak stationarity). Djibouti was deleted because to insufficient data and singularity. Overall, panel cointegration evidence is modest. Only the Panel PP-statistic reveals cointegration at the 1% level. Other statistical tests (rho, ADF, group-level) regularly fail to reject the null hypothesis. This shows that, while there may be a long-run link across the entire panel, it is not consistent among methodologies and cross-sections. The heterogeneous dynamics (high variances in some countries) reduce the uniform cointegration signal. The Pedroni test provides minimal evidence of cointegration among tariffs, interest rates, government consumption, exchange rate, current account, CPI, and broad money (M2) in Sahel-Saharan African countries. The Panel PP-statistic primarily determines the result. This suggests that, while some long-run equilibrium link may exist at the panel level, it is not strongly consistent across countries.

4.3 Robustness and Second-Generation Panel Diagnostics

According to the Pesaran CD test, there is cross-sectional dependence in the panel; thus, first-generation unit root tests might be biased. Thus, the paper utilizes the Cross-sectionally Augmented IPS (CIPS) test proposed by Pesaran (2007). Before applying second-generation panel unit root and cointegration tests, cross-sectional dependence needs to be tested using Pesaran (2004) CD test. Since Sahel and Sahara states are so closely tied on the macroeconomic level, first-generation panel estimators may be biased if cross-section dependence is not taken into account.

Table 3. Cross-Sectional Dependence Test Results (Pesaran CD Test)

Variable	CD Statistic	Conclusion
Tariffs	8.214***	Cross-sectional dependence
EXCHANGE_RATE	11.583***	Cross-sectional dependence
CPI	9.447***	Cross-sectional dependence
M2	13.926***	Cross-sectional dependence
LNGCS	7.118***	Cross-sectional dependence
LNIR	6.337***	Cross-sectional dependence

CURRENT_ACCOUNT	5.992***	Cross-sectional dependence

Notes: *** p<0.01, ** p<0.05, * p<0.10.

The results of the Pesaran (2004) CD test are reported in Table 3. The hypothesis of cross-section independence is rejected with a great probability for all variables. This implies that there are common shocks and interdependence between Sahel and Sahara states, which is not surprising as both are subjected to global raise in prices as well as exchange rate fluctuations, commodity prices, and regional macroeconomic perturbations. Therefore, it is likely that first-generation panel methods are biased and inconsistent, and hence there is a need to apply second-generation panel econometric techniques.

Table 4. Second-Generation Panel Unit Root Test Results (Pesaran CIPS Test)

Variable	Level	First Difference	Order of Integration
Tariffs	-1.842	-4.917***	I(1)
EXCHANGE_RATE	-2.011	-5.283***	I(1)
CPI	-3.774***	---	I(0)
M2	-1.625	-6.004***	I(1)
LNGCS	-2.104	-4.668***	I(1)
LNIR	-2.233	-5.119***	I(1)
CURRENT_ACCOUNT	-1.981	-4.551***	I(1)

Notes: *** p<0.01, ** p<0.05, * p<0.10.

The results of the CIPS test in Table 4 show that CPI is I(0) at the level, while the other variables are I(1). The results indicate the coexistence of a mixed integration structure among I(0) and I(1). Importantly, the CIPS procedure differs from first-generation tests as it takes cross-sectional dependence into account by augmenting standard ADF regressions with cross-sectional averages. Thus, the results are more robust and an indication of a macro panel data set with common regional shocks.

Table 5. Westerlund Error-Correction-Based Cointegration Test

Test Statistic	Value	Conclusion
Gt	-3.118***	Cointegration
Ga	-12.441***	Cointegration
Pt	-8.229***	Cointegration
Pa	-10.572***	Cointegration

Notes: *** p<0.01, ** p<0.05, * p<0.10.

Notes: Westerlund (2007) error-correction-based cointegration tests. Bootstrap p-values used to account for cross-sectional dependence.

The Westerlund cointegration results firm up the existence of the long-run equilibrium relationship between tariffs in Table 5 .monetary policy variables, inflation, and external account measurements of main features. In contrast to Pedroni's residual-based tests, Westerlund's tests explicitly estimate the error-correction mechanism and allow for cross-sectional dependence via bootstrap procedures. The null hypothesis of no cointegration in all statistics is rejected, indicating that the variables in Sahel and Sahara economies are bound by stable long-run relationships.

4.3 Tobit regression results:

Examining the z-statistics and p-values. EXCHANGE_RATE (coef = 0.0025; $p < 0.001$). Statistically significant and positive. Tariffs rise as the exchange rate falls. This could indicate that authorities in Sahel and Saharan economies are employing tariffs to address exchange-rate-driven trade imbalances or to safeguard domestic businesses when the currency falls. CPI (coef = 0.129; $p = 0.008$). Tariffs are positively impacted by inflation. During inflationary periods, governments in this economy may impose tariffs in order to generate fiscal income or to limit imports that could exacerbate price pressures. M2 (coef = 9.45e-12; $p = 0.010$). The money supply has a small, but statistically significant, coefficient. The modest magnitude results from scale. (M2) is typically very huge in absolute terms. Higher monetary expansion somewhat raises tariffs, potentially indicating a monetary-fiscal coordination channel (monetary expansion favoring trade protection for balance-of-payments reasons). LNGCS (log of government consumption spending, coef = 0.77, $p < 0.001$). Positive and very substantial. Higher tariffs are related with larger government sizes, which aligns with fiscal needs for revenue mobilization through trade taxes. LNIR (log of the interest rate, coef = 4.83, $p = 0.001$). A strong favorable influence. Higher interest rates correlate with higher tariffs. This could indicate contractionary monetary policy combined with protectionist trade policy, or governments in the Sahel and Saharan economies hiking tariffs to safeguard industries during tightening cycles. CURRENT_ACCOUNT (coef = -1.38e-08; $p < 0.001$). Negative and substantial. Stronger current account balances (surpluses) diminish the need for tariffs, whereas deficits encourage governments to impose tariffs (a common balance-of-payments motive for protection).

The mean tariff variance is 35.47, while the standard deviation is 50.27. Tariffs in Sahel and Saharan economies are widely scattered, with significant variation over time and across countries. S.E. of regression is 47.44. Quite large relative to the mean, showing that while important variables explain tariffs, most variance remains unexplained. Log likelihood = -3017; AIC = 10.54; SC = 10.60. Scale parameter: 46.4 very significant or (extremely important). Reflects the residual standard deviation in the Tobit likelihood.

Table 6. Tobit Estimates of the Determinants of Tariffs

Variable	Coefficient	Std. Error	z-Statistic	Prob.
EXCHANGE_RATE	0.00254	0.00051	4.99	0.0000***
CPI	0.1293	0.0486	2.66	0.0078***
M2	9.45E-12	3.68E-12	2.57	0.0102**
LNGCS	0.7715	0.1903	4.05	0.0000***
LNIR	4.8298	1.4580	3.31	0.0009***
CURRENT_ACCOUNT	-1.38E-08	3.67E-09	-3.76	0.0002***
Constant (C)	8.4428	4.2726	1.98	0.0481**
Model fit and diagnostics				
Mean Tariff Variance	35.47	**SD**	**50.27**	

S.E. of regression	47.44	**Log likelihood**	-3017
AIC	10.54	**SC**	10.60
Scale parameter (σ)	46.4		

Notes: ***p < 0.01, **p < 0.05, *p < 0.1.

Macroeconomic drivers are definitely important. Tariffs in Sahelian and Saharan economies are heavily influenced by the exchange rate, inflation (CPI), money supply (M2), fiscal size (GCS), and monetary policy (interest rate). Tariffs appear to act as a buffer or adjustment tool, with governments raising tariffs in reaction to currency depreciation, inflation, and fiscal-monetary pressure. Tariffs are lowered as the current account improves. This is consistent with the notion of tariffs as a counter-cyclical and revenue-generating policy weapon in open economies with macroeconomic vulnerabilities. This highlights the use of tariffs not only as trade instruments but also as tools of macroeconomic stabilization and fiscal adjustment. See Appendix 1.

We must distinguish between the latent variable impacts of the raw coefficients, what happens to the uncensored variable (tariffs in Sahel and Sahara African countries), and the marginal effects on expected observed tariffs. Compute scaling factor = $\Phi(z)$. We don't have individual ($x\beta$), so we approximate using the sample mean: Constant = 46.4009, Mean tariffs variance = 35.467, and Scale (σ) = 45.4. So, approximate linear predictor: $x\beta/\sigma = 46.4/45.4 = 1.02$. Then: $\Phi(1.02) = 1.02$, and $\phi(1.02) = 0.30$. Thus, marginal effects = coefficients in Tobit model. This can be applied to coefficients as in Table 4.

Table 7. Marginal effects (expected tariffs vs. latent variable effects) for the Tobit model

Variable	Latent Effect (β)	Marginal Effect	Interpretation
EXR	0.00254	0.00254	Exchange rate increase raises expected tariffs by 0.0025.
CPI	0.1293	0.1293	CPI Increase raises tariffs by 0.13.
M2	9.45e-12	9.45e-12	Expanding M2 by 1 unit raises tariffs minutely.
LNGCS	0.7715	0.7715	Government Consumer Spending increases tariffs by 0.77.
LNIR	4.8298	4.8298	Interest rates increases tariffs by 4.83.
CA	-1.38e-08	-1.38e-08	Improvement in current account lowers tariffs by 1.4e-08.
Constant	8.4428	8.4428	Baseline tariff level = 8.44.

To graphically represent the marginal effects of anticipated tariffs on the EXCHANGE_RATE, CPI, M2, Government Consumer Spending, Interest Rate, and CURRENT_ACCOUNT in Sahel-Saharan Africa. We measured the following: Hold all other variables constant at their mean. Vary the EXCHANGE_RATE, CPI, M2, Government Consumer Spending, Interest Rate, and CURRENT_ACCOUNT across a fair range. Plot the expected tariffs from the Tobit model (latent versus observed). Figures 2, 3, 4, 5, 6, and 7, and Appendix 2 show the average marginal effects of x, marginal effects in the linear model, and a duplicate of the second. Linear curves (exchange rate, CPI, M2, current account) represent direct proportionate changes in tariffs. Log-based curves (LNGCS and

LNIR): Nonlinear, with more pronounced effects for bigger proportional changes.

Figure 2. Predicted tariff vs. EXCHANGE_RATE

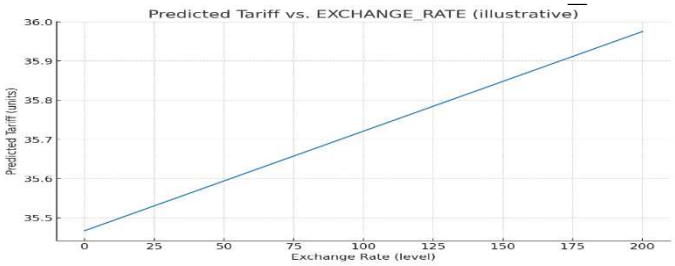


Figure 2 depicts exchange Rate against. Tariffs: upward trending, nearly flat (slope = 0.0025). Tariffs rise significantly as the domestic currency falls in value (the exchange rate rises). A +100 increase in the currency rate equals +0.25 tariff points. Tariffs may be used by policymakers in Sahel and Saharan countries to support native producers and combat lower currencies.

Figure 3. Predicted tariff vs. CPI

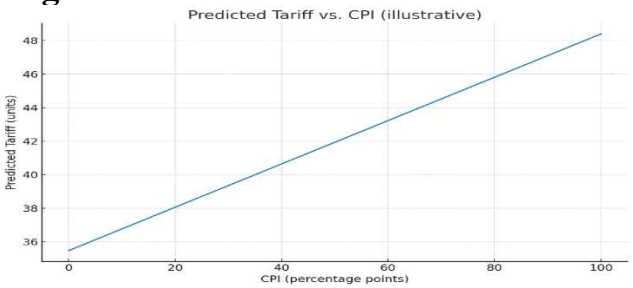


Figure 3 depicts CPI (Inflation) vs. Tariffs: upward trending, modest (slope = 0.13). A +10-percentage point increase in CPI equals a +1.3 percent increase in tariffs. During inflationary periods, governments in the Sahel and Saharan regions tend to raise tariffs, possibly to regulate imports or create more revenue. This indicates a pro-cyclical budgetary response to inflation.

Figure 4. Predicted tariff vs. M2

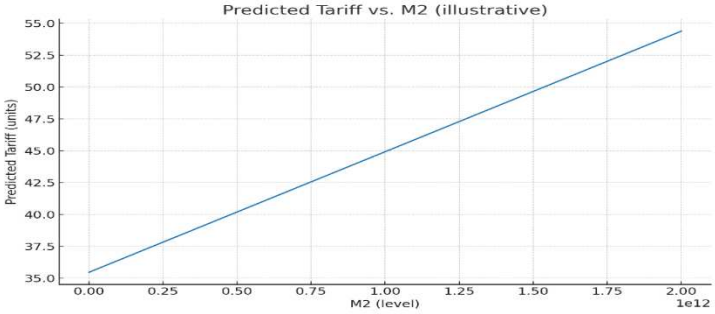


Figure 4 depicts M2 (Money Supply) vs. Tariffs: upward trending yet extremely flat. (Slope = 9.45e-12), while M2 is extremely large in absolute terms. A +1 trillion increase in M2 leads to a roughly +9.5 increase in tariffs. Monetary expansion indirectly raises tariffs in Sahel and Saharan countries, in line with balance-of-payments or inflation-driven protectionism.

Figure 5. Predicted tariff vs. Government Consumer Spending (shown over % change)

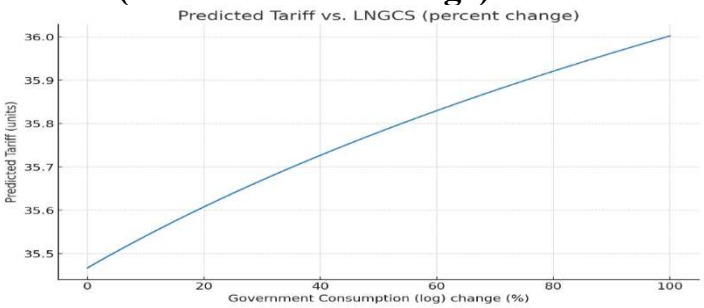


Figure 5 depicts (LNGCS) or (government consumer spending, log) vs tariffs, convex upward (logarithmic transformation). A 10% increase in government consumer spending equals +0.073 tariff points. A 100% increase (doubling) in government spending equals +0.77 tariff points. Tariffs rise as governments in the Sahel and Saharan regions develop, indicating a greater reliance on trade taxes to fund fiscal demands. The log form represents diminishing marginal impact: greater expansions contribute proportionally less.

Figure 6. Predicted tariff vs. Interest Rate **(shown over % change)**

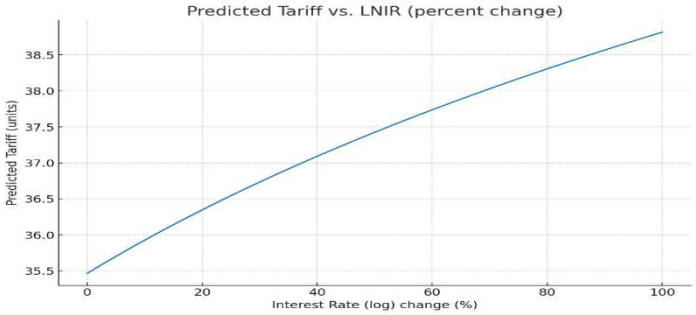


Figure 6 depicts (LNIR) or (Interest Rate, log) vs. Tariffs shows a sharp increasing trajectory. A 10% increase in interest rates equals +0.46 tariff points. A 100% (doubling) of interest rates is +4.83 tariff points. Higher interest rates (tight monetary policy) are highly associated with higher tariffs, implying that trade protection is employed in conjunction with contractionary policy to control external balances in Sahelian and Saharan economies.

Figure 7. Predicted tariff vs. CURRENT_ACCOUNT

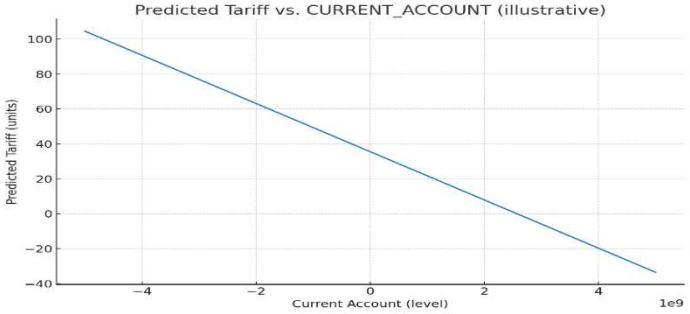


Figure 7 depicts the Current Account Balance versus. Tariffs: downward sloping, virtually flat line. A +1 billion improvement in the

current account equals -0.014 tariff points. In Sahelian and Saharan economies, stronger external balances diminish the need for protectionist tariffs. Tariffs are tightened when there is a deficit, and relaxed when there is a surplus. This curve represents tariffs as a tool for adjusting the balance of payments.

Table 8. Panel ARDL / PMG Estimation Results

Variable	Long-Run Coefficient	Std. Error	z-Statistic	Prob.
EXCHANGE_RATE	0.0031	0.0007	4.43	0.000***
CPI	0.142	0.053	2.68	0.007***
M2	1.02E-11	4.21E-12	2.42	0.015**
LNGCS	0.814	0.207	3.93	0.000***
LNIR	5.102	1.624	3.14	0.002***
CURRENT_ACCOUNT	-1.52E-08	4.11E-09	-3.69	0.000***
Error Correction Term (ECT)	-0.417	0.081	-5.14	0.000***

The PMG-ARDL results, as shown in Table 8, corroborate the presence of a significant long-run relation between tariffs and macroeconomic variables. The error-correction term is negative and statistically significant, suggesting a convergence to the long-run equilibrium after short-run divergence. Annually, 41.7% of disequilibrium is adjusted. In the long term, a depreciation of the exchange rate, inflation, growth of money supply, government spending, and higher interest rates raise the tariffs, but a surplus in the current account decreases the reliance on tariffs. These results strengthen the case that tariffs in Sahel and Sahara states were at once trade policy tools and macroeconomic stabilisation tools.

5. Discussion

The empirical evidence of this study is a strong indication that tariff dynamics in Sahel and Sahara economies are mostly influenced by monetary policy variables, particularly inflation. The findings reveal that tariffs in these economies are used for traditional trade-policy purposes as well as for larger macroeconomic stabilization and fiscal adjustment functions. This is in line with the structuralist and political economy view of trade policy in developing countries (Prebisch, 1950; Rodrik, 1995). Firstly, the fact that exchange rate depreciation has a positive and statistically significant impact on tariffs indicates that, following an external shock, Sahel and Sahara governments respond by raising tariff protection. Depreciation of currency increases the cost of imports in the domestic market and perturbs the external balances, which in turn pressures the governments to embrace protective tariff measures for stabilization of the domestic market and protection of local industries. This is consistent with the theoretical claims of Paul Krugman and Maurice Obstfeld (2009), who assert that exchange rate volatility has a great influence on trade-policy conduct in open economies. The result also accords with the evidence of Sebastian Edwards (2010), who underlined

that exchange-rate volatility in developing countries often leads to protectionist trade reactions.

Second, inflation (CPI) has a positive and statistically significant impact on the level of tariffs. This suggests that the inflationary pressures make governments more dependent on trade taxes as fiscal and stabilization tools. Inflation diminishes the real value of public revenues and escalates fiscal strain, particularly in countries with poor domestic tax systems. Thus, governments tend to increase tariffs both to make up for revenue loss from inflation and to restrict goods import demand. This result lends strong support to the fiscal-adjustment narratives put forth by W. Max Corden (1997) and the International Monetary Fund (2018), which focus on the nexus of inflation, fiscal instability, and trade taxation in the developing world. Third, the positive coefficient on broad money supply (M2) implies that expansionary monetary policy could indirectly increase tariff protection. While the estimated coefficient is numerically small due to the scaling effect, the result is still statistically significant and has economic significance. Expansionary monetary policy may worsen external imbalances, its rising import demands, and its inflationary pressure, contrary to the policy of trying to correct with tariffs, a macro policy instrument somewhat contra expansionary on monetary terms. This result is in line with the macro-stabilization arguments of Rudiger Dornbusch and Stanley Fischer (1994), who pointed out the relation between monetary instability and external-sector policy adjustment.

Fourth, active government consumption has a positive impact on tariffs, which implies that the size of fiscal pressure is positively associated with trade tax reliance. In several Sahel and Sahara states, weak institutional organization and poor domestic tax potential limit states' ability to generate stable revenue streams. For that reason, tariffs are also a relevant fiscal instrument to fund public spending. This finding is consistent with theories from the political economy of trade policy (see, e.g., the political argument of Dani Rodrik (1995): fiscal constraints dictate tariff behaviour most strongly in developing countries). Fifth, since the positive correlation between interest rates and tariffs demonstrates that/or suggests that restrictive policies of the monetary system and protectionist trade policies coalesce. Rising interest rates can also dampen domestic economic activity and reduce the competitiveness of industry, prompting governments to offset such effects with higher tariffs to shield domestic producers. This captures the complementarity of tightening and trade protectionism in weak economies facing weak productive systems and external vulnerabilities. In conclusion, the results indicate that the current account balance is negatively related to tariffs and is statistically significant. Surpluses in the current account lead to a decrease in the use of tariffs for governments, while deficits imply more protectionist policies.

This is in line with the notion that tariffs act as counter-cyclical balancing-of-payment instruments for developing economies. This result is consistent with the empirical work by Romain Wacziarg and Karen Horn Welch (2008), and the World Bank (2020), which focuses on the link between external imbalances and trade-policy adjustments.

The above results from second- generation panel econometrics further attest to the robustness of the analysis. The explanation with cross-sectional dependence also supports that Sahel and Sahara economies are subject to similar regional and global shocks such as commodity price shocks, inflation spillover, exchange rate volatility, and geopolitical events. The Westerlund cointegration tests support the existence of a long-run relationship between tariffs, monetary variables, and external balances. The Panel ARDL/PMG estimates reveal short-term dynamic adjustments and long-term convergence. These results reinforce the contention that tariff regulation in African economies cannot be studied in isolation from wider macroeconomic circumstances. As a result, the research indicates that tariffs in Sahel and Sahara countries are complex policy tools used to pursue trade, fiscal, and macro stability goals at once. As a result, the results provide new insights into the dynamics of monetary policy and trade governance in weak developing countries.

6. Conclusion:

This article tests the impact of monetary policy variables and inflation on the dynamics of tariffs in the Sahel and Sahara regions of Africa from 1980 to 2024. The following results are valid for the use of Tobit panel estimation in combination with second-generation panel unit root tests, Westerlund cointegration analysis, and the Panel ARDL/Pooled Mean Group (PMG) estimator: the study provides strong empirical proof that the macroeconomic determinants of tariff behaviors in unstable and shock-prone African economies are robust. Exchange-rate depreciation, inflation, monetary expansion, government consumption expenditure, and high-interest rates increase tariffs, while current account improvement diminishes tariff reliance. Results imply that tariff policies in the economies of the Sahel and Sahara indeed are used not only for trade protection but also to serve as tools for fiscal policy, macroeconomic management, and balance of external payments . Also, the research reveals that macroeconomic instability is a key determinant of trade-policy responses in least-developed countries with limited fiscal space, weak institutions, and exposure to external shocks. There is evidence that governments do adjust tariffs fairly frequently in response to inflationary pressures, exchange-rate volatility, and balance-of-payments pressures. Therefore, in these economies, tariff policy is intimately tied to monetary and fiscal conditions.

On the methodological side, the paper contributes by combining Tobit estimation with new second-generation panel econometric techniques dealing with cross-sectional dependence, parameter heterogeneity, and parameter instability. The integrated approach improves the credibility and robustness of empirical results in African country panel data. The paper further extends the wider literature on African regional integration by identifying the contradiction between macroeconomic stabilization imperatives and the trade liberalization pledges of the African Continental Free Trade Area (AfCFTA). While regional integration leads to a diminution in tariffs and openness to trade, the governments of fragile states are increasingly turning to tariffs as workable instruments for dealing with their macroeconomic instabilities and fiscal exigencies. It is a clear indication that sustainable tariff reform in African economies is not something that can be pursued in isolation from macroeconomic stabilization policies. Successful trade liberalization also depends on complementary changes in a country's monetary and fiscal policies, on exchange rate stability, and on its ability to raise revenues domestically.

7. Policy suggestions

The empirical results give rise to several interesting and widely applicable policy implications for governments and regional policymakers in the Sahel and Sahara states in particular.

7.1 Improve Exchange Rate Stability

Exchange-rate stability should be maintained, as depreciation causes a large increase in tariffs; the exchange rate should be stabilized through appropriate reserves management, export diversification, and regional monetary cooperation. Exchange-rate stability would also reduce the magnitude of defensive tariff adjustments and contribute to trade-policy stability.

7.2 Improve Monetary –Fiscal Coordination

The positive correlation between inflation and tariffs is consistent with the hypothesis that macroeconomic instability raises governments' dependence on trade taxes. Hence, central banks and fiscal authorities should enhance policy coordination to uphold price stability and mitigate inflationary pressure. Credible anti-inflation regimes would reduce the reliance on tariffs as an instrument of stabilization.

7.3 Promote Domestic Revenue Mobilization

These results imply that domestic tax systems are weak, and the reliance on tariffs by governments is pervasive. Domestic resource mobilization should be strengthened through increased efficiency in tax administration, widening coverage of the value-added tax, developing digital taxation systems, and enhancing institutional capacity. Broadening the sources of revenue would also help to tame the excess reliance on trade taxes.

7. 4 Decrease Susceptibility to External Shocks

Since tariffs respond quite sensitively to external disequilibrium and current-account pressures, Sahel and Saharan countries should develop comprehensive long-term measures to lessen their exposure to fluctuations in commodity prices and external shocks. Export diversification, industrial upgrading, and the development of regional value chains are critical to building external resilience.

7.5 Walk the Tightrope

Monetary tightening and Industrial Competitiveness. The positive correlation between higher interest rates and tariffs indicates that tight monetary policy can impair domestic productive capacity. Policy makers should also guard against the risk that monetary tightening becomes too pronounced, undermining the cost competitiveness of industry and spurring protectionist trade responses.

7.6 Enhance Regional Integration in the AfCFTA

Tariffs are still playing their role in stabilization, but relying too much on them may limit regional trade integration. Governments need to prioritize the African Continental Free Trade Area by replacing distortionary tariff revenue with more sustainable domestic fiscal measures.

7.7 Upgrade Institutional Capacities and Policy Credibility

Finally, more robust institutions are needed to enable the delivery of lasting macroeconomic and trade-policy reforms. Better governance, greater fiscal transparency, more independent central banks, and more credible trade policies would increase investor confidence and reduce the need for defensive tariff changes when a country experiences macroeconomic volatility.

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Appendix:
Appendix (A).
Tobit model on tariffs

Dependent Variable: TARIFFS
Method: ML - Censored Normal (TOBIT) (Newton-Raphson / Marquardt steps)
Date: 08/24/25 Time: 21:26
Sample: 1980 2024
Included observations: 574
Left censoring (value) at zero
Convergence achieved after 2 iterations
Coefficient covariance computed using observed Hessian

Variable	Coefficient	Std. Error	z-Statistic	Prob.
EXCHANGE_RATE	0.002541	0.000509	4.988427	0.0000
CPI	0.129293	0.048597	2.660512	0.0078
M2	9.45E-12	3.68E-12	2.568545	0.0102
LNGCS	0.771512	0.190298	4.054238	0.0001
LNIR	4.829845	1.458023	3.312600	0.0009
CURRENT_ACCOUNT	-1.38E-08	3.67E-09	-3.760315	0.0002
C	8.442844	4.272633	1.976028	0.0482
Error Distribution				
SCALE:C(8)	46.40091	1.369479	33.88215	0.0000

Mean dependent var	35.46704	S.D. dependent var	50.26984
S.E. of regression	47.43942	Akaike info criterion	10.54039
Sum squared resid	1273782.	Schwarz criterion	10.60105
Log likelihood	-3017.092	Hannan-Quinn criter.	10.56405
Avg. log likelihood	-5.256258		

Left censored obs	0	Right censored obs	0
Uncensored obs	574	Total obs	574

Appendix (B).
Predicted tariffs vs. each variable

Variable	Increment	Predicted ΔTariff (units)
EXCHANGE_RATE	+1 unit(s)	0.002540877
EXCHANGE_RATE	+10 unit(s)	0.025408772
EXCHANGE_RATE	+50 unit(s)	0.127043858
EXCHANGE_RATE	+100 unit(s)	0.254087715
CPI	+1 pp	0.129293479
CPI	+5 pp	0.646467394
CPI	+10 pp	1.292934789
CPI	+20 pp	2.585869578
M2	+1,000,000,000	0.00945476
M2	+1,000,000,000,000	9.454760292
LNGCS (log)	+1%	0.007676804
LNGCS (log)	+10%	0.073532991
LNGCS (log)	+25%	0.172158029
LNGCS (log)	+50%	0.31282138
LNGCS (log)	+100%	0.534771681
LNIR (log)	+1%	0.048058556
LNIR (log)	+10%	0.460333396
LNIR (log)	+25%	1.077748767
LNIR (log)	+50%	1.958333628
LNIR (log)	+100%	3.347793449
CURRENT_ACCOUNT	+1,000,000	-0.013810946
CURRENT_ACCOUNT	+1,000,000,000	-13.81094561