

# The Determinants of Bond Yields: Case of the WAEMU Public Securities Market

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## Abstract

This paper investigates the determinants of three-year Treasury Bond yields in the WAEMU region—a maturity frequently used in sovereign debt auctions. The methodological framework combines Principal Component Analysis (PCA), used to construct a composite financial development index, with a fixed-effects panel data model incorporating macroeconomic, financial, and institutional variables. The findings indicate a significant and negative effect of the public debt-to-GDP ratio on bond yields. However, the level of financial development is not statistically significant in the model, although the typology derived from the composite index clearly distinguishes three country groups by their level of financial maturity. This segmentation highlights the need for differentiated policy approaches: structural reforms to promote financial inclusion in less mature markets, and consolidation efforts in more advanced countries. Furthermore, prudent public debt management stands out as a critical tool for containing financing costs and sustaining investor confidence.

## Keywords

Sovereign Bonds, Yields, Sovereign Debt Market, Public Debt Stock, Financial Development Index, Risk Premiums

## 1. Introduction

Modern financial markets position sovereign securities as essential investment instruments, attracting both institutional and individual investors. These instruments, perceived as relatively safe, allow investors to diversify their portfolios while benefiting from fixed returns. The bond yield represents the expected return rate for holding a bond until its maturity.

Within the West African Economic and Monetary Union (WAEMU), the public securities market is structured around two issuance methods: auction and syn-

dication. However, regarding the primary market organized by the UMOA-Titres Agency, issuances are exclusively conducted via auction, in accordance with the harmonized procedures in force within the zone (UEMOA, 2013).

This market has experienced significant growth, reaching an estimated volume of 5255 billion CFA francs in 2022, compared to 3330 billion in 2016 (RMTP, 2023). Despite the progress made in recent years, WAEMU's sovereign securities primary market remains less developed compared to other African markets. According to the IMF, the share of sovereign debt issued on WAEMU's domestic fixed-income market remains significantly lower (30%) than in other sub-Saharan African countries such as Ghana, Kenya, and Nigeria, where it reached 35%, 48%, and 75%, respectively, at the end of 2020 (FMI, 2022).

Recent trends reveal contrasting developments in bond issuances. In 2022, funds raised on the regional market through auctions reached 5255 billion CFA francs, representing a decline of 297 billion compared to 2021. This drop is mainly due to a decrease in Treasury bill issuances (−14.6%), partially offset by a slight increase in Treasury bonds (+0.1%).

Strong demand for three-year Treasury bonds, which totaled 1233 billion CFA francs (35.2% of annual bond issuances), illustrates investors' preference for these instruments, perceived as offering an optimal balance between yield and investment horizon.

Bond yields also reflect the risk level associated with the issuing country. In 2022, Senegal and Côte d'Ivoire were able to borrow at relatively low rates, ranging between 3.58% and 5.57% for their three-year bonds. Conversely, Mali had to offer higher yields—between 6.12% and 6.22%—to compensate for the heightened perceived risk due to political and economic instability.

These recent changes in WAEMU bond yields raise several questions about the underlying factors influencing their dynamics. Traditional literature distinguishes two main theoretical approaches to explain risk premiums and bond yields. The first set of approaches, such as market segmentation (Culbertson, 1957), preferred habitat (Modigliani & Sutch, 1966), and liquidity preference (Keynes, 1937), views the risk premium as largely exogenous and determined by supply and demand structures. Conversely, modern approaches place the risk premium at the center of bond yield fluctuations. Empirical studies by (Kumar & Baldacci, 2010; Capelle-Blancard et al., 2019) show that the risk premium is significantly influenced by economic and financial variables, including inflation, economic growth, debt levels, and monetary policy.

In light of these findings, a fundamental question arises: What are the main determinants of bond yields in WAEMU, particularly for three-year maturity securities? How do these factors influence their evolution?

The main objective of this research is to analyze the explanatory factors behind the formation of public bond yields in WAEMU. More specifically, the aim is to:

- Identify the key factors influencing public securities yields in the region;
- Quantify the impact of these factors on observed yield levels.

Bond yields are influenced by a combination of factors some macroeconomic, others institutional, and market-related. The hypotheses of this research are as follows:

- Public bond yields are influenced by the level of financial development, inflation, total public debt, real economic growth, the current account balance, and public investment;
- Inflation and public debt have a positive effect on bond yields, while sustained economic growth, financial development, current account balance and public investment tend to reduce them.

The methodology used in this research combines econometrics and factorial analysis methods, particularly principal component analysis (PCA). Following the works of (Johnston John, 1985; Michelle Volle, 1978; Xavier Bry, 1999b), PCA is employed to construct a composite index to capture the level of financial development. The second model relies on panel data analysis. It will quantify the effect of the identified factors on bond yields. The yields analyzed correspond to the post-accounting weighted average yields of three-year bonds issued via auction, due to investor appetite and data availability.

The remainder of the document is structured into four (4) sections as follows: after the literature review in Section 2, the methodological approach is presented in Section 3. Section 4 focuses on the data and empirical results. The conclusion and recommendations precede the results analysis.

## 2. Literature Review

When an economic agent has a surplus of income, they will only agree to part with it if it generates additional earnings. In the capital market, yield is a key indicator for evaluating the magnitude of these potential gains. It depends both on current market conditions and the risk level associated with the financial securities held. Among these factors, risk is the most critical. In practice, investors demand a risk premium to compensate for this uncertainty. The higher the risk, the greater the premium. Two major approaches are used to analyze this risk premium: the first views the premium as exogenous, generally constant; the second recognizes its variability and attempts to explain it either empirically or through optimization models.

### 2.1. Traditional Approaches

Traditional approaches to the risk premium consider it to be exogenous. Theories supporting this view include market segmentation, preferred habitat, and liquidity preference.

The market segmentation theory (Culbertson, 1957) assumes perfectly separated markets. There is no arbitrage between different maturities to shape a proper yield curve. Investors operate within specific maturities, and yields reflect supply and demand in those segments.

The preferred habitat theory, by (Modigliani & Sutch, 1966) recognizes inves-

tors' risk aversion but allows for finite risk premiums. Investors favor specific maturities and require a premium to move away from their preferred segment.

The liquidity preference theory, attributed to (Keynes, 1937), suggests investors prefer short-term instruments. A liquidity premium is added to longer maturities, increasing with time. This theory has been criticized for underestimating reinvestment risk. A key limitation of these traditional theories is the lack of explanation for the volatility of risk premiums.

## 2.2. Modern Approaches

Modern approaches attempt to explain risk premium volatility empirically. The premium is influenced by short-term rate variability, inflation variance, and covariances with long-term rates.

When inflation is low and predictable but short-term rates are volatile, investors prefer longer durations, resulting in lower or negative premiums. Conversely, high and volatile inflation leads to higher risk premiums. (Kumar & Baldacci, 2010) found a positive link (+0.13) between 10-year bond yields and inflation in 31 emerging countries using GMM estimation over 1980-2008.

External debt raises risk premiums in debtor countries and reduces them in creditor ones. This is due to the hedging value of foreign-held securities against exchange rate risks. Studies show public debt has a significant and positive impact on yields: +2.28 in emerging countries and +0.007 in OECD countries.

Covariance between domestic and foreign yields increases risk, reducing diversification, and raising required premiums on long-term bonds.

Central banks use refinancing and deposit rates to influence short-term interest rates. This segmentation influences expectations and contributes to yield volatility.

Three theories link yield spreads to economic activity: 1) Consumption smoothing (Lucas Jr, 1978); 2) Monetary policy expectations; 3) The credit channel. In the credit channel, tight monetary policy limits bank lending, slowing economic activity. Higher short-term rates result in smaller increases in long-term rates. (Kumar & Baldacci, 2010) found that economic growth reduces yields (-0.07), indicating expansion lowers sovereign bond yields.

Risk premiums are dynamic and depend on macroeconomic expectations and monetary policy signals.

## 3. Methodology

Given the large number of explanatory variables relative to our dataset and the objectives of this study, it is essential to adopt analysis methods that can accommodate this information volume while adhering to econometric principles. Principal Component Analysis (PCA), as outlined by (Johnston John, 1985), offers an effective solution.

When multiple explanatory variables are likely to influence a dependent variable (Y), two main approaches emerge. The first method, described by (Kindall M.,

1957), addresses multicollinearity by computing the principal components of the explanatory variables, discarding those associated with low eigenvalues, and regressing  $Y$  on the retained components.

The second approach, proposed by (Pidot, 1969), is relevant when variables are numerous and correlated. It selects a few key variables and complements them with principal components from the rest, provided they have clear interpretations. This is the approach used in our study.

Beyond econometric use, PCA is an exploratory tool to visualize variable correlations, supporting theoretical result interpretation (Xavier Bry, 1999a).

### 3.1. Presentation of the PCA Model

This presentation draws from the work of (Abdou, 2002). PCA standardizes variables using the following formula:

$$x_{ik} = (x'_{ik} - \bar{\mu}_k) / \sigma_k, \quad k = 1, \dots, p. \quad (1)$$

where  $\bar{\mu}_k$  and  $\sigma_k$  denote the mean and standard deviation of variable  $k$ , respectively.

A variable  $X^j$  is projected D-orthogonally  $\widehat{Q}_p x_i$  onto the subspace  $F_q$  formed by the first  $q$  factorial axes. Its coordinate  $x^j$  on  $u^k$  is:

$$\langle x^j, u^k \rangle_D = x^j D u^k = (x^j D \bar{X} M v^k) / \sqrt{\lambda_k} = (e^j \bar{X}' D \bar{X} M v^k) / \sqrt{\lambda_k} = \sqrt{\lambda_k} v_j^k. \quad (2)$$

The representation quality of variable  $x^j$  is given by the squared cosine of the angle it forms with its projection:

$$\left[ \cos \theta(x^j, \widehat{Q}_q x^j) \right]^2 = \sum_{k=1}^q \lambda_k (v_k^j)^2 / \sum_{k=1}^p \lambda_k (v_k^j)^2 \quad (3)$$

Correlations with axes  $(C^k)$  help interpret variable contributions. The correlation circle shows how well variables are represented, closer to the circle, better the representation.

$$\text{cor}(X^j, C^k) = \cos \theta(x^j, C^k) = \cos \theta(x^j, u^k) = \langle x^j, u^k \rangle_D / \|x^j\|_D = \sqrt{\lambda_k} / \sigma_j \quad (4)$$

$X^j$  and  $C^k$  are linearly related if  $|\text{cor}(X^j, C^k)| \approx 1$ .

The proportion of information summarized along a vector subspace is called inertia along that space. It is measured by the eigenvalue associated with the axis:

$$r_q = \left( \sum_{k=1}^q \lambda_k \right) / \left( \sum_{k=1}^p \lambda_k \right) \quad (5)$$

where  $\lambda_k$  represents the eigenvalue associated with axis  $k$ .

### 3.2. Presentation of the Econometric Model

The goal is to identify determinants of WAEMU bond yields. Panel data is used due to time and country dimensions. It helps isolate individual ( $i$ ) and time effects ( $t$ ). Panel data offers several advantages, such as the ability to distinguish individual and time-specific effects, account for heterogeneity across entities, and improve estimator efficiency and convergence. However, it is also sensitive to outliers and often exhibits autocorrelated errors, making robust error evaluation es-

sential.

$$y_{it} = \sigma_{0i} + \sigma'_i x_{it} + \epsilon_{i,t} \quad (6)$$

where  $y_{it}$ ,  $x'_{it} (x_{1it}, x_{2it}, \dots, x_{kit})$ ,  $\sigma'_i (\sigma'_{1i}, \sigma'_{2i}, \dots, \sigma'_{ki})$ ,  $\sigma_{0i}$  and  $\epsilon_{i,t}$  denote the dependent variable, vector of explanatory variables, coefficient vector, individual effect and error term, respectively.

According to (Régis Bourbonnais, 2015), four cases based on:  $\sigma_{0i}$  and  $\sigma'_i$  homogeneity determine model type:

- Total homogeneity:  $\sigma_{0i}$  and  $\sigma'_i$  are the same for all individuals, then the pooled OLS.
- Total heterogeneity: both  $\sigma_{0i}$  and  $\sigma'_i$  differ, then the estimate separate equations.
- Heterogeneous  $\sigma'_i$ , homogeneous  $\sigma_{0i}$ : treated as case 2.
- Heterogeneous  $\sigma_{0i}$ , homogeneous  $\sigma'_i$ : leads to fixed or random effects models.

## 4. Methodology

### 4.1. Data

The selection of explanatory variables is grounded in a comprehensive analysis of both theoretical and empirical studies on the determinants of sovereign bond yields, as well as considerations of data availability. Although direct access to investor profiles would offer clearer insights into their behavior within the sovereign debt market, this is limited by actor heterogeneity, the absence of standardized behavioral models, and informational asymmetries. Consequently, an indirect approach is employed, whereby investor behavior is inferred through macroeconomic, institutional, Central Bank of West African States and financial contexts. The data were collected annually for the 2016-2022 period and cover all WAEMU member countries. Sources include the BCEAO, UMOA-Titres, and the World Bank. The list of selected variables, along with their labels and data sources, is presented below **Table 1**:

**Table 1.** Summary of variables.

Variables	Description	Source
Corrup	Control of Corruption	World Bank
Gouv	Government Effectiveness	World Bank
Regul	Regulatory Quality	World Bank
Droit	Rule of Law	World Bank
Balance	Current Account Balance (excluding grants) as % of GDP	BCEAO
Credit	Domestic Credit to the Private Sector by Banks	World Bank
Deposits	Bank Deposits as % of GDP	World Bank

**Continued**

Liquid	Liquid Liabilities (M2/GDP)—Financial Depth	World Bank
Inflation	Inflation	BCEAO
Tx_cr	Real GDP Growth	BCEAO
RMP	3-Year Weighted Average Yield of Treasury Bonds	UMOA-Titres
Debt	Public Debt Outstanding as % of GDP	BCEAO
InvestPublic	Public Investment Rate/GDP (%)	BCEAO

**4.2. Empirical Results and Discussion****4.2.1. Descriptive Statistics**

**Table 2** highlight country-specific yield patterns. High variability is observed in Guinea-Bissau (1.438%) and Niger (1.28%), while skewness values suggest asymmetric behavior: strongly positive in Guinea-Bissau (1.554) and negative in Niger (−1.13) and Senegal (−1.071). The excess kurtosis in Guinea-Bissau (4.138) reveals the influence of outliers. Normality assumptions are largely respected except in Guinea-Bissau (0.021) and the WAEMU (0.002).

**Table 2.** Descriptive statistics.

Countries	Mean	Standard D.	Skewness	Kurtosis	Shapiro-Wilk Pr.
Benin	6.25	1.071	−0.788	2.721	0.397
Burkina Faso	6.295	0.84	−0.191	2.002	0.968
Côte d'Ivoire	5.858	0.538	0.035	1.567	0.743
Guinea-Bissau	7.713	1.438	1.554	4.138	0.021
Mali	6.431	0.628	−0.248	2.036	0.936
Niger	6.245	1.28	−1.13	3.572	0.200
Senegal	5.635	0.636	−1.071	3.779	0.095
Togo	6.545	0.78	0.139	1.723	0.729
UEMOA	6.372	1.064	0.841	7.174	0.002

The correlation coefficient is a symmetric indicator that measures the strength and direction of a linear relationship between two variables. According to **Table 3**, the sign of the correlation coefficients between the explanatory variables and Treasury Bond yields (OATs) varies across countries. The Financial Development Index (FDI), total public debt (Debt-to-GDP ratio), inflation and public investment (InvestPublic) are negatively correlated with bond yields. In Niger, the correlations of the FDI, public debt, and public investment with yields are statistically significant at the 5% level. While the current account balance generally exhibits a weak positive correlation with yields, an exception is observed in Mali, where the correlation is strongly negative (−0.6849).

**Table 3.** Correlation coefficients with the yield.

Countries	FDI	Debt	Inflation	Balance	Tx_cr	InvestPublic
Benin	-0.7520*	-0.6176	-0.1847	0.1169	0.1474	-0.6434
Burkina Faso	-0.1217	-0.4969	-0.5989	0.1709	0.5729	-0.2209
Cote d'Ivoire	-0.3325	-0.7075*	-0.5799	0.4844	-0.1993	-0.7151*
Guinea-Bissau	-0.5254	-0.1695	0.0666	-0.2224	-0.0689	0.1684
Mali	-0.038	-0.3669	0.429	-0.6849*	0.6940*	0.0831
Niger	-0.8814**	-0.7941**	-0.5197	0.6455	0.4227	-0.8022**
Senegal	-0.3242	-0.3221	0.3449	-0.0022	-0.0964	-0.1956
Togo	-0.5782	-0.2123	-0.1900	-0.4994	0.0997	-0.0763

To assess the existence of mean differences in Treasury Bond yields among WAEMU countries, a one-way ANOVA test was conducted on the dataset. The results support the assumption of variance homogeneity and reveal no statistically significant differences in yields between the countries.

#### 4.2.2. Construction of the Financial Development Index

##### 1) Robustness Tests

Three distinct approaches were used to re-estimate the composite index. The first is Principal Component Analysis (PCA) with non-standard normalization, which adjusts the eigenvectors of the data matrix by multiplying them by the square root of the eigenvalues. This ensures that the sum of the squared coefficients corresponds to the variance explained by each component. The second method relies on an equally weighted index, assigning a uniform weight of 1/7 to each of the seven variables used to construct the index. Finally, the third approach uses the first factor (F1) as a new index, derived from the weighted linear combinations obtained via Factor Analysis (FA).

Correlation coefficients were calculated between the indices obtained by these methods. The results, summarized in **Table 4**, show strong correlations between indices, confirming methodological consistency:

**Table 4.** Computation of KMO.

	PCA Standard	PCA Non-Standard	Uniform weight	AF
PCA Standard	1.0000			
PCA Non-Standard	0.9869	1.0000		
Uniform weight	0.9300	0.8707	1.0000	
AF	0.9492	0.9876	0.7925	1.0000

The KMO test (Kaiser, 1974) examines whether the partial correlations between variables are weak. The variable “liquid liabilities” (0.4691) appears problematic. This simply reflects a weak correlation with the first factor compared to other var-

ables, although it is correlated with other factors. The standard remedy involves using more than one factor. In this study, four (4) factors were used, increasing the explained variance from 89.93% to 96.87%. Notably, the “liquid liabilities” variable contributes more significantly to components 2 (64.51%) and 3 (61.34%), justifying its retention in the multidimensional analysis (Table 5).

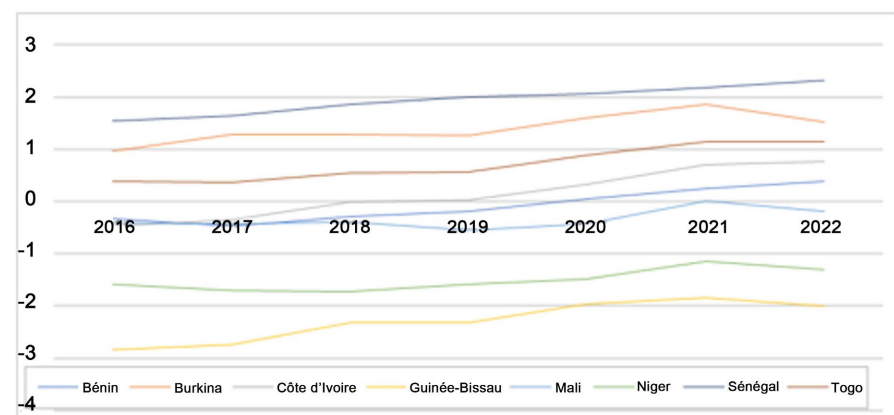
**Table 5.** Computation of KMO.

Corruption	Gouv	Regul	Droit	Credit	Deposits	Liquid
0.8811	0.7334	0.8608	0.8375	0.7367	0.7129	0.4691

Cronbach’s alpha coefficient was calculated to assess the internal consistency of the selected variables. It stands at 0.769, indicating an acceptable level of reliability and suggesting that the variables can be meaningfully aggregated into a composite score. Furthermore, the Bartlett’s test of sphericity (Bartlett, 1938) was performed to evaluate the relevance of dimensionality reduction using PCA. The associated  $p$ -value (0.000) allows for the rejection of the null hypothesis of no correlation between variables, confirming that the correlation matrix is suitable for PCA. These results validate the construction of a robust synthetic index based on the extracted components.

## 2) Results and Discussion

The composite financial development index is calculated through a linear transformation of the seven (7) indicators. Three components were used to build the index, explaining 96.87% of the data variance. An analysis of 56 observations across 8 WAEMU countries over a 7-year period yields results consistent with those of Cezar (2012), revealing a clear segmentation into three distinct country groups (Figure 1).



**Figure 1.** Evolution of the FDI of WAEMU member countries.

The first group comprises countries whose Financial Development Index (FDI) hovers around zero, reflecting moderate but improving financial development. This group includes Benin, Mali, Côte d’Ivoire, and Togo, although the latter two

have exhibited trends moving them closer to the group of more financially advanced economies. Benin has seen a slight improvement in its FDI, rising from -0.3283 in 2016 to 0.3818 in 2022, driven by increased financial depth (from 29.83% to 33.42% of GDP) and stable bank deposits (around 21% of GDP). Mali experienced a decline in its index until 2020 (-0.4271), followed by a modest recovery to -0.1833 in 2022, largely due to a rise in financial depth from 27.71% to 40.73% of GDP. Côte d'Ivoire and Togo, initially positioned around zero, have also recorded steady gains. Côte d'Ivoire's index reached 0.7082 in 2021, while Togo's rose to 0.5552 as early as 2018. These improvements signal a transition toward more advanced financial systems. In Côte d'Ivoire, progress stems from both improved financial depth (35.366% to 38.367%) and enhanced political stability (-1.033 to -0.7150). Togo's performance is attributed to a 3.86% increase in financial depth, from 42.565% in 2017 to 44.207%.

The second group includes Guinea-Bissau and Niger, countries with persistently negative FDI scores, indicating significant structural weaknesses. In Guinea-Bissau, the FDI rose from -2.8363 in 2016 to -1.9954 in 2022, though it remains deeply negative. This stagnation is linked to declining bank deposits (16.30% of GDP in 2022, down from 19.60% in 2016), stagnant private credit (around 14% of GDP), and persistently high corruption levels (average -1.44), despite gradual improvements. Niger's index remains negative yet stable, moving from -1.5928 to -1.3046 over the same period.

The third group consists of countries with positive FDI scores, indicating robust financial development momentum. Senegal and Burkina Faso lead this category. Senegal, the regional frontrunner, recorded an increase from 1.5504 in 2016 to 2.3198 in 2022, with steady growth estimated at 6.994%. Burkina Faso also improved, with its index climbing from 0.9599 to 1.5191 over the same period. Côte d'Ivoire (since 2021) and Togo (since 2018) have joined this group following significant improvements.

#### 4.2.3. Panel Data Model Estimation

The explanatory variables used in the econometric estimation include the financial development index along with all other variables presented in **Table 6**, except those used to construct the index. These variables are: real GDP growth rate ( $Tx\_cr$ ), total public debt ( $Debt$ ), inflation, current account balance excluding grants ( $Balance$ ), public investment ( $InvestPublic$ ) and the Financial Development Index (FDI). The dependent variable is the three-year weighted average yield on Treasury Bonds ( $RMP$ ). The decision to focus on three-year government bonds is justified by their strategic role in shaping the structure of the regional public securities market. This intermediate maturity is among the most frequently issued and traded within the WAEMU, making it a particularly relevant empirical benchmark for analyzing yields. Between 2014 and 2022, the amounts raised at this horizon reached 7321 billion CFA francs, compared to 6032 billion for five-year bonds and 6952 billion for one-year instruments. In 2022—a year marked by the lingering effects of the Covid-19 pandemic and the onset of the Russia-Ukraine war—

the volume issued at three years (1233 billion CFA francs) exceeded that of five-year bonds (1219 billion) and one-year bonds (883 billion). On the secondary market, securities with maturities between one and three years also dominated trading, with volumes rising from 1365 billion in 2021 to 1578 billion in 2022.

Nevertheless, the findings observed for the three-year maturity cannot be systematically generalized to the entire yield curve. According to the term structure of interest rate theory, short-term bonds are more responsive to immediate monetary conditions and liquidity needs, whereas long-term instruments primarily reflect expectations regarding growth, inflation, and debt sustainability. Consequently, results at the three-year horizon should be interpreted with caution and situated within a broader intertemporal perspective of sovereign bond yield analysis.

### 1) Robustness Tests

The multicollinearity analysis indicates VIF values ranging from 1.05 to 2.54, with an average of 1.70, well below the critical threshold of 10. These findings ensure that each variable retains sufficient statistical independence, thereby guaranteeing the reliability of the estimated coefficients and reinforcing the robustness, validity, and credibility of the econometric results.

**Table 6.** Multicollinearity analysis.

Variables	VIF	1/VIF
IDF	2.04	0.49
Dette	2.54	0.39
Inflation	2.01	0.50
Balance	1.28	0.78
Tx_cr	1.05	0.95
InvestPublic	1.28	0.78
Mean VIF	1.70	

**Table 7** presents the results of cross-sectional dependence and stationarity tests, conducted at the 5% significance level. The Pesaran cross-sectional dependence test (Pesaran, 2021) was used and revealed that all variables exhibit cross-sectional dependence. Therefore, second-generation unit root tests, including Im (2003), were applied. The results indicate that the weighted average yield (RMP), total public debt (Debt), and real GDP growth (Tx\_cr) are stationary at level I (0). In contrast, the financial development index (FDI), current account balance (Balance), public investment (InvestPublic) and inflation are stationary after first differencing, i.e., they are I (1).

Additional diagnostic tests were conducted, including the Hsiao's homogeneity test, Hausman's specification test (Hausman, 1978), and Breusch-Pagan tests for homoskedasticity and autocorrelation. These tests assess the validity of assumptions required for robust econometric modeling.

**Table 7.** Cross-Sectional dependence and stationarity tests.

Variables	Cross-Sectional Dependence Test		Stationarity Test	
	<i>P</i> -value	Conclusion	Pesaran	Conclusion
RMP	0.000	Dependence	-3.258*	I (0)
IDF	0.000	Dependence	-3.088*	I (1)
Debt	0.000	Dependence	-3.745*	I (0)
Inflation	0.000	Dependence	-2.805*	I (1)
Balance	0.001	Dependence	-2.924*	I (1)
Tx_cr	0.000	Dependence	-2.960*	I (0)
InvestPublic	0.121	Independence	0.0438*	I (1)

(\*) indicates significance at the 5% level.

Hsiao's test (Hsiao, 2005) rejects the null hypothesis of parameter homogeneity, confirming the presence of individual-specific effects. The Hausman test ( $p$ -value = 0.0011) rejects the null hypothesis, thereby validating the fixed effects specification over the random effects one. Consequently, the retained model is a fixed effects panel model. Accordingly, the selected model is a fixed effects panel model.

Furthermore, the Breusch-Pagan tests (Breusch & Pagan, 1979) indicate that the model errors exhibit inter-individual heteroscedasticity ( $p$ -value = 0.1760) and significant inter-individual autocorrelation ( $p$ -value = 0.0033). These results highlight the presence of both heteroscedastic and serially correlated disturbances. Accordingly, subsequent model estimations will incorporate corrections to address these identified issues.

## 2) Results and Discussion

The fixed effects panel model, selected following the statistical tests, is globally significant at the 1% level ( $p$ -value = 0.0000). Three specifications were estimated: 1) without the financial development indicator, 2) with the indicator, and 3) replacing the indicator with the variables used to construct it. Although the financial development indicator itself is not statistically significant, some of its components are. Specifically, financial depth (Pas\_liquid) exerts a negative effect on bond yields, while corruption (Corrup) and bank deposits (Liquid) show a significant positive effect. These findings suggest that certain underlying factors of financial development indeed influence public bond yields in the WAEMU region.

The total public debt-to-GDP ratio remains significant across all three model specifications. However, its sign, like that of real GDP growth (Tx\_cr), does not align with our initial hypotheses. In fact, this result contradicts those of (Kumar & Baldacci, 2010; Capelle-Blancard et al., 2019), who found that public debt positively affects bond yields in OECD countries. However, within the specific context of the WAEMU, several factors may explain this divergence. First, the region's debt structure remains largely reliant on concessional financing from multilateral institutions such as the World Bank, IMF, the African Development Bank, and

the Islamic Development Bank. These loans, characterized by low interest rates, long maturities, and extended grace periods, mitigate short-term debt servicing pressures and reduce perceived sovereign risk. Second, the CFA franc's peg to the euro, alongside monetary oversight by the BCEAO, enhances macroeconomic credibility and reassures investors regarding debt sustainability. Finally, although the regional public securities market faces certain limitations—such as limited investor diversification, low secondary market liquidity, and the predominance of institutional actors—its increasing depth provides a relatively stable investor base. Consequently, the debt-yield relationship in the WAEMU appears to be shaped less by classical theoretical mechanisms than by institutional arrangements and structural specificities.

Real GDP growth ( $Tx\_cr$ ) shows a positive effect on Treasury bond yields, although this effect is not statistically significant. The observed trend runs counter to that identified by (Kumar & Baldacci, 2010) in their study on emerging markets. In advanced economies, growth is generally perceived as a factor reducing sovereign risk. However, in the UEMOA countries, recent economic expansion has been accompanied by a substantial increase in public financing needs. Between 2014 and 2021, the amount raised and the total outstanding debt on the UEMOA public debt market increased from 2516 and 3620 billion CFA francs to 5552 billion CFA francs, respectively, reflecting heightened capital demand to support public investments. This intensification has exerted upward pressure on yields, as investors require higher compensation to absorb the additional supply of securities. Moreover, the regional economic structure, heavily dependent on commodity exports and exposed to volatile fiscal revenues, limits the translation of growth into tangible improvements in sovereign solvency. The dynamics of infrastructure financing, often undertaken during periods of economic expansion, further exacerbate short-term pressures on the domestic market, independently of long-term productivity gains. Finally, the relative narrowness of the regional debt market, coupled with the concentration of institutional investors, amplifies scarcity effects and intensifies yield responses to increased issuances. These factors suggest that, in the UEMOA, economic growth can paradoxically coexist with elevated sovereign bond yields due to structural constraints and heightened pressures on capital demand.

**Table 8.** Estimation results.

Variables	fixed effects panel model		
	(1)	(2)	(3)
$\Delta$ Inflation	0.063	0.052	0.142**
Debt	-0.085***	-0.084***	-0.123**
$\Delta$ balance	-0.052	-0.035	-0.130*
$Tx\_cr$	0.053	0.038	0.286**
$\Delta$ InvestPublic	-0.036	-0.007	0.054

**Continued**

$\Delta$ FDI		-1.100	
Liquid2			-0.172*
$\Delta$ Corrup			5.228*
$\Delta$ Gouv			3.766
$\Delta$ Regul			-3.314
$\Delta$ 2Droit			0.098
$\Delta$ 2Credit			0.427
$\Delta$ Pas_liquid			0.167*
_Const	10.175***	10.343***	14.775***
Witin	0.3525	0.3804	0.6189
Significance	* $p < 0.10$ ; ** $p < 0.05$ ; *** $p < 0.01$		

A one-way ANOVA test was conducted. This test reveals a significant difference in the levels of total public debt among the eight WAEMU countries. Guinea-Bissau, Senegal, and Togo exhibit significantly higher debt levels compared to the other countries. In particular, Mali and Niger display notably lower debt levels than Guinea-Bissau. These differences suggest structural and/or cyclical disparities in public debt management within the Union.

To assess the empirical robustness of the results, additional estimations were carried out using a fixed effects panel model that includes the five main explanatory variables, while successively altering the sample composition. Columns (1) to (7) present results from distinct subsamples: Column (1) corresponds to the baseline estimation, while the following columns implement targeted exclusions based on the Financial Development Index (FDI). Specifically, Columns (2) to (4) test the effect of excluding Senegal, Guinea-Bissau, and both simultaneously. Column (5) excludes Senegal, Burkina Faso, and Togo; Column (6) excludes Côte d'Ivoire, Benin, and Mali; and Column (7) removes Guinea-Bissau and Niger. The results obtained exhibit strong consistency with the baseline estimations (2) in **Table 8**, thereby confirming the structural robustness of the relationships identified in the main model.

## 5. Conclusion and Policy Implication

The objective of this paper is to identify the factors influencing bond yields, specifically the yields on three-year Treasury Bonds within the WAEMU region, with a particular focus on the three-year maturity commonly used in sovereign auctions. The methodological approach is based on two components: a principal component analysis to construct a composite index reflecting the level of financial development, and an econometric analysis to examine the drivers behind the dynamics of bond yields.

Based on the construction of the financial development index, three groups of countries were identified. The first group includes Benin and Mali, whose index

values fluctuate around zero. The second group comprises Guinea-Bissau and Niger, characterized by negative index scores. The third group includes Senegal and Burkina Faso, both displaying positive index values. Côte d'Ivoire and Togo have progressively shifted from the first group to the third, since 2021 and 2018 respectively, due to the steady improvement in their financial development indices. This classification highlights the varying levels of financial development within WAEMU. The econometric analysis uses a fixed-effects panel data estimation method across the eight WAEMU member states, incorporating macroeconomic, financial, and institutional variables. The results indicate that the ratio of total public debt to GDP has a significant and negative effect on bond yields.

From this study, several economic policy implications can be drawn. Although the level of financial development does not appear statistically significant in the econometric model, the classification of countries into three distinct groups underscores the need for differentiated policies tailored to each country's level of financial maturity. Countries with negative index scores (Guinea-Bissau and Niger) should prioritize the modernization of their financial systems by strengthening basic financial infrastructure, promoting financial inclusion, and investing in financial literacy. Meanwhile, countries with positive index scores should focus on consolidating their progress. Given the sensitivity of bond yields to public debt levels, WAEMU countries should adopt prudent borrowing strategies, enhance fiscal transparency, and improve public debt management in order to preserve investor confidence, limit risk premiums, and reduce long-term financing costs.

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## Conflicts of Interest

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

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