Digitalisation and female unemployment in West Africa: Evidence from panel ARDL analysis

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ABSTRACT

Digital transformation could be crucial for reducing gender gaps and promoting sustainable economic progress in West Africa. However, the role of digitalization in female economic participation remains unclear. This research examined the influence of digitalization on female labor market performance in West African countries, focusing on total female and female youth unemployment. Data from 1995 to 2022 included measures such as internet penetration rate, mobile telephone subscriptions, and fixed telephone subscriptions. The Im-Pesaran-Shin (IPS) stationarity test indicated that the model was suitable for panel ARDL estimation. The Hausman test confirmed that the Pool Mean Group (PMG) estimator was most appropriate for establishing cointegration. Results showed that female unemployment is a long-term phenomenon. Specifically, (i) fixed telephone subscriptions reduce female unemployment, (ii) internet penetration decreases female youth unemployment but increases total female unemployment, and (iii) mobile phone subscriptions increase female unemployment. To improve female labor market outcomes, policymakers should implement digital literacy programs, ensure affordable access to technology, and promote gender equality. While fixed telephone subscriptions help reduce unemployment, mobile subscriptions tend to worsen it, and internet penetration has mixed effects, necessitating targeted strategies for sustainable economic progress.

Contribution/ Originality: This study contributes to the literature by assessing the short- and long-term effects of digitalization on female youth and overall female unemployment in West Africa through internet, mobile, and fixed telephone subscriptions. It also presents the heterogeneous short-run impacts across 15 West African countries. Additionally, the study offers policy recommendations on utilizing digital technologies to promote gender equality, economic development, and youth employment in the region.

1. INTRODUCTION

The global economy is highly affected by digitalization, which has not only changed the way industries operate but also transformed the labour market and created new requirements for digitally compatible skills. The shift in the digital environment, where internet penetration is increasing, mobile devices are becoming more prevalent, and e-commerce systems are common, is impacting changes to the workforce, both as a technology (tool) and as a profession (Raja, Imaizumi, Kelly, Narimatsu, & Paradi-Guilford, 2013). In developed economies, digitalization has been vital

for creating employment and stability. For example, the European Union has created an average of 3.4 million new jobs annually due to digital advancement (Muylle & Vijverman, 2013). However, these advantages have not reached other regions of the world, including West Africa, and the benefits of digital transformation are hindered by numerous obstacles to realization, such as poor infrastructure, high internet prices, and technical incompetence (Manyika et al., 2014). The relevance of such disparities is to understand how the digitalization process can be leveraged to enhance growth and create decentralized jobs, particularly among young women, in line with Sustainable Development Goal 8 (Decent Work and Economic Growth).

Inclusive economic benefits are a problem that has been proven numerous times through research, demonstrating that they can be created through digitalization. It facilitates delivery of services (Uzochukwu, Nwankwo, Okoro, & Adebayo, 2025), enhances productivity, and reinforces the development of enterprises, especially informal ones (Batuo, 2015; Datta & Agarwal, 2004). As a matter of fact, the digital-enabled job creation entails direct and indirect jobs through digital platforms and freelance gig economies (Laguerre, 2013). Although it offers these advantages, its impact is minimal in West Africa due to disjointed digital infrastructure and inconsistent policies. Recent works, including those by Efobi, Tanankem, and Asongu (2018) and Shamaki, Ibrahim, and Philemon (2022), emphasize the importance of increasing digital access to unlock economic value, including in the ECOWAS territory. Nevertheless, the literature has yet to provide an empirical study that thoroughly examines the impacts of these tendencies on youth and gender-specific employment outcomes.

Empowering women is an area that has been underexplored but holds significant potential in the digital transition. Digital technologies can overcome socio-cultural divisions, especially in patriarchal societies where mothers are often restricted from engaging in labor. In line with SDG 5 (Gender Equality), digitalization has increased female labor force participation in many countries, notably India and Turkey, where it has promoted e-commerce and remote work (Maier & Nair-Reichert, 2007; Sovbetov, 2018). Nonetheless, these success stories are never replicated in West Africa, where many women remain in informal and low-income occupations. Digitalization presents a powerful policy tool for advancing gender equality in the workplace, although limited empirical data exists on the West African context. This research aims to test the effect of digitalization on female unemployment, focusing on both overall female unemployment and youth female unemployment.

Recent work has also begun to consider the generalized implications of digital tools on vulnerable groups of females, such as transgender and marginalized ethnic groups, predominantly in high-income nations (Gamarel et al., 2025). These new works highlight the pivotal importance of digital implementation models and inclusive design in ensuring that digitalization does not perpetuate existing inequalities. However, this level of attention is absent in West Africa, where youth unemployment, particularly among women, is extremely high (Azu, Okorie, Akadile, & Okafor, 2025). The majority of studies on African-related topics generalize about female economic activity in Sub-Saharan Africa without accounting for cultural, religious, and regional peculiarities (Asongu & Odhiambo, 2020; Efobi et al., 2018). The knowledge gap is the lack of location-specific, data-driven studies examining the impact of digital technologies on the unemployment rate among young females in West Africa.

Moreover, the validity of the results might also have been affected by the instruments applied in previous studies. Several studies used the Generalized Method of Moments (GMM), a widely used and versatile econometric instrument whose strengths have been questioned due to its sensitivity to model specifications. In this paper, the approach employed is the Dynamic Panel Autoregressive Distributed Lag (ARDL) method, with Pooled Mean Group (PMG) estimators to ensure the inference is more consistent and reliable. The paper is based on long-term panel data (1995-2022) on 15 ECOWAS states to empirically estimate the long-run impacts of digitalization on female and youth female unemployment. Such an approach enhances the validity of the results and provides practical guidance on designing policies for inclusive digital economies.

Finally, the study can be used in academic and policy discussions as it addresses major gaps at the intersection of digitalization, gender, and employment in West Africa. It claims that digital inclusion is not only technically

necessary but also a socio-economic necessity, aligning with SDG 5 (Gender Equality), SDG 8 (Decent Work and Economic Growth), and SDG 10 (Reduced Inequality). It is assumed that the study will provide insights to create more gender-sensitive digital policies and underline the transformative capacity of remote work, e-commerce, and ICT entrepreneurship to curb unemployment among young women. This study contributes to the global research and development policy issue by taking a regional approach to West Africa. It offers a background for future research and development interventions.

2. REVIEW OF THEORIES, LITERATURE, AND ICT USAGE IN WEST AFRICA

Two key behavioral theories underpin this research: the Theory of Reasoned Action (TRA) and the Technology Acceptance Model (TAM). They provide an analytical framework capable of explaining digital adoption and its effectiveness. Efobi et al. (2018) emphasize that the theories are very useful for contextualizing the uptake of technology in socio-economically diverse settings such as West Africa. TRA was formulated by Fishbein and Ajzen (1975), supported by Ajzen and Fishbein (1980) and Bagozzi (1982). It assumes that people make rational, informed judgments based on their beliefs about the consequences of their actions. TRA applies to this research for estimating the perceived benefits and social costs of digital work or entrepreneurship among young women who are constrained by cultural norms, have limited exposure to the company, or are economically vulnerable. In the meantime, TAM, the theory offered by Davis (1989), based on TRA, plays a crucial role in shaping the impact of perceived usefulness and ease of use on technology adoption. TAM can be used to explain how women in West Africa are influenced by digital environments, such as mobile banking, online marketplaces, or remote work programs, to influence their intent to engage. The model is vital in establishing attitudinal barriers, including digital fear, lack of confidence, or skepticism, and motivational drivers, including perceptions of being empowered or a need to integrate into the digital economy. These factors determine the integration of women into the digital economy. Thus, these theories form the empirical model and provide a perspective on behavioral patterns that are vital in eradicating female unemployment through digitalization.

Digitalization also promotes diverse economic activities and serves as a key catalyst for inclusive growth at both micro and macro levels. It enhances Total Factor Productivity (TFP) through innovation and industrial research and development (Efobi et al., 2018; Franck & Galor, 2017). According to Heshmati and Rashidghalam (2016), digitalization has expanded the capacity of production resources, thereby improving the ability to enhance people's economic welfare. Again, it rekindles development outcomes, which include but are not limited to an increase in household income (Comin & Mestieri, 2013), an improved educational system (Abedi, 2024; Zhao & Chen, 2023), and health (Makun, Singh, Lal, & Chand, 2022), and reduces marginalization (Asongu & Odhiambo, 2018, 2020; Efobi et al., 2018; Makun et al., 2022). Most importantly, it is imperative for economic growth (Abedi, 2024; Ejemeyovwi & Osabuohien, 2020) and trade (Abendin, Pingfang, & Nkukpornu, 2022). Azu, Jelivov, Aras, and Isik (2021) found that digitalization could alleviate long-term youth unemployment in West Africa.

A reasonable number of macro-level studies on the impact of ICT development on female unemployment have been conducted, yielding consistent outcomes despite differences in survey scope, proxy selection, and econometric methodologies. Sovbetov (2018) examined the effects of e-commerce activities on female unemployment in Turkey using a dynamic ARDL model with time-series data for 1994-2016. The study examined e-commerce and internet penetration rates and postulated that digitalization is responsible for the increase in employment among Turkish females, similar to Khosrow-Pour (2006) submission. There is evidence that digitalization has improved female labour participation in various countries, such as Britain (MacGregor & Vrazalic, 2007) and India (Maier & Nair-Reichert, 2007), while the World Bank (2015) reports on the possible influence of e-commerce on women in Sri Lanka. The study of the topic reveals that female labor involvement is limited by cultural background but is enhanced through better ICT in the nation. It demonstrates that e-commerce and ICT can help bridge the gender inequality gap, allowing women to work from home, which might not be possible otherwise due to cultural and religious limitations.

A literature is emerging about the effect of ICT on female labour participation in Africa, which offers consistent evidence on the impact of ICT on female unemployment. Efobi et al. (2018) assessed the impact of ICT change on the formal economic role of women in Sub-Saharan Africa with a sample size of 48 African countries in the period 1990 to 2014. The research results established strong arguments that females' economic participation is enhanced by ICT progression, using OLS, fixed effects, and GMM. Conversely, Asongu and Odhiambo (2020) evaluate the effects of ICT in mediating the effects of inequality on the economic participation of women using 2004-2014 and a sample of 42 countries in sub-Saharan Africa. It was established that ICT would need to increase information and communication technologies beyond certain levels to alleviate inequality and improve the best economic contribution by women. Similarly, in their study, Asongu and Odhiambo (2018) examined the importance of ICT in counteracting the impact of financial access on economic participation by women in 48 African countries. Using the GMM method, the article indicates that ICT moderates financial accessibility with positive effects on female economic participation, as it has been found by Jonathan and Camilo (2008) and Ondiege (2010).
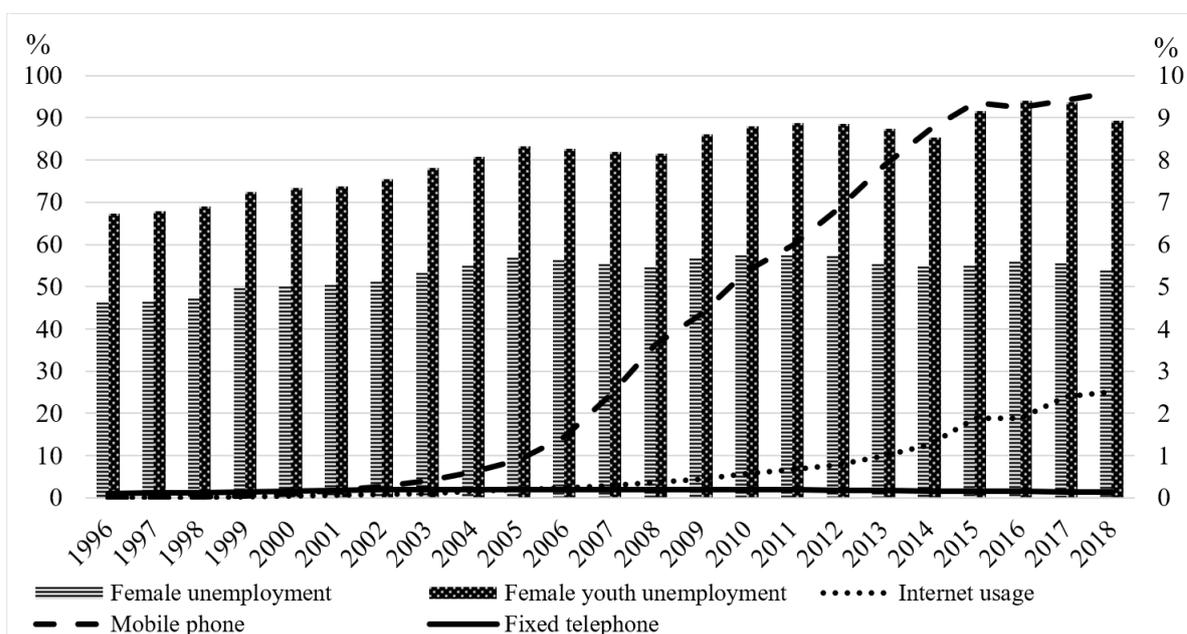

Figure 1. ICT Adaptation and Female Unemployment in West Africa.

Note: Primary Y-Axis-Internet Usage, Mobile Phone subscription and Fixed Telephone Subscription. Secondary Y-Axis-Female Unemployment and Female Youth Unemployment.

Sources of Data: World Development Indicator (WDI).

Focusing on three ICT indicators, adoption increased slowly until the late 2000s. It could be suggested that Nigeria maintained the numerical lead in the level of appreciation. In 1997, statistics reveal that out of fifteen (15) ECOWAS countries, Cape Verde (approximately 0.24%) recorded the highest percentage of the population using the Internet, followed by Togo (0.21%), Gambia (0.051%), Ghana (0.028%), and Sierra Leone (0.027%)[1]. In 2000, the percentage of Cape Verdeans using the Internet increased the most; the country remains first with 1.82%, followed by Gambia at 0.92%. Nations with the lowest Internet use include Liberia (0.017%), Niger (0.036%), Nigeria (0.06%), Burkina Faso (0.077%), and Guinea (0.095%). The percentage of the population with Internet access continues to vary by country. Still, in 2018, Sierra Leone (66.34%), Cape Verde (58.17%), Côte d'Ivoire (46.82%), Nigeria (40.55%), and Benin (23.16%) were among the leading internet users in the region. On average, 26.52% of internet subscribers were

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[1]By number of individuals using the internet, Nigeria could be regarded to having the highest internet subscribers being the most populated country in the region but not when converted to percent of population.

unemployed, with female unemployment at 10.2% and female youth unemployment at 5.64% in the region (see Figure 1). Female youth unemployment is always higher than the aggregate female unemployment rate.

The amount of mobile phone subscriptions is measured per 100 people. In 1997, Gambia had the highest mobile cellular subscriptions per 100 people at 0.39, followed by Cote d'Ivoire (0.24) and Ghana (0.12). As of this period, Guinea-Bissau and Liberia reported no subscribers. By 2018, Gambia, Mali, and Ghana, with 130.19, 130.16, and 125.71 per 100, respectively, became the highest subscribers in the region, while Burkina Faso, Sierra Leone, Guinea-Bissau, Togo, and Niger, with 79.77, 78.88, 71.29, 66.3, and 44.79 per 100, respectively, fell among the lowest subscribers. On average, the region's mobile cellular subscriptions increased from approximately 0.071 per 100 in 1997 to 93.52 in 2015 and 95.98 in 2018 (see Figure 1). However, Adeleye and Eboagu (2019) note that Nigeria has consistently maintained the lead in Africa in terms of the number of mobile cellular subscribers.

On the other hand, the number of fixed telephone subscriptions (per 100 people) in the region was 0.95 in 1996. It increased to 1.89 in 2010 and decreased to 1.33 in 2018. In country-specific figures, Cabo Verde (6.38), Gambia (1.83), and Senegal (1.07) had the highest subscriber numbers in 1996. In 2013, these countries remained the highest subscribers, with Cabo Verde, Gambia, and Senegal having 12.93, 3.27, and 2.49 subscriptions per 100, respectively. The lowest subscriber countries as of 2018 are Guinea and Guinea-Bissau, which have no subscriptions. Overall, mobile phone subscriptions are increasing rapidly, while fixed telephone subscriptions are decreasing. This can be related to the convenience of using mobile phones and multiple subscriptions to alternative networks or service providers. The West African area is still developing and slowly adopting new technologies, but this is inevitable given digitalization's central role in the current wave of globalization and the restructuring of the global economic system.

3. METHODOLOGICAL NOTE

3.1. Model Specification and Data

This research comprises a panel of 15 ECOWAS countries from 1995 to 2022. We will augment the empirical model by Sovbetov (2018) for the empirical analysis. Thus.

$$FU_t = \alpha_0 + \sum_{i=1}^{2} \varphi_{it} T_{i,t} + \sum_{i=3}^{4} \varphi_{it} Y_{i,t} + \varepsilon_t \qquad (1)$$

FU_t denotes the female unemployment rate at time t, captured through two indicators: overall female unemployment ($FU_{1,t}$) and female youth unemployment ($FU_{2,t}$). In line with the International Labour Organisation's classification, youth are defined as individuals aged 17–24, a group whose unemployment dynamics may differ considerably since many are still engaged in formal education. The intercept term is represented by α_0. Digitalisation ($T_{i,t}$) is operationalised in three proxies: internet penetration rate (T_1), mobile phone subscriptions (T_2) and fixed telephone subscriptions (T_3). The internet penetration is expressed in a percentage of the total population, and the mobile and fixed telephone subscriptions are expressed per 100 persons, hence they are comparable to percentages.

$Y_{i,t}$ is a vector of control variables, which includes national income (Y_1) and inflation (Y_2). Both are theoretically and empirically related to the dynamics of unemployment as a result of the Okun Law and Phillips Curve, respectively. To ensure data consistency and minimize distortions caused by missing observations, the GDP deflator was selected as the inflation measure over the Consumer Price Index (CPI). As mentioned by Sovbetov (2018), with these macroeconomic controls included, the explanatory ability of the model is enhanced because it provides a more vivid evaluation of the correlation between digitalization and female unemployment in the ECOWAS region.

The strength of the model is improved by reducing the chances of multicollinearity through restricting the number of control variables, which would otherwise misrepresent the estimates of the coefficients and inflate the standard errors. This is a parsimonious specification that allows for more accurate and less biased inference about the impact of digitalization on female unemployment. Moreover, the information used is obtained from credible and official organizations, thereby enhancing the credibility and integrity of the empirical findings. Table 1 shows variables employed in the estimation, including the anticipated signs of their coefficients.

Table 1. Variable, sources of data, and expected coefficients signs.

Variables	Coefficient Sign	Sources
Female unemployment ($FU_{1,t}$)	Dependent	WDI
Female youth unemployment ($FU_{2,t}$)	Dependent	WDI
Internet penetration rate (T_1)	Negative (-)	WDI
Mobile telephone (T_2)	Negative (-)	WDI
Fixed telephone (T_3)	Negative (-)	WDI
National income-GDP (Y_1)	Negative (-)	UNCTAD
Inflation rate (Y_2)	Negative (-)	WDI

Note: UNCTAD- United Nations Conference on Trade and Development.
Source: WDI- World Development Indicator

3.2. Estimation Method

The research uses panel data from 28 years and 15 West African countries, where the time dimension exceeds the number of cross-sectional units. This necessitates the use of the Panel Autoregressive Distributed Lag (ARDL) model, introduced by Pesaran and Smith (1995) and optimized by Pesaran, Shin, and Smith (2001). In line with recent empirical practices (Azu et al., 2021), this method is relevant where variables are either level or first difference integrated. In order to justify the legitimacy of this assumption, we use the Im-Pesaran-Shin (IPS) unit root test (Im, Pesaran, & Shin, 2003), which takes into consideration the heterogeneity and cross-sectional dependence. ARDL models assist in estimating both short-term and long-term dynamics. The Mean Group (MG) estimator captures heterogeneity by averaging country-specific coefficients, while the Pooled Mean Group (PMG) estimator assumes homogeneous long-term relationships and allows for heterogeneous short-term dynamics. Although MG is consistent, it may be inefficient when long-run homogeneity exists, making PMG the preferred choice. A Hausman test is conducted, and a p-value above 0.05 indicates that PMG is the most effective and reliable estimator.

The ARDL model panel is expressed in its reparameterized error-correction form as a single equation to capture both short-run dynamics and long-run equilibrium relationships.

$$\Delta lnFU_{it} = \theta_i\big[lnFU_{i,t-1} - \phi_i'(lnT_{i,t} + Y_{i,t})\big] + \sum_{j=1}^{p-1} \lambda_{ij}\Delta lnFU_{i,t-j} + \sum_{j=0}^{q-1} \varphi_{ij}'\Delta lnT_{i,t-j} + \sum_{j=0}^{q-1} \varphi_{ij}'\Delta Y_{i,t-j} + \alpha_i + \varepsilon_{it}$$

(2)

Here, $\Delta lnFU_{it}$ denotes the change in female unemployment, while the bracketed term represents the error correction component (ECT), measuring deviations from long-run equilibrium. The coefficient θ_i captures the speed of adjustment and is expected to be negative, indicating convergence towards equilibrium. The vector ϕ_i' reflects long-run relationships between unemployment, digitalisation (T_1: internet, T_2: mobile, T_3: fixed telephone – all in logarithms), and control variables $Y_{i,t}$ (national income (Y_1) in log form and inflation (Y_2) in level form due to negative values). The parameters λ_{ij} and φ_{ij}' capture short-run dynamics, while α_i and ε_{it} denote fixed effects and the error term, respectively.

The ARDL panel method was employed to capture both short- and long-term dynamics while accounting for lags in all variables. Since digitalization's impact on female and youth unemployment may manifest over time, this approach reflects its true influence. It is particularly suited to gradual structural adjustments, such as technology adoption (Elsalih, Sertoglu, & Besim, 2021).

4. RESULTS AND DISCUSSION

The summary statistics are reported in panel A, while the correlation is reported in panel B of Table 2. Two sets of variables are highly correlated in panel B. First: female unemployment and female youth unemployment. Second, internet usage and mobile phone subscriptions. These variables will be estimated separately in the model to prevent multicollinearity, which can occur when estimating correlated variables (Azu et al., 2025). Therefore, the ARDL model is estimated in two sets. Firstly, with female unemployment as the dependent variable, the model is estimated with the internet penetration rate (hereafter known as FU_1T_1 model), then with a mobile telephone subscription

(hereafter known as FU_1T_2 model) and finally, with a fixed telephone subscription (hereafter known as FU_1T_3 model). Secondly, with female youth unemployment as a dependent variable, we estimated the internet penetration rate (hereafter known as FU_2T_1 model), then with a mobile telephone subscription (hereafter known as FU_2T_2 model) and lastly, with a fixed telephone subscription (hereafter known as FU_2T_3 model). All the results are presented in a single table for easy comparison.

Table 2. Summary statistics and correlation.

Panel A: summary statistics							
Variable	$FU_{1,t}$	$FU_{2,t}$	T_1	T_2	T_3	Y_1	Y_2
Obs	420	420	420	420	420	415	414
Mean	4.693	8.041	10.389	44.064	1.5408	2.97E+10	7.749
Std. Dev.	3.733	6.839	15.383	43.632	2.8957	8.50E+10	12.904
Min	0.218	0.156	0	0	0	2.06E+08	-7.901
Max	13.972	39.862	75.041	174.03	14.938	5.74E+11	100.61
Panel B Correlation							
Variables	$lnFU_{1,t}$	$lnFU_{2,t}$	lnT_1	lnT_2	lnT_3	lnY_1	Y_2
$lnFU_{1,t}$	1						
$lnFU_{2,t}$	**0.960**	1					
lnT_1	0.1485	0.1894	1				
lnT_2	0.0833	0.1012	**0.9086**	1			
lnT_3	0.5063	0.5123	0.1804	0.1198	1		
lnY_1	-0.0898	-0.0049	0.3	0.2978	-0.1961	1	
Y_2	0.0777	0.0788	-0.1358	-0.1107	-0.1006	0.0816	1

Note: Both the summary statistics were estimated from raw data (before logarithmic transformation), while the correlation was obtained from logarithm-transformed data.

As reported in Table 3, the stationarity test indicates that all dependent and independent variables are stationary at the level or in first differences. While the internet penetration rate, mobile phone subscriptions, and inflation are stationary at the level, female unemployment, the female youth unemployment rate, national income, and fixed telephone subscriptions are stationary at the first difference. These findings support the suitability of the variables for the panel ARDL estimation technique.

Table 3. Unit root test (IPS).

Variable	Level		1st difference		Remark
	Constant	Trend	Constant	Trend	
$lnFU_{1,t}$	-0.6581	-2.5023***	-10.3042***	-8.3863***	I1
$lnFU_{2,t}$	-0.4123	-2.2361**	-10.0197***	-7.7479***	I1
lnT_1	-4.5002***	-3.7030***	-7.3370***	-5.8470***	I0
lnT_2	-6.6712***	1.5776	-5.1985***	-7.8587***	I0
lnT_3	0.1199	1.5960	-5.0381***	-4.5961***	I1
Y_1	3.3931	1.1969	-9.2282***	-7.5775***	I1
Y_2	-12.2759***	-10.8575***	-18.6164***	-16.0314***	I0

Note: Outputs are t-statistics. *** $p<0.01$, ** $p<0.05$

The Hausman test was used to assess the suitability of the MG or PMG estimator, and the results indicated that the PMG estimator was preferred across all models. The null hypothesis of homogeneity of MG and PMG estimators cannot be rejected in all the models (FU_1T_1 FU_1T_2, FU_1T_3 FU_2T_1, FU_2T_2 and FU_2T_3) since the null hypotheses of homogeneity of MG and PMG estimators could be rejected because the p-values > 0.05. Thus, the PMG estimator is most appropriate for all the models.

The Hausman test was used to decide which estimator to use: the MG or the PMG estimators. The findings consistently favored the PMG estimator across all model specifications. The null hypothesis of the homogeneity

between the MG and the PMG estimators was not rejected in any cases (FU_1T_1 FU_1T_2, FU_1T_3 FU_2T_1, FU_2T_2 and FU_2T_3) because the p-values were greater than the 0.05 level of significance. By extension, the PMG estimator is considered the best one to suit all the models.

Appropriate lags were selected for each variable in each country using the unconstrained model across all four models. The most common lag reveals that the proper lag selection for FU_1T_1, FU_1T_2, FU_1T_3 FU_2T_1 FU_2T_2 models is (2, 0, 0, 0) while FU_2T_3 model is (2, 0, 2, 0).

4.1. Long-run Effect of Digitalization on Female Unemployment in West Africa

This sub-section emphasizes the assessment of the long-term dynamics of digitalization on female unemployment and female youth unemployment in the ECOWAS region. As indicated in Table 4, cointegration between the dependent and explanatory variables is common in all model constructions as indicated by the size and statistical significance of the error-correction terms (ECTs). The ECT coefficients are found to be negative and significant at the 1 percent level in the FU_1T_1, FU_1T_2 and FU_1T_3 models with consistency with the long-run equilibrium conditions observed in the FU_2T_1 FU_2T_2 and FU_2T_3 models.

The speed of adjustment to long-run equilibrium is estimated by the values of ECT across all models. As it is consistent with Azu et al. (2025), the coefficients of ECT are within the range of -1 and 0, indicating that possible structural breaks did not cause serial correlation or model instability. Particularly, they are the ECT magnitudes of the FU_1T_1, FU_1T_2 and FU_1T_3 models, which are /0.152/, /0.238/ and /0.138/, respectively, representing convergence rate of 15.2% and 23.8% and 13.8% respectively. Correspondingly, the FU_2T_1 FU_2T_2 and FU_2T_3 models determine the ECT values of /0.177/, /0.267/ and /0.177/ proposing convergence rates of 17.7%, 26.7% and 17.7% respectively. Overall, the results revealed a relatively slow convergence rate, indicating weak cointegration across the panels.

Table 4. PMG short-run and long-run estimation.

Short-Run Effects						
	Female Unemployment (FU_1)			Female Youth Unemployment (FU_2)		
Variables	FU_1T_1	FU_1T_2	FU_1T_3	FU_2T_1	FU_2T_2	FU_2T_3
ECT	–0.152***	–0.238***	–0.138***	–0.177***	–0.267***	–0.177***
	(0.0590)	(0.0607)	(0.0428)	(0.0530)	(0.0574)	(0.0471)
ΔlnT_{it}	0.0145	0.0840	0.0813	–0.0459	0.0727	0.0758
	(0.0200)	(0.0627)	(0.0587)	(0.0291)	(0.0543)	(0.0639)
ΔlnY_1	–0.144*	–0.0978	–0.0205	0.0471	–0.0724	–0.0749
	(0.0831)	(0.0926)	(0.0848)	(0.180)	(0.111)	(0.103)
ΔY_2	0.0301	0.0250	0.0304	0.00976	0.0319	0.0387
	(0.0264)	(0.0300)	(0.0280)	(0.00817)	(0.0370)	(0.0331)
Constant	–0.506***	–0.686***	1.243***	0.615***	0.428***	1.536***
	(0.173)	(0.148)	(0.389)	(0.175)	(0.103)	(0.411)
Observations	388	377	375	388	377	375
Long-run Effects						
lnT_{it}	0.0223***	0.0272***	–0.249***	–0.101**	0.0326***	–0.175***
	(0.00275)	(0.00330)	(0.0571)	(0.0402)	(0.00992)	(0.0479)
lnY_1	0.191***	0.167***	–0.349***	–0.0827	–0.00705	–0.314***
	(0.00144)	(0.00139)	(0.00491)	(0.122)	(0.00695)	(0.0498)
Y_2	0.0101*	0.00650	–0.0676***	0.0156	–0.01000	–0.0649***
	(0.00558)	(0.00545)	(0.0164)	(0.0556)	(0.0251)	(0.0148)

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Lag selection for FU_1T_1, FU_1T_2, FU_1T_3, FU_2T_1 and FU_2T_2 models is (2, 0, 0, 0) while FU_2T_3 model is (2, 0, 2, 0).

Considering the consequences of digitalization on overall female unemployment, the results are not similar with respect to FU_1T_1, FU_1T_2 and FU_1T_3 models. The estimated long-run coefficient for FU_1T_1 and FU_1T_2 models were not consistent with expectations. The outcome revealed positive coefficients of 0.0223 and 0.0272 for FU_1T_1 and

FU_1T_2. In both cases, the models were statistically significant at the 1% level. But the coefficient for FU_1T_3 model was negative (-0.249) and statistically significant. This implies that as digitalization increases, female unemployment will tend to increase by 2.23% (with internet penetration rate) and 2.72% (with mobile phone subscription) for FU_1T_1 and FU_1T_2 models, respectively. However, with regard to FU_1T_3 the result implies that, as fixed telephone subscriptions increase by 1%, female unemployment will be reduced by 24.9%, all else equal. These later results align with Shamaki et al. (2022); Asongu and Odhiambo (2018); Asongu and Odhiambo (2020), and Makun et al. (2022), which attest that digitalization improves female economic engagement but contradicts the initial results on internet penetration rates and mobile phone subscriptions.

The results on the consequences of digitalization for female youth unemployment differ across countries with different internet penetration rates. The estimated long-run coefficient for FU_2T_1 and FU_2T_3 models were consistent with expectations. The FU_2T_1 and FU_2T_3 models revealed negative coefficients of -0.101 and -0.175, respectively, which are statistically significant at 5% and 1% in that order. The implication is that as internet penetration and fixed telephone subscriptions increase by 1%, female youth unemployment decreases by 10.1% and 17.5%, respectively. This is consistent with Azu et al. (2021), who attest that digital technologies are instrumental in reducing youth unemployment in West Africa. But FU_2T_2 model indicates a contrary view. It shows a positive coefficient of 0.0326 for mobile phone subscriptions and is statistically significant at the 1% level, implying that for every 1% increase in mobile phone subscriptions, youth unemployment increases by approximately 3.3%. This result contradicts the claim that digitalization could reduce marginalization (Asongu & Odhiambo, 2018, 2020; Efobi et al., 2018; Makun et al., 2022) and, hence, improve female economic participation.

The preceding results demonstrate that an increase in internet usage can lead to a rise in female unemployment but a decrease in female youth unemployment due to the differential impact of digital adoption across age groups. Females younger than 18, who tend to be more flexible and open to new technologies, can receive a greater advantage when using the internet more due to the opportunity to get online education, remote employment opportunities, as well as online entrepreneurship. This has the potential to make them more employable and minimize youth unemployment. Conversely, older women who may not be digitally literate or able to adapt to emerging technologies might be pushed out of their traditional jobs as these roles become digitized. These older women might find themselves at a disadvantage once the economy becomes more digital, and as a result, they will become more unemployed.

The growth of mobile phone usage would increase female unemployment and female youth unemployment because mobile technology is ubiquitous and affects the conventional job market. Mobile technology has been used in automation and even to replace low-skilled workers with tasks; women, particularly in West Africa, take most of the jobs. With mobile services and applications increasingly present in areas such as retail, customer service, and informal trade, older and younger women may not have alternative jobs, especially when they lack the skills or resources to take on more technology-focused roles. Such a large-scale upheaval may lead to higher unemployment rates among women, particularly young women, who are already sensitive to labor-market changes.

Conversely, as the number of people using fixed telephones increases, female unemployment and female youth unemployment would decrease in West Africa because of the technology's security and familiarity. Sectors with large concentrations of women in customer service, administration, and certain retail and hospitality roles are frequently served by fixed telephone lines. These jobs are less likely to be displaced by rapid technological advancements and can provide stable employment opportunities. Moreover, fixed telephones can facilitate communication and coordination for women entrepreneurs and small business owners, enhancing business operations without requiring advanced digital skills. This stability and support can help reduce unemployment rates among women of all ages in the region.

4.2. Short-Run Effect of Digitalization on Female Unemployment in West Africa

Generally, there was no indication of a homogeneous and significant short-term impact of digitalization on female unemployment, including overall female unemployment and female youth unemployment, in the ECOWAS region. However, the PMG estimator provides short-term results for the countries in the panel. FU_1T_1 model indicates that five-panel members exhibit cointegration (see Appendix 1). Of these, only Burkina Faso (-0.0324) and the Gambia (-0.0213) reported negative and significant short-run coefficients for digitalization. Results for other countries are not statistically significant. Similarly, from FU_1T_2 model, six-panel countries revealed cointegrations in the model (see Appendix 2). However, only Benin was consistent with expectations, with a negative coefficient of -0.360, which was statistically significant at the 5% level. Also, from FU_1T_3 In the six-panel model, countries revealed cointegration (see Appendix 3), with the Gambia being the only country with results consistent with expectations: a negative coefficient of -0.0500 and statistically significant at the 10% level. Guinea (0.131), Senegal (0.694), and Togo (0.117) reported positive and significant coefficients.

Concerning female youth unemployment, the FU_2T_1 model indicates elements of cointegration with some countries (see Appendix 4). But only Burkina Faso (-0.0437), Cape Verde (-0.148), Guinea-Bissau (-0.294), and Mali (-0.242) reported negative, statistically significant short-run coefficients for the internet penetration rate. Also, from FU_2T_2 model, as posted in Appendix 5, about eight countries showed evidence of cointegration of the model. The countries reporting statistically significant negative ECM coefficients are Benin, Burkina Faso, Ghana, Guinea, Mali, Nigeria, Sierra Leone, and Togo. Among these, only Benin (-0.303) and Burkina Faso (-0.109) showed a negative, significant short-term impact of digitalization on female youth unemployment. This indicates that a 1% increase in digitalization in the short term led to a 30.3% decrease in female youth unemployment in Benin and a 10.9% decrease in Burkina Faso. Other results were not statistically significant, except for Ghana, which reported a positive (0.685) and significant influence of digitalization on female youth unemployment. Lastly, from FU_2T_3 Models: six countries in the panel were found to have cointegrations in the model (see Appendix 6). Overall, it showed that digitalization would instead increase female youth unemployment in Guinea, Senegal, and Togo in the short term.

The region has expressed great interest in embracing digital technologies, considering the wide scope of their implications. Nevertheless, the success of these outputs depends on how these technologies are exploited, as this largely determines short-term outcomes, especially for individual countries. In this context, intention is defined as the perception of the usefulness of technology or an individual's attitude towards its adoption (Asongu & Odhiambo, 2018). Again, the theory of reasoned action assumes that consumers are rational in considering all potential consequences; thus, if adopting digitalization in internet usage and mobile phone subscriptions results in reduced female unemployment, it is reasonable to expect that more females in West Africa are empowered to accept these technologies voluntarily.

5. CONCLUSION

The primary goal of this study is to examine the role of digitalization in fostering long-term empowerment of women in the workforce. The article uses three proxies to represent digitalization to accomplish these ends: internet penetration rate, mobile telephone subscription, and fixed telephone subscription. The data were subjected to an IPS unit-root test to assess suitability for the panel ARDL estimation method, and the Hausman test indicated the superiority of the PMG estimator across all models. The results revealed a relatively slow convergence rate, indicating weak cointegration across the panels. This research found that, in the long run, digitalization tends to reduce female and female youth unemployment in the region by 24.9% and 17.5%, respectively, through fixed telephone subscriptions. It further revealed that the internet penetration rate reduces female youth unemployment by 10.1% but increases female unemployment by 2.23%. Conversely, mobile phone subscriptions increase female unemployment by 2.72% to 3.26%. However, in the short run, the effect of digitalization was not statistically significant. It further revealed that the short-run estimates for the respective panel members were inconsistent in

some countries and, hence, not robust. This indicates that increased internet penetration increases access to education, remote work, and e-commerce, thereby advancing the SDGs. Financial services, healthcare, and entrepreneurship are facilitated by mobile phones, leading to economic development and equality.

It is suggested that specific digital literacy programs and vocational training be implemented to enhance the technological skills of women. Governments and organizations should aim to provide affordable technology and Internet services to underserved groups. It is expected to equip women and young girls with the means of participating in the digital economy. To be more precise, policies promoting gender equality in education and employment, mentorship programs, and networking services are essential for closing the digital divide. It can also encourage women to work in technology-intensive fields and reduce female unemployment. The weaknesses of this study stem from the fact that we could not measure e-commerce penetration, the level of digital financial inclusion, or e-payments as a component of digitalization, as the data were not available. Hence, an additional study is suggested in that regard.

The ECOWAS region offers a valuable case study of harmonizing regional policies related to the digital economy and gender-friendly labor-market policies. Through regional integration in digital infrastructure, training, and access to technology, ECOWAS countries can jointly reduce barriers that limit the female workforce and empower women in the region. These harmonization efforts could also be extended to Asian nations, particularly Southeast Asian countries, which face similar socio-economic and technological challenges. Digital literacy, mobile connectivity, and entrepreneurship policies can be localized to support women across different cultures and economies, ensuring the digital divide is bridged and women are provided with sustainable employment opportunities.

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Appendices

Appendix 1. PMG short-run estimation for respective countries (FU_1T_1 Model).

Variable	ECT		$\Delta lnT_{1,it}$		ΔlnY_1		ΔY_2		Constant		
Country	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error	Observations
Benin	-0.136*	(0.0825)	-0.0893	(0.0782)	-0.109	(0.516)	0.0160	(0.0407)	-0.508	(0.338)	388
Burkina Faso	-0.466***	(0.120)	-0.0324*	(0.0190)	0.0185	(0.118)	-0.00529	(0.0203)	-1.377***	(0.365)	388
Cape Verde	0.0309	(0.104)	-0.0321	(0.0809)	-0.139	(0.118)	0.00480	(0.0200)	0.0581	(0.173)	388
Cote d'Ivoire	0.00472	(0.0466)	0.0612	(0.0796)	-0.0404	(0.168)	0.000270	(0.0111)	-0.0611	(0.0926)	388
Ghana	-0.115*	(0.0631)	0.120	(0.1000)	-0.401**	(0.191)	-0.0202	(0.0164)	-0.366*	(0.205)	388
Gambia	-0.838***	(0.120)	-0.0213*	(0.0124)	-0.177***	(0.0522)	-0.00126	(0.00313)	-2.386***	(0.344)	388
Guinea	0.0375	(0.0764)	0.0146	(0.0296)	-0.266***	(0.0943)	0.0160***	(0.00619)	0.128	(0.229)	388
Guinea Bissau	-0.0214	(0.0859)	-0.0831	(0.105)	-0.291	(0.430)	-0.00225	(0.0307)	-0.0350	(0.281)	388
Liberia	-0.0739	(0.0896)	0.0254	(0.0295)	-0.539***	(0.159)	0.0196	(0.0191)	-0.210	(0.300)	388
Mali	-0.171	(0.140)	-0.0916	(0.0820)	-0.767**	(0.358)	0.0607	(0.0494)	-0.569	(0.569)	388
Niger	-0.242	(0.172)	0.172	(0.300)	0.125	(1.580)	0.391	(0.386)	-1.158	(0.809)	388
Nigeria	-0.126*	(0.0679)	-0.0112	(0.0447)	-0.0692*	(0.0411)	-0.00215	(0.0134)	-0.445*	(0.258)	388
Senegal	0.00986	(0.0571)	0.0836	(0.0769)	0.623*	(0.340)	-0.0416	(0.0808)	-0.0728	(0.143)	388
Sierra Leone	-0.102	(0.0889)	0.0685	(0.0622)	0.140	(0.130)	0.000500	(0.00848)	-0.352	(0.280)	388
Togo	-0.0741	(0.0489)	0.0332	(0.0393)	-0.273	(0.213)	0.0153	(0.0169)	-0.234	(0.164)	388

Note: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix 2. PMG short-run estimation for respective countries (FU_1T_2 Model).

Variables	ECT		$\Delta lnT_{2,it}$		ΔlnY_1		ΔY_2		Constant		
Country	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error	Observations
Benin	-0.265***	(0.0982)	-0.360**	(0.156)	0.200	(0.456)	-0.0824	(0.0513)	-0.897**	(0.349)	377
Burkina Faso	-0.593***	(0.144)	-0.0243	(0.0310)	0.0408	(0.114)	-0.00702	(0.0204)	-1.483***	(0.367)	377
Cape Verde	-0.0111	(0.100)	0.00369	(0.0198)	-0.133	(0.118)	0.00580	(0.0199)	-0.0100	(0.115)	377
Cote d'Ivoire	0.00987	(0.0464)	0.0348	(0.0557)	-0.0324	(0.170)	0.00111	(0.0111)	-0.0485	(0.0688)	377
Ghana	-0.388***	(0.0995)	0.819***	(0.232)	-0.443***	(0.162)	-0.0260*	(0.0137)	-1.135***	(0.295)	377
Gambia	-0.877***	(0.129)	-0.00841	(0.0151)	-0.112**	(0.0535)	0.00229	(0.00421)	-2.096***	(0.309)	377
Guinea	-0.242	(0.148)	0.0193	(0.0176)	0.0248	(0.133)	-0.00935	(0.0160)	-0.629	(0.383)	377
Guinea Bissau	-0.0946	(0.0858)	0.210*	(0.119)	-0.0730	(0.413)	0.0273	(0.0308)	-0.306	(0.239)	377
Liberia	-0.182	(0.137)	0.0346	(0.0459)	-0.438**	(0.183)	0.00762	(0.0214)	-0.496	(0.409)	377
Mali	-0.181	(0.138)	-0.00744	(0.0881)	-0.652	(0.425)	0.0455	(0.0556)	-0.561	(0.488)	377

Variables	ECT		$\Delta lnT_{2,it}$		ΔlnY_1		ΔY_2		Constant		
Country	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error	Observations
Niger	-0.274	(0.183)	0.158	(0.192)	-0.580	(1.723)	0.432	(0.398)	-1.120	(0.754)	377
Nigeria	-0.108*	(0.0621)	-0.0139	(0.0243)	-0.0649	(0.0420)	-0.00243	(0.0131)	-0.316	(0.197)	377
Senegal	-0.0121	(0.0578)	0.124*	(0.0667)	0.803**	(0.338)	-0.0282	(0.0780)	-0.144	(0.123)	377
Sierra Leone	-0.195*	(0.105)	0.0769	(0.0774)	0.177	(0.185)	0.00256	(0.00963)	-0.565**	(0.284)	377
Togo	-0.161**	(0.0711)	0.193*	(0.105)	-0.184	(0.215)	0.00666	(0.0172)	-0.489**	(0.223)	377
Note: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1											

Note: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix 3. PMG short-run estimation for respective countries (FU_1T_3 Model).

Variables	ECT		$\Delta lnT_{3,it}$		ΔlnY_1		ΔY_2		Constant		
Country	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error	Observations
Benin	-0.00853	(0.0522)	0.0781	(0.0835)	0.213	(0.499)	-0.00277	(0.0405)	0.107	(0.426)	375
Burkina Faso	-0.0337	(0.0293)	0.0403	(0.123)	0.0292	(0.182)	-0.0121	(0.0248)	0.332	(0.265)	375
Cape Verde	-0.144	(0.0925)	-0.207	(0.207)	-0.0865	(0.110)	0.0107	(0.0190)	1.516	(0.972)	375
Cote d'Ivoire	0.0248	(0.0552)	0.183	(0.184)	-0.0648	(0.166)	0.00101	(0.0110)	-0.300	(0.545)	375
Ghana	-0.502***	(0.146)	0.0488	(0.126)	0.0139	(0.217)	-0.0126	(0.0147)	5.105***	(1.484)	375
Gambia	0.0442*	(0.0244)	-0.0500*	(0.0286)	-0.0806**	(0.0371)	0.00221	(0.00159)	-0.366*	(0.214)	375
Guinea	-0.246***	(0.0628)	0.131***	(0.0467)	-0.141*	(0.0838)	0.0155***	(0.00342)	1.984***	(0.493)	375
Guinea Bissau	-0.196*	(0.103)	0.0432	(0.221)	-0.0417	(0.417)	0.0195	(0.0287)	1.972*	(1.037)	375
Liberia	-0.188**	(0.0732)	0.00897	(0.0403)	-0.466***	(0.142)	0.0191	(0.0167)	1.519***	(0.575)	375
Mali	0.0179	(0.0622)	-0.271	(0.358)	-0.553	(0.379)	0.0310	(0.0507)	-0.0576	(0.533)	375
Niger	-0.435**	(0.202)	0.378	(0.563)	-0.184	(1.513)	0.417	(0.369)	3.261**	(1.531)	375
Nigeria	-0.0833	(0.0722)	-0.0272	(0.0526)	-0.0200	(0.0472)	-0.00256	(0.0141)	0.866	(0.741)	375
Senegal	-0.0221	(0.0462)	0.694***	(0.181)	0.924***	(0.284)	-0.0454	(0.0640)	0.133	(0.483)	375
Sierra Leone	-0.0536	(0.0418)	0.0538	(0.0359)	0.136	(0.130)	0.00302	(0.00832)	0.431	(0.349)	375
Togo	-0.245***	(0.0569)	0.117*	(0.0624)	0.0139	(0.190)	0.0126	(0.0135)	2.136***	(0.492)	375

Note: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix 4. PMG short-run estimation for respective countries (FU_2T_1 Model).

Variables	ECT		$\Delta lnT_{1,it}$		ΔlnY_1		ΔY_2		Constant		
Country	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error	Observations
Benin	-0.0474	(0.0428)	-0.111	(0.0861)	0.0979	(0.490)	0.00882	(0.0389)	0.235	(0.211)	388
Burkina Faso	-0.0576*	(0.0298)	-0.0437*	(0.0263)	-0.0313	(0.146)	0.00507	(0.0242)	0.263	(0.197)	388
Cape Verde	-0.0982*	(0.0564)	-0.148*	(0.0821)	-0.214*	(0.114)	0.00631	(0.0199)	0.584	(0.383)	388
Cote d'Ivoire	0.00390	(0.0590)	0.0453	(0.0464)	-0.0275	(0.124)	-0.000158	(0.00826)	-0.0682	(0.271)	388
Ghana	-0.451***	(0.146)	-0.0691	(0.0648)	-0.288	(0.191)	-0.0235	(0.0181)	2.008	(1.605)	388
Gambia	0.000239	(0.0188)	-0.0302	(0.0216)	-0.0884	(0.0691)	0.000780	(0.00377)	0.0396	(0.0722)	388
Guinea	-0.0630	(0.0392)	-0.00168	(0.0249)	-0.199**	(0.0850)	0.0117**	(0.00532)	0.223	(0.203)	388
Guinea Bissau	-0.535***	(0.114)	-0.294***	(0.0799)	0.439	(0.354)	0.0551**	(0.0275)	2.208	(1.651)	388
Liberia	-0.188	(0.154)	0.0530	(0.0621)	-0.496	(0.368)	0.0337	(0.0406)	0.535	(0.681)	388
Mali	-0.136	(0.0947)	-0.242*	(0.143)	-1.058*	(0.567)	0.0707	(0.0754)	0.570	(0.494)	388
Niger	-0.645***	(0.193)	0.0651	(0.336)	2.038	(1.886)	0.0306	(0.442)	1.097	(1.846)	388
Nigeria	-0.0295	(0.0562)	-0.0175	(0.0806)	-0.0153	(0.0596)	-0.00598	(0.0206)	0.135	(0.296)	388
Senegal	-0.123	(0.0858)	-0.0203	(0.0633)	0.795**	(0.390)	-0.0634	(0.0892)	0.508	(0.529)	388
Sierra Leone	-0.254**	(0.109)	0.115	(0.0770)	0.245	(0.193)	-0.00405	(0.0139)	0.751	(0.764)	388
Togo	-0.0290	(0.0751)	0.00854	(0.0485)	-0.492*	(0.267)	0.0206	(0.0215)	0.140	(0.293)	388

Note: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix 5. PMG short-run estimation for respective countries (FU_2T_2 Model).

Variables	ECT		$\Delta lnT_{2,it}$		ΔlnY_1		ΔY_2		Constant		Observations
Country	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error	Coefficient	Std Error	
Benin	-0.131**	(0.0600)	-0.303**	(0.147)	0.387	(0.411)	-0.0763	(0.0465)	0.226**	(0.0952)	377
Burkina Faso	-0.350***	(0.109)	-0.109**	(0.0474)	-0.0326	(0.127)	-0.00381	(0.0226)	0.740***	(0.224)	377
Cape Verde	-0.122	(0.103)	-0.00806	(0.0165)	-0.201*	(0.116)	0.0146	(0.0207)	0.435	(0.343)	377
Cote d'Ivoire	0.00467	(0.0499)	0.0271	(0.0419)	-0.0218	(0.129)	0.000437	(0.00840)	-0.0574	(0.136)	377
Ghana	-0.549***	(0.120)	0.685***	(0.175)	-0.258	(0.163)	-0.0236*	(0.0143)	1.136***	(0.275)	377
Gambia	-0.0903	(0.0811)	-0.0240	(0.0229)	-0.0128	(0.0800)	-0.00123	(0.00488)	0.201	(0.153)	377
Guinea	-0.900***	(0.230)	0.0212	(0.0164)	-0.101	(0.125)	0.00998	(0.0155)	1.315***	(0.379)	377
Guinea Bissau	-0.190	(0.133)	0.171	(0.138)	0.0871	(0.498)	0.0251	(0.0373)	0.316	(0.263)	377
Liberia	-0.285	(0.187)	0.136	(0.134)	-0.0772	(0.531)	-0.00979	(0.0519)	0.263	(0.164)	377
Mali	-0.316**	(0.147)	-0.0174	(0.118)	-0.871	(0.568)	0.0563	(0.0757)	0.376**	(0.160)	377
Niger	-0.274	(0.183)	0.208	(0.252)	-0.790	(2.245)	0.537	(0.519)	0.0148	(0.246)	377
Nigeria	-0.326***	(0.101)	-0.0137	(0.0290)	-0.0662	(0.0518)	-0.00888	(0.0171)	0.786***	(0.255)	377
Senegal	-0.0727	(0.0830)	0.110	(0.0785)	0.850**	(0.405)	-0.0547	(0.0929)	0.0837	(0.216)	377
Sierra Leone	-0.214**	(0.103)	0.105	(0.120)	0.379	(0.287)	-0.000923	(0.0150)	0.242	(0.164)	377
Togo	-0.185**	(0.0769)	0.101	(0.0975)	-0.357	(0.252)	0.0148	(0.0203)	0.339**	(0.134)	377

Note: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix 6. PMG Short-run estimation for respective countries (FU_2T_3 Model).

Variables	ECT		$\Delta lnT_{3,it}$		ΔlnY_1		ΔY_2		Constant		
Country	Coefficient	Std error	Coefficient	Std error	Coefficient	Std Error	Coefficient	Std error	Coefficient	Std error	Observations
Benin	–0.000274	(0.0373)	0.0905	(0.0744)	0.334	(0.435)	–0.00947	(0.0350)	0.0619	(0.300)	375
Burkina Faso	–0.0380	(0.0306)	0.00804	(0.125)	0.0342	(0.181)	–0.00135	(0.0251)	0.362	(0.269)	375
Cape Verde	–0.0715	(0.0634)	–0.242	(0.224)	–0.249**	(0.120)	0.0200	(0.0215)	0.770	(0.656)	375
Cote d'Ivoire	0.0148	(0.0576)	0.164	(0.139)	–0.0342	(0.124)	6.04e-05	(0.00851)	–0.180	(0.545)	375
Ghana	–0.562***	(0.149)	–0.00621	(0.126)	–0.156	(0.186)	–0.00318	(0.0157)	5.578***	(1.536)	375
Gambia	0.0476*	(0.0276)	–0.0431	(0.0311)	–0.0320	(0.0330)	0.000933	(0.00178)	–0.376	(0.230)	375
Guinea	–0.262***	(0.0715)	0.0775***	(0.0300)	–0.164***	(0.0413)	0.0156***	(0.00220)	2.023***	(0.507)	375
Guinea Bissau	–0.260*	(0.134)	0.00795	(0.270)	0.00978	(0.495)	0.0313	(0.0362)	2.476*	(1.308)	375
Liberia	–0.436***	(0.137)	0.0598	(0.0860)	–0.205	(0.311)	0.0310	(0.0336)	3.253***	(1.156)	375
Mali	–0.0779	(0.0934)	–0.289	(0.527)	–0.781	(0.571)	0.0376	(0.0755)	0.720	(0.768)	375
Niger	–0.416**	(0.211)	0.586	(0.756)	–0.623	(1.996)	0.494	(0.486)	2.955*	(1.604)	375
Nigeria	–0.149	(0.113)	–0.104	(0.0745)	–0.0348	(0.0544)	–0.000139	(0.0199)	1.529	(1.164)	375
Senegal	–0.0945	(0.0680)	0.610***	(0.229)	0.947***	(0.364)	–0.0636	(0.0815)	0.860	(0.686)	375
Sierra Leone	–0.0965	(0.0686)	0.0570	(0.0589)	0.189	(0.203)	0.00132	(0.0134)	0.746	(0.566)	375
Togo	–0.259***	(0.0704)	0.160*	(0.0828)	–0.359	(0.225)	0.0255	(0.0175)	2.270***	(0.655)	375

Note: Standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$