

REGIONAL SPILLOVERS OF INFORMAL ECONOMIC ACTIVITIES IN THE ECOWAS: A BAYESIAN PANEL VAR APPROACH

Ismail Aremu Muhammed^{a*}; Gamini Premaratne^b; Norulazidah H. Omar^c; & Ahmed Masood Khalid^d

^{abc}School of Business and Economics, Universiti Brunei Darussalam, Brunei

^dLahore University of Management Sciences, Lahore, Pakistan

*Corresponding author's email: 22h1903@ubd.edu.bn

Abstract

The informal economy is an important part of economic activity in ECOWAS countries, accounting for a sizable portion of employment and GDP. Earlier research focused on national-level informality, with little known about cross-border spillovers of informal economic activities. The regional transmission of informal economy shocks across ECOWAS countries is investigated in this study using a Bayesian Panel Vector Autoregression (VAR) framework on quarterly series from 2006 to 2021. The framework is ideal to account for parameter uncertainty, cross-country relationships, and limited data availability. Annual data for the informal economy series were obtained from the World Bank database and were transformed into quarterly series using the Chow-Lin temporal disaggregation method. Quarterly series for global commodity prices, an exogenous variable, were collected from the UNCTAD database. The study revealed some variations in informal economy spillovers across the region. While Nigeria, Ghana, and Côte d'Ivoire have strong links with neighbouring nations, smaller economies like Cabo Verde and The Gambia have limited or nonexistent spillover effects. Furthermore, Francophone-Anglophone asymmetries exist, with Francophone nations having larger informal economy linkages due to historical trade ties and a common currency. Border-sharing realities are particularly important, as shocks from Nigeria and Côte d'Ivoire significantly impact neighbouring economies. By implication, harmonising informal trade restrictions, enhancing cross-border financial integration, and building economic resilience reduce negative spillovers. Shifting the focus from national to regional informal economy interdependencies, this study improves understanding of informal sector dynamics and contributes to the development of coordinated ECOWAS policies that combine informality regulation with economic stability.

Keywords: Informal Economy, ECOWAS, Bayesian VAR, Cross-Border Spillovers, Economic Integration

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Introduction

The informal economy has been a major source of employment and income in West Africa, accounting for more than 80 per cent of total employment and 40-60 per cent of GDP in various countries (ILO, 2020; Medina and Schneider, 2019). Unlike in industrialised economies, where informality is frequently regarded as marginal or residual, it is deeply established in socioeconomic institutions in developing countries, acting as a shock absorber during economic downturns (La Porta & Shleifer, 2014). The industry employs low-skilled workers, women, and youth who face impediments to entry into the official labour market (Chen, 2012). Despite its importance, research on the informal economy in West Africa has primarily concentrated

on national-level dynamics, ignoring cross-border spillovers that affect regional economic performance (Benjamin & Mbaye, 2012). Given the region's porous borders, shared economic policies (e.g., ECOWAS), and significant commercial relations, informal economic activity in one nation can have a knock-on effect in others (OECD, 2018). These consequences are manifested through trade flows, labour migration, remittances, financial links, and regulatory arbitrage (African Development Bank, 2019).

Existing research frequently views the informal economy as a closed system, neglecting to acknowledge how regional and global variables influence informal sector dynamics (Kanbur, 2017). This study fills a vacuum by investigating the spread of informal economic shocks across West African countries, with an emphasis on spillover routes and their macroeconomic repercussions. While specific West African nations' informal economies have been thoroughly investigated (see, for example, Golub & Mbaye, 2019; Grimm et al., 2012; ILO, 2021; Ajide et al., 2024), empirical information on cross-country spillovers is lacking. Some concerns have been expressed recently about the likelihood of cross-border informal economic activities. For example, informal trade spillovers may exist among countries in a region or economic cooperation, affecting nearby markets through informal commerce in agriculture, textiles, and manufactured commodities (Golub & Mbaye, 2019). Informal labour mobility may result in cross-border informal economy spillovers, with pay differentials, migration, and economic shocks influencing informal labour supply across nations (ILO, 2021). Financial spillovers may occur when informal credit networks, remittances, and cross-border investments influence informal business expansion and household incomes (World Bank, 2020). Regulatory spillovers may also exist, whereby the differences in tax policies, business registration regulations, and enforcement strategies create distortions affecting informal enterprises regionally (OECD, 2019).

However, the possibility of these transmission channels causing a regional spillover of informal economic activities has been generally neglected in previous empirical studies. Moreover, most empirical studies on the informal economy used cross-sectional data and panel regressions, which failed to capture cross-border dynamic interdependence and causal linkages. The regional analysis of informal economic activities in ECOWAS is critical from a policy perspective due to the bloc's shared socioeconomic and institutional frameworks. ECOWAS member states are deeply interconnected through trade, labour mobility, and financial flows, often facilitated by porous borders and historical ties. Informal sector shocks in one country can spill over into neighbouring economies, undermining regional stability and growth. For instance, Nigeria's large informal economy significantly impacts Benin and Togo, while Francophone countries exhibit stronger linkages due to the CFA franc. A national-level focus fails to capture these cross-border dynamics, leading to fragmented policies that may inadvertently exacerbate regional disparities or inefficiencies. By adopting a regional lens, this study highlights the need for coordinated policies, such as harmonised trade regulations, cross-border financial integration, and joint enforcement strategies, to mitigate negative spillovers and leverage the informal sector's role as a regional shock absorber. Such an approach aligns with ECOWAS's broader goals of economic integration and resilience, ensuring policies are mutually reinforcing rather than solo.

To address this issue, this study applies a Bayesian panel VAR model, a versatile econometric technique that accounts for uncertainty, incorporates prior knowledge, and minimises overfitting, which is crucial in a situation with little data (Koop & Korobilis, 2010). Therefore, the main objectives of this study are to: (i) estimate the magnitude of cross-country interdependencies in informal economic activities in ECOWAS countries; and (ii) assess the responsiveness of informal economies to both domestic and external shocks.

This study makes significant theoretical, methodological, and policy contributions to the literature on informality in developing regions. Theoretically, it bridges a critical gap by shifting the focus from isolated national analyses to a regional spillover framework, uncovering how informal economic shocks transmit across ECOWAS borders through trade, labour mobility, and financial linkages, a dimension largely

overlooked in prior work. Methodologically, it advances the field by employing a Bayesian panel VAR approach, which not only addresses data scarcity challenges but also quantifies dynamic interdependencies between countries, offering a more robust alternative to static cross-country models.

More importantly, the study delivers actionable policy insights for ECOWAS stakeholders. Its investigation of a potential asymmetric spillover underscores the need for coordinated regional policies to manage informal trade and tax regimes, reducing destabilising cross-border arbitrage. The investigation may also reveal the difference between “complementary” (i.e. positive spillover) and “competitive” (i.e. negative spillover) informal economies, which will help in revealing the need for sector-specific formalisation that preserves livelihoods while curbing illicit flows.

By considering these issues in an empirical spillover analysis, the study will equip policymakers to balance economic integration with inclusive growth, a pressing priority for ECOWAS’s development agenda.

Literature Review

While much of the work has concentrated on the causes, characteristics, and consequences of informality at the national level, there is an increasing need to investigate cross-border spillover effects and regional interdependence. This section conducts a thorough assessment of existing research on the informal economy, focusing on its theoretical foundations, drivers, macroeconomic consequences, and spillover effects. Furthermore, it emphasises methodological advances in examining the informal sector, specifically the use of Bayesian VAR models in economic analysis.

The informal economy has been investigated via a variety of theoretical lenses, each providing unique explanations for its existence and persistence. Lewis’ (1954) Dual Sector Model impacted early studies on the informal economy, which holds that developing economies are divided into two sectors: modern, capital-intensive formal and traditional, labour-intensive informal. The informal economy is viewed as a transitional sector that absorbs surplus labour from rural regions before declining as the economy modernises (Harris & Todaro, 1970). The legalist viewpoint (de Soto, 1989) contends that informality is caused by burdensome government restrictions, bureaucratic inefficiencies, and high entry costs, which deter enterprises from formalising. Similarly, institutional theorists contend that lax enforcement of property rights, high taxation, and corruption foster an atmosphere in which informal firms thrive (Djankov et al. 2002).

According to regional economic integration theories, economic activities, including informal enterprises, do not operate in isolation but rather traverse boundaries through trade, labour migration, remittances, and financial links (Golub & Mbaye, 2019). Economic geography theories (Krugman, 1991) stress that regions with substantial trade linkages have interrelated economic dynamics, including informal economic activities. Introduced in Krugman’s (1991) seminal work titled “Increasing Returns and Economic Geography,” the theory transformed the knowledge of geographic economic distribution by explaining why economic activity clusters in specific places rather than being evenly distributed. This theory, which combines elements of trade theory, agglomeration, and increasing returns to scale, lays the groundwork for assessing regional economic interdependence, including informal sector spillover.

As for the empirical literature, several factors have been found to empirically determine the informal economy. These include the socioeconomic factors (La Porta & Shleifer, 2014), institutional factors (Medina & Schneider, 2019; Kanbur & Keen, 2015), financial development (Beck et al., 2008; World Bank, 2020), and global economic shocks (Kanbur, 2017). For instance, using the World Bank’s enterprise survey, La Porta and Shleifer (2014) investigated the relationship between informality and economic development. They discovered that the informal sector serves as a survival mechanism for millions of people who are excluded from regular work. Furthermore, informal enterprises are less productive, smaller in size, and

have less access to capital than formal firms. Ajide et al. (2024) investigated the relationship between the shadow economy and income inequality in the West African region. Their findings demonstrated that the shadow economy reduces economic disparity in the region, both in the short and long term. The informal economy's persistence has also been attributed to an inadequate regulatory environment. Medina and Schneider (2019) used the Multiple Indicators Multiple Causes (MIMIC) model to estimate the extent of the informal economy in 158 countries between 1991 and 2017. They discovered that nations with extensive bureaucracy and expensive business registration fees are likely to have greater informal economies. Kanbur and Keen (2015) discovered that tax thresholds influence informality in their research on the function of taxes and firm-size thresholds. They also discovered that countries with high corporate tax rates and tight business registration requirements are likely to have a larger informal sector, and high levels of corruption encourage informal activity as firms seek to avoid paying bribes or taxes.

As for the impact of financial development, Beck et al. (2008) investigated the relationship between financial access and informality using World Bank Enterprise Survey data. They discovered that limited access to banking services forces enterprises to operate informally, and countries with higher levels of financial inclusion tend to have smaller informal economies. World Bank's (2020) specific study for West Africa on informal enterprises and economic resilience also found that during economic downturns, informal businesses act as a shock absorber, sustaining employment, however, they struggle to access emergency funding, limiting their ability to recover. Considering the role of global economic shocks in informality size, Medina and Schneider (2019) examined how commodity price shocks influence the informal sector and found that when oil prices fall, informality rises due to the fall in government revenues, and when oil prices rise, informality decreases because inflation lowers purchasing power. In his study on the impact of financial crises in informality, Kanbur (2017) discovered that financial crises frequently lead to an expansion of the informal economy as job losses in the formal sector push workers into informal employment. Furthermore, the study by ILO (2021) on informality and labour market dynamics in developing countries discovered that informal employment rises during economic downturns as formal positions drop; yet, informal workers lack social protections, putting them vulnerable to lengthy recessions. Furthermore, Ajide and Dada (2024) investigated the role of globalisation in determining the size of the shadow economy in several African countries and discovered that rising globalisation reduces the size of the shadow economy.

Some attempts have been made to examine how the informal sector responds to the macroeconomic fluctuations in neighbouring countries. For instance, Benjamin and Mbaye (2012) investigated the structure and dynamics of informal economies in Francophone Africa. The study discovered that informal enterprises are extensively interwoven into the formal economy, frequently serving as subcontractors, and that regional integration through ECOWAS influences informal market structures by affecting trade routes and labour mobility. Golub and Mbaye (2019) also investigated how informal trade networks in West Africa generate cross-country spillovers. They discovered that currency rate fluctuations in Nigeria harm informal traders in Benin, Ghana, and Togo. They also demonstrated that informal traders used parallel currency markets to get around official exchange rate regulations.

Despite this empirical evidence, there are still some areas of the informal economy that need to be addressed, especially those related to cross-border spillovers. One of these areas is the response of the informal economy to sudden changes in the size of the informal economy in other countries in a regional or economic cooperation. While existing studies focus on national-level informality, regional spillovers in ECOWAS remain underexplored despite their policy relevance. Cross-border informal trade, labour mobility, and financial flows create interdependencies that national policies alone cannot address. For example, shocks in Nigeria's informal economy spill over to Benin and Togo, while Francophone countries

exhibit tighter linkages due to shared currency and trade networks. A regional analysis is critical for ECOWAS policymakers to design harmonised regulations, enhance cross-border financial integration, and mitigate destabilising spillovers, ensuring cohesive strategies that align with the bloc's economic integration goals. This study fills that gap by quantifying these spillovers, offering actionable insights for regional policy coordination. This aspect is the main contribution this study seeks to make to the literature. The use of the Bayesian panel VAR approach lends great support to making such a contribution by providing information on the magnitude of cross-border informal economy interdependencies and their responsiveness to domestic and external shocks.

Data and Methodology

Data

This study is conducted for 15 ECOWAS member states between the first quarter of 2006 and the fourth quarter of 2021, making (total of 64 quarters for each country. The end periods have some missing data, which were filled up with data imputations. Also, data on the informal economy is largely reported on an annual basis. Due to this limitation, the Chow-Lin temporal disaggregation method was applied to convert annual data into quarterly series. This enables more robust estimation and allows for the capturing of the short-run dynamics of the relationship between the informal economy and the formal economy, consistent with prior literature (e.g., Abeyasinghe & Lee, 1998; Chow & Lin, 1971). Such transformation is a common practice in economic and financial analysis, especially when higher-frequency data is needed for forecasting, policy analysis, or econometric modelling (Chow & Lin, 1971). The linear interpolation method was used because it is suitable for gradually changing variables (Hagan & West, 2006), just as it is the case with the informal economy data. The selection of the periods was largely based on data availability. Moreover, the ECOWAS bloc implemented some policy initiatives aimed at enhancing regional economic integration and agricultural development between 2005 and 2006. These include the ECOWAS agricultural policy and trade investment initiatives.

Data were collected for the informal economy of all 15 ECOWAS member states, which are treated as endogenous variables, as well as global commodity prices, which entered the equation as an exogenous variable. The data for the informal economy were obtained from the World Bank's database, while the data for global commodity prices were obtained from UNCTAD's database. The informal economy data was based on Medina and Schneider (2019), who employed the multiple indicators multiple causes model-based (MIMIC) estimates of informal output (% of official GDP), a structural equation model (SEM) that links an unobservable variable (the informal economy) to observable causes and indicators. Given that the study focuses on the spillover informal economy, the endogenous variable is the informal economy estimates obtained from the World Bank's database, while global commodity prices were included in the model as an exogenous variable.

Figure 1 presents the trends of the informal economy over the 64 quarters for each ECOWAS country. Although there are other indicators of the informal economy, as presented in the World Bank database. The choice of the MIMIC approach is based on its holistic approach to measuring the informal economy through the use of multiple causes and indicators. The choice is also based on its wider use in the literature, which ensures comparability with existing studies.

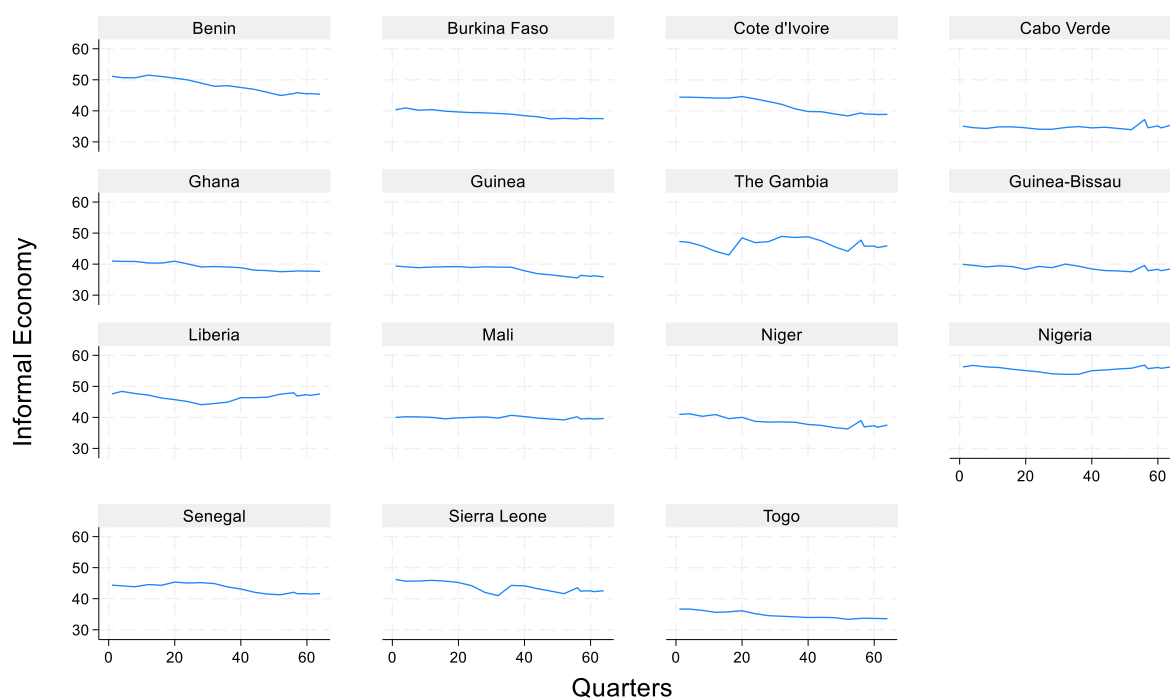


Figure 1: Informal Economy Trends across ECOWAS Countries

Figure 1 illustrates interesting variations in the size of the informal economy across ECOWAS countries over the 64 quarters considered. Nigeria stands out with the largest informal sector, consistently exceeding 50% of GDP. This aligns with its status as the region's largest economy, where informality thrives due to weak formal job creation, regulatory barriers, and a dominant agricultural sector. Benin and Liberia also show persistently high informality (nearly 50%), likely driven by cross-border trade (e.g., Benin's dependence on Nigeria's markets) and post-conflict labour market fragility (Liberia). Senegal, Sierra Leone, The Gambia, and Ghana cluster in this range. Senegal and Ghana's relatively stronger formal institutions may explain their lower informality compared to Nigeria, though sectoral disparities (e.g., Ghana's informal mining) persist. Côte d'Ivoire shows fluctuations, possibly tied to its cash-crop economy's sensitivity to global commodity prices. Cabo Verde has the smallest informal sector, reflecting its service-based economy, stronger governance, and limited agrarian dependence. Burkina Faso, Niger, and Mali hover near 40 per cent, with stability likely due to subsistence farming's dominance, which is often uncaptured in formal metrics.

Some notable trends were also revealed from the graphs. Francophone nations (e.g., Senegal, Côte d'Ivoire, and Togo) generally exhibit lower informality than Anglophone peers (Nigeria, The Gambia, and Liberia), possibly due to the CFA franc zone's tighter monetary policies. Countries sharing borders with Nigeria (Benin, Niger) show higher informality, suggesting spillovers from its large informal sector.

Method of analysis

Bayesian Panel Vector Autoregressive (VAR) Framework

The panel BVAR was employed in this study to analyse the data for 15 ECOWAS countries over 64 quarters (from 2006 to 2021). The BVAR is an extension of the classic Vector Autoregression (VAR) model that uses Bayesian statistical approaches to improve estimation, particularly when there is little data or a high

number of parameters. BVAR is frequently used in macroeconomics, finance, and forecasting because it generates more stable estimates by adding prior assumptions about the parameters. These prior assumptions are especially important when dealing with small samples or overparameterisation issues that arise in large VAR models. This is particularly useful when there are many variables relative to the number of observations, as it shrinks parameters towards prior beliefs to avoid overfitting.

A Vector Autoregression (VAR) of order p , abbreviated as VAR(p), with N endogenous variables is stated as follows:

$$Y_{it} = A_{i1}Y_{i,t-1} + \dots + A_{ii}Y_{i,t-1} + \dots + A_{iN}Y_{N,t-1} + C + \varepsilon_{it} \quad (1)$$

where A_{ij} is an $G \times G$ coefficient matrices for each $i, j = 1, 2, \dots, N$; C is an $N \times 1$ vector of constants; and $\varepsilon_{it} \sim N(0, \Sigma_{ii})$ is an $G \times G$ vector of error terms with covariance matrices Σ_{ii} .

This unrestricted PVAR model is written as follows:

$$Y_t = AY_{t-1} + U_t \quad (2)$$

where $Y_t = [Y'_{1t}, Y'_{2t}, \dots, Y'_{Nt}]$ is a $NG \times 1$ vector of endogenous variables; $U_t \sim (0, \Sigma_{ii})$ with Σ a full $NG \times NG$ matrix. It is assumed that $cov(u_{it}, u_{jt}) = \Sigma_{ij} \neq 0$, where Σ_{ij} denotes the covariance matrix between the errors of country i and country j .

The estimation of A in classical VAR is usually done by ordinary least squares (OLS) for each equation separately, assuming no cross-equation restrictions. In Bayesian estimation, parameters are treated as random variables rather than fixed unknowns. It imposes a prior distribution on B and updates it with the likelihood function to obtain the posterior distribution.

The choice of prior

Choosing a shrinkage prior is crucial in Bayesian estimation¹. This study employed the Minnesota Prior (or the Litterman Prior), which is the most widely used shrinkage prior. It assumes that variables in a VAR follow a random walk. The Minnesota prior assumes:

$$B_{i,j} \sim N(0, \sigma_{i,j}^2) \quad (3)$$

where $B_{i,j}$ is the coefficient of lagged variable j in equation i ; and $\sigma_{i,j}^2$ is chosen to shrink higher-order lags more than lower-order lags.

The Minnesota prior mean assumes that:

$$E[A_{i,j}] = \begin{cases} 1, & \text{if } i = j \text{ (own lags follow a random walk)} \\ 0, & \text{otherwise (cross - variable lags)} \end{cases} \quad (4)$$

The Minnesota variance is given by:

$$\text{Var}(A_{i,j}) = \frac{\lambda_1}{l^{\lambda_2} \sigma_i^2} \quad (5)$$

¹ See Karlsson (2013) for an in-depths discussion on the use of Bayesian VAR model for economic forecasting, covering various priors, estimation techniques, and practical considerations. Chan (2018) provides a flexible approach to modelling error covariances in large Bayesian VARs.

where λ_1 controls the overall tightness; λ_2 controls the decay across lags; and σ_i^2 is the variance of the residual in equation i .

The use of prior makes the Bayesian VAR regularise the parameter estimates, which serves as an improvement over the classical VAR. It also helps to avoid overfitting and collinearity, which often plague large models in macroeconomics and finance (Koop & Korobilis, 2010). With the aim of this study focused on the spillover of informal economies in ECOWAS countries, the impulse-response function was estimated and plotted for a pair of countries in the region.

Informal economy shocks

After estimating the Bayesian panel VAR model, the impulse-response function was obtained to capture the response of the informal economy to shocks to the informal economy in other ECOWAS countries. In this study, “informal economy shocks” refer to sudden, exogenous changes in the size or dynamics of the informal sector that propagate across borders. These shocks arise from policy changes, i.e. sudden tax hikes, crackdowns on informal trade, or currency devaluations (such as in the case of Nigeria’s 2016 forex restrictions that disrupted informal cross-border trade with Benin). The shocks may also arise due to economic disruptions. For instance, commodity price crashes (e.g. cocoa price volatility in Cote d’Ivoire) or recessions that push workers into informality (ILO, 2021). The shocks may also arise due to socio-political events, border closures (e.g., ECOWAS sanctions on Mali in 2022) or conflicts that displace labour (e.g., Burkina Faso’s insurgency-driven migration to coastal states). Therefore, this study analyses informal economy shocks, which are distinct from formal sector fluctuations, as they operate through informal trade networks, labour mobility, and parallel markets.

Results

The summary statistics presented in Table 1 offer information on the informal economy (IE) in various ECOWAS countries, as well as worldwide commodity price growth. The important statistics examined are the mean (average), standard deviation (volatility), minimum (lowest observed value), and maximum (highest observed value) for each variable. Benin's informal economy accounts for 48.36 per cent of GDP on average, indicating that over half of the country's economic activity takes place outside of the formal sector. The standard deviation of 2.23 indicates considerable changes in the level of informality. The least recorded number is 44.96 per cent, and the greatest is 51.52 per cent, indicating that informality in Benin does not fluctuate much but is relatively high. Burkina Faso's informal economy is less than Benin's, with an average of 38.93 per cent. The standard deviation of 1.14 implies that informal economic activity is generally constant over time. The minimum number (37.39%) and maximum (40.95%) indicate that informality remains below 41 per cent and does not vary much. Cabo Verde has the weakest informal economy among the listed countries, with an average of 34.66 per cent. The low standard deviation of 0.51 indicates excellent stability, which means informality does not change considerably over time. The smallest score is 33.93 per cent, and the maximum is 37.20 per cent, indicating that the informal sector is relatively managed when compared to other nations.

The informal economy in Côte d'Ivoire averages 41.69 per cent, with a standard deviation of 2.37, showing moderate variations. The minimum of 38.37 per cent and the maximum of 44.60 per cent indicate that informality in the country varies more than in Burkina Faso or Cabo Verde. On average, the Gambia's informal economy accounts for 46.57 per cent of total economic activity, or nearly half. The standard deviation of 1.58 suggests considerable variability. The informal economy fluctuated between 42.95 per cent and 48.94 per cent, but remained quite high. Ghana has an average informal economy size of 39.23 per cent, with a standard deviation of 1.24, indicating a moderate level of volatility. The numbers vary from

37.57 per cent to 41.02 per cent, demonstrating that informality stays within a narrow margin of 3.45 percentage points. Guinea's informal economy averages 38.01 per cent, with a standard deviation of 1.34, indicating moderate variations. The range is 35.55 per cent to 39.39 per cent, which is rather steady when compared to countries with larger standard deviations. Guinea-Bissau's informal sector has a mean value of 38.81 per cent and a low standard deviation of 0.69, indicating considerable stability. The lowest of 37.54 per cent and the maximum of 40.01 per cent indicate slight fluctuations throughout time. Liberia has a high rate of informality, with an average of 46.42 per cent and a standard deviation of 1.20, indicating moderate variability. The range of 44.10 per cent to 48.39 per cent indicates that informality has remained strong.

Mali's informal economy is moderate in size, at 39.90 per cent, with a very low standard deviation of 0.32, indicating that it is relatively stable. The results vary from 39.20 per cent to 40.68 per cent, with little change over time. The informal economy in Niger averages 38.65 per cent, with a standard deviation of 1.46, showing some variation. The numbers vary from 36.29 per cent to 41.16 per cent, indicating that, while informality varies, it does not surpass 42 per cent. Nigeria has the highest informal economy among all countries, with an average of 55.41 per cent. This suggests that informal activities account for more than half of Nigeria's GDP. The standard deviation of 0.87 suggests minimal variability, implying that informality has been consistently high (varying from 53.87% to 56.86%). Senegal's informal economy has an average size of 43.46 per cent and a standard deviation of 1.42, showing considerable variations. The numbers vary from 41.27 per cent to 45.36 per cent, indicating that informality is strong but under control. Sierra Leone's informal economy averages 43.79 per cent, with a standard deviation of 1.55, indicating substantial variations. The numbers vary from 40.98 per cent to 46.20 per cent, indicating that informality has remained within a 5.22 percentage point zone. Togo's informal economy has an average size of 34.74 per cent, ranking among the lowest in West Africa. The standard deviation of 1.08 indicates comparatively modest variability. The results vary between 33.35 per cent and 36.68 per cent, showing a stable informal sector.

Global commodities price growth has a mean value of 6.33 per cent, showing that global commodity prices have risen in general. However, the relatively high standard deviation of 27.22 indicates severe volatility. The smallest value of -44.80 per cent and the greatest value of 71.73 per cent demonstrate that commodity prices have fluctuated dramatically over time. This significant unpredictability demonstrates commodity prices' vulnerability to global economic conditions, supply shocks, and market demand.

Overall, Nigeria has the largest informal economy (55.41%), while Cabo Verde (34.66%) and Togo (34.74%) have the smallest. The informal economy is prevalent throughout West Africa, with most countries ranging between 38 per cent and 48 per cent. Mali's informal economy is the most stable (std. dev = 0.32), whereas Côte d'Ivoire's and Benin's are more unpredictable. Countries with a large informal economy tend to have sustained informality with little variability. Global commodities prices are extremely volatile, with significant swings over time.

Table 1: Summary Statistics of Informal Economy across the ECOWAS Countries

Variable	Acronym	Mean	Std. dev.	Min	Max
Benin	ben	48.36	2.23	44.96	51.52
Burkina Faso	bfa	38.93	1.14	37.39	40.95
Cabo Verde	cpv	34.66	0.51	33.93	37.20
Cote d'Ivoire	civ	41.69	2.37	38.37	44.60
The Gambia	gmb	46.57	1.58	42.95	48.94
Ghana	gha	39.23	1.24	37.57	41.02
Guinea	gin	38.01	1.34	35.55	39.39
Guinee-Bissau	gnb	38.81	0.69	37.54	40.01
Liberia	lbr	46.42	1.20	44.10	48.39
Mali	mli	39.90	0.32	39.20	40.68
Niger	ner	38.65	1.46	36.29	41.16
Nigeria	nga	55.41	0.87	53.87	56.86
Senegal	sen	43.46	1.42	41.27	45.36
Sierra Leone	sle	43.79	1.55	40.98	46.20
Togo	tgo	34.74	1.08	33.35	36.68
Global commodity prices growth	cp	6.33	27.22	-44.80	71.73

Source: Authors' Computations

Table 2: Unit Root Test

Variable	Augmented Dickey-Fuller test				Phillips-Perron test			
	Level		1st Difference		Level		1st Diff	
	Constant	With trend	Constant	With trend	Constant	With trend	Constant	With trend
ben	0.011	-1.292	-0.272	-1.834	-3.115**	-3.097	-3.207**	-3.19*
bfa	-0.253	-1.864	-4.903***	-4.866***	-0.385	-2.487	-4.829***	-4.764***
cpv	-3.444***	-3.705**	-8.084***	-8.056***	-3.523***	-3.754**	-8.184***	-8.154***
civ	-0.128	-0.942	-3.175**	-3.136*	-0.346	-1.417	-3.2**	-3.154*
gmb	-1.41	-1.401	-4.706***	-4.666***	-1.957	-1.952	-4.767***	-4.728***
gha	-0.727	-0.948	-3.141**	-3.128*	-0.776	-1.917	-3.387**	-3.373*
gin	0.389	-1.24	-6.12***	-6.186***	0.104	-1.421	-6.183***	-6.239***
gnb	-2.127	-2.382	-7.002***	-6.975***	-2.221	-2.619	-6.97***	-6.942***
lbr	-0.737	-0.728	-4.888***	-5.345***	-1.066	-0.981	-4.874***	-5.284***
mli	-1.673	-1.981	-5.98***	-5.925***	-2.059	-2.4	-5.969***	-5.914***
ner	-1.478	-2.144	-7.292***	-7.309***	-1.466	-2.303	-7.267***	-7.288***
nga	-0.921	-0.805	-6.55***	-6.946***	-1.083	-0.903	-6.568***	-6.925***
sen	0.272	-1.257	-3.707***	-3.729**	-0.242	-1.461	-3.747***	-3.772**
sle	-1.4	-1.268	-4.225***	-4.213***	-1.639	-2.002	-4.281***	-4.274***
tgo	-1.828	-0.404	-3.03**	-3.173*	-1.454	-1.34	-3.303**	-3.428**
cp	-2.19	-2.078	-5.261***	-5.297***	-2.859*	-2.738	-5.202***	-5.232***

Source: Authors' Computations

Note: *, **, and *** indicate stationarity at 10%, 5%, and 1% significance levels, respectively. ben is Benin; bfa is Burkina Faso; cpv is Cabo Verde; civ is Cote d'Ivoire; gmb is the Gambia; gha is Ghana; gin is Guinea; gnb is Guinea-Bissau; lbr is Liberia; mli is Mali; ner is Niger; nga is Nigeria; sen is Senegal; sle is Sierra Leone; tgo is Togo.

Table 3: Lag Selection

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	243.7				1.60E-22	-7.625	-7.421	-7.102
1	733.9	980.3	225	0.000	2.80E-26	-16.46	-13.18	-8.087
2	875.3	282.7	225	0.005	2.00E-24	-13.67	-7.328	2.553
3	2121.5	2492.4*	225	0.000	9.7e-37*	-47.71*	-38.29*	-23.63*

Source: Authors' Computations

Note: * indicates lag selection

Table 4: Model Stability

Eigenvalue modulus	Mean	Std. dev.	MCSE	Median	Equal-tailed [95% cred. interval]	
1	1.0292	0.0224	0.0002	1.0257	0.9957	1.0830
2	1.0133	0.0169	0.0002	1.0114	0.9850	1.0518
3	1.0017	0.0134	0.0001	1.0011	0.9768	1.0296
4	0.9930	0.0125	0.0001	0.9929	0.9688	1.0182
5	0.9847	0.0127	0.0001	0.9852	0.9586	1.0085
6	0.9764	0.0139	0.0001	0.9775	0.9464	1.0011
7	0.9655	0.0165	0.0002	0.9669	0.9292	0.9934
8	0.9521	0.0204	0.0002	0.9545	0.9054	0.9858
9	0.9340	0.0257	0.0003	0.9369	0.8759	0.9759
10	0.9062	0.0346	0.0003	0.9104	0.8274	0.9613
11	0.8626	0.0494	0.0005	0.8687	0.7512	0.9403
12	0.7858	0.0735	0.0007	0.7934	0.6357	0.9059
13	0.6772	0.0869	0.0009	0.6753	0.5121	0.8445
14	0.5652	0.0934	0.0009	0.5717	0.3881	0.7322
15	0.4509	0.0779	0.0008	0.4401	0.3276	0.6255
16	0.3819	0.0558	0.0006	0.3749	0.2909	0.5082
17	0.3376	0.0424	0.0004	0.3331	0.2675	0.4325
18	0.3076	0.0341	0.0003	0.3046	0.2496	0.3831
19	0.2849	0.0283	0.0003	0.2826	0.2354	0.3457
20	0.2665	0.0247	0.0002	0.2647	0.2225	0.3191
21	0.2515	0.0223	0.0002	0.2506	0.2111	0.2991
22	0.2381	0.0206	0.0002	0.2373	0.2002	0.2810
23	0.2264	0.0192	0.0002	0.2257	0.1905	0.2660
24	0.2153	0.0184	0.0002	0.2145	0.1809	0.2533
25	0.2055	0.0175	0.0002	0.2050	0.1729	0.2411
26	0.1955	0.0170	0.0002	0.1950	0.1635	0.2303
27	0.1868	0.0163	0.0002	0.1862	0.1561	0.2200
28	0.1776	0.0159	0.0002	0.1772	0.1473	0.2094
29	0.1694	0.0154	0.0002	0.1692	0.1395	0.2003

30	0.1607	0.0153	0.0002	0.1605	0.1312	0.1908
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Pr(eigenvalues lie inside the unit circle) = 0.0537
Source: Authors' Computations

Table 5: Pairwise Model Stability

Model	ben	bfa	cpv	civ	gmb	gha	gin	gnb	lbr	mli	ner	nga	sen	sle	tgo
ben	-														
bfa	0.875	-													
cpv	0.679	0.892	-												
civ	0.608	0.817	0.725	-											
gmb	0.575	0.853	0.892	0.781	-										
gha	0.707	0.909	0.827	0.741	0.748	-									
gin	0.668	0.817	0.402	0.831	0.499	0.682	-								
gnb	0.674	0.875	0.684	0.594	0.868	0.795	0.485	-							
lbr	0.829	0.719	0.869	0.913	0.900	0.827	0.563	0.602	-						
mli	0.476	0.759	0.685	0.619	0.783	0.661	0.341	0.816	0.598	-					
ner	0.858	0.936	0.886	0.809	0.890	0.889	0.719	0.824	0.728	0.736	-				
nga	0.690	0.687	0.774	0.783	0.799	0.731	0.660	0.478	0.862	0.502	0.551	-			
sen	0.667	0.662	0.331	0.701	0.739	0.746	0.391	0.381	0.750	0.487	0.632	0.630	-		
sle	0.687	0.863	0.911	0.830	0.882	0.783	0.355	0.913	0.788	0.692	0.912	0.613	0.587	-	
tgo	0.879	0.854	0.929	0.935	0.860	0.945	0.789	0.880	0.896	0.771	0.924	0.812	0.850	0.933	-

Source: Authors' Computations

Note: Values are the probability that eigenvalues lie inside the unit circle. ben is Benin; bfa is Burkina Faso; cpv is Cabo Verde; civ is Cote d'Ivoire; gmb is the Gambia; gha is Ghana; gin is Guinea; gnb is Guinea-Bissau; lbr is Liberia; mli is Mali; ner is Niger; nga is Nigeria; sen is Senegal; sle is Sierra Leone; tgo is Togo.

Unlike the standard VAR model, which requires stationarity for valid inference, BVAR does not require stationarity because of its probabilistic foundation and use of shrinkage priors. Nonetheless, a unit root test was conducted in this study to be sure all variables are at least integrated of first order. The unit root test results in Table 2 show that most informal economy variables in ECOWAS countries, as well as global commodities prices (cp), are non-stationary at the level but become stationary after initial differencing, indicating that they follow an I(1) process. Cabo Verde (cpv) is an exception, as it is already at level and does not require differencing. Both the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests yield consistent results, with first differencing resulting in statistical significance at the 1 per cent or 5 per cent level, ensuring stationarity. Even though most of these variables are non-stationary, it is not much of a concern for this study, as non-stationary variables in BVAR can be addressed using priors.

A lag selection test was conducted for the BVAR model. According to the lag selection results in Table 3, lag 3 is the ideal lag length for the BVAR model based on numerous statistical factors. The Final Prediction Error (FPE), Akaike Information Criterion (AIC), Hannan-Quinn Information Criterion (HQIC), and Schwarz Bayesian Information Criterion (SBIC) all reach their lowest values at lag 3, indicating that model fit and complexity are optimally balanced. The Likelihood Ratio (LR) test demonstrates that lag 3 greatly improves the model over lag 2. Although the log-likelihood (LL) increases with more lags, adding data than three lags may result in overfitting. As a result, lag 3 is indicated as the optimal lag duration for achieving accurate and steady estimation.

The BVAR model's stability test is based on the eigenvalue modulus criteria, which determine if the estimated model is dynamically stable. A stable VAR model requires all eigenvalues to be within the unit circle (modulus < 1). If any eigenvalue surpasses one, the model is deemed unstable, which means it may exhibit explosive behaviour. As for the result in Table 4, the first three eigenvalues have means slightly greater than 1 (1.0292, 1.0133, 1.0017). These values indicate potential instability, as they exceed the unit circle threshold. The remaining 27 eigenvalues are below 1, indicating that most components of the system are stable. The largest eigenvalue (1.0292) has a 95 per cent credible interval ranging from 0.9957 to 1.0830, meaning that in some iterations of the Bayesian estimation, it falls inside the unit circle, but in others, it exceeds 1. This is similar to the intervals obtained for the other two eigenvalues that are greater than 1. The probability that all eigenvalues lie inside the unit circle is 0.0537, which is weakly significant, suggesting that there may be a likelihood that the model is unstable.

To further verify the stability, the model was re-estimated for a pair of countries at a time. This makes the before-work more effective and improves model stability. The *cons* about this are that the model is no longer considered as a system of all ECOWAS countries altogether, but a system among pairs of countries in the bloc. The re-estimated model yielded dynamically stable results, as Table 5 presents the probability value for each model, which revealed that they are all greater than 0.1, indicating that all eigenvalues lie inside the unit circle. The stability of this pairwise analysis is therefore used to strengthen the weak significance of the panel BVAR stability, and hence, further analysis was based on the system of all ECOWAS countries.

To analyse the spillovers of IE across ECOWAS countries, the impulse-response function graphs were plotted as presented in Figures 2 through 16 in Appendix A. In the following paragraphs, each ECOWAS country's IE responds to a 1 per cent change in the IE of every other country. This aids in determining the interconnectedness of the region's IEs and the extent to which spillover effects exist. In Figure 2, A shock to Benin's IE does not have a significant impact on the IEs of Burkina Faso, Cabo Verde, the Gambia, Ghana, Guinea-Bissau, Mali, Niger, Sierra Leone, and Togo because the IRF intervals include zero, indicating insignificant responses. On the contrary, there is a significant IE spillover from Benin to other countries, demonstrating that informal sector disruptions in Benin result in some structural alterations in the IEs of these countries. The IEs of Côte d'Ivoire, Guinea, and Senegal show positive responses to Benin's IE shock, while the IEs of Liberia and Nigeria show negative responses to Benin's IE shock. This suggests

a rise in IE in the former countries and a fall in IE in the latter countries as a result of a shock to Benin's IE.

For a 1% shock to Burkina Faso's IE (Figure 3), the IEs of Cabo Verde, Côte d'Ivoire, the Gambia, Guinea, Guinea-Bissau, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo only responded weakly as their IRF intervals include zero. Only the IEs of Benin, Ghana, and Liberia are relatively strong, with Benin's and Ghana's IEs showing positive responses and Liberia's IE showing a negative response. Most of the countries have weak responses to Cabo Verde's IE shock (Figure 4). Only Guinea seem to have a strong response with significant IRF intervals. Guinea's response to Cabo Verde's IE shock is positive and increasing throughout the 24 horizons, but at a decreasing rate. The lack of connectedness between Cabo Verde's IE and most of the ECOWAS countries is not surprising, as the country is relatively small and outside mainland Africa.

In Figure 5, a 1 per cent Shock to Côte d'Ivoire's IE has a significant impact on the IEs of some ECOWAS countries, such as Guinea, Liberia, Nigeria, and Senegal. While a positive IE response was reported for Guinea and Senegal, a negative IE was reported for Liberia and Nigeria. In Figure 6, the Gambia's IE shock has a significant impact only on the IEs of Côte d'Ivoire, Ghana, Senegal and Togo. All these IEs responded negatively to a 1 per cent shock to the Gambia's IE. As for a 1 per cent shock to Ghana's IE (Figure 7), only the IEs of Benin, Liberia, Nigeria, and Senegal have significant responses, with Benin and Senegal having positive IE responses and Liberia and Nigeria having negative IE responses. In Figure 8, a 1 per cent shock to Guinea's IE only triggers a response from Côte d'Ivoire's IE but not from any other country's IE. The Côte d'Ivoire's IE response to this shock is negative, indicating that Côte d'Ivoire's IE reduces to an unexpected rise in the IE of Guinea. In Figure 9, the IEs of Benin, Guinea, and Nigeria responded significantly to a 1 per cent Guinea-Bissau's IE shock. Both the IEs of Benin and Guinea show positive responses, while the IE of Nigeria shows a negative response. In Figure 10, a 1 per cent shock to Liberia's IE triggers a positive response from the IEs of Benin, Côte d'Ivoire, and Togo, but not a significant response from any other country's IE. A shock to Mali's IE does not generate a strong response from other countries' IE (Figure 11), as the intervals of the IRFs for all countries included a zero.

In Figure 12, a 1 per cent shock to Niger's IE triggers a positive response from the IEs of Benin, Ghana, and Guinea, and a negative response from the IEs of Liberia and Nigeria, indicating that the IEs of the former countries rise as a result of an unanticipated rise in Niger's IE but the IEs of the latter countries fall due to an unexpected rise in Niger's IE. In Figure 13, a 1 per cent shock to Nigeria's IE causes a rise in the IEs of Benin, Côte d'Ivoire, and Togo. This implies that when Nigeria's IE rises unexpectedly, the IEs of Benin, Côte d'Ivoire, and Togo also rise. The rise in Côte d'Ivoire's IE seems to be greater and stronger. In Figure 14, the IEs of Côte d'Ivoire, Liberia, and Nigeria show negative responses to a 1% shock to Senegal's IE, while the IE of Guinea shows a positive response to a 1 per cent shock to Senegal's IE. There is a positive response from Côte d'Ivoire's IE due to a 1 per cent shock to Sierra Leone's IE, while Liberia's IE shows a negative response to a 1 per cent shock to Sierra Leone's IE (Figure 15). In Figure 16, A 1 per cent shock to Togo's IE triggers positive IE responses in Benin, Côte d'Ivoire, Ghana, and Senegal but triggers negative IE responses in Liberia and Senegal.

Concluding Remark and Policy Implications

The spillover effects of informal economy (IE) shocks across ECOWAS countries, as shown by Bayesian VAR (BVAR) impulse response functions (IRFs), are critical insights for economists and policymakers. These consequences underscore the economic interdependence of the region's Francophone and Anglophone states, as well as those with common borders. The policy implications outlined here take into

account cross-border trade realities, economic integration, and the structural role of informality in ECOWAS.

The findings revealed that some informal economies are strongly connected with others. For instance, Nigeria's IE has significant spillovers, particularly in Benin, Côte d'Ivoire, and Togo. When Nigeria's IE unexpectedly rises, these countries' informal economies grow as well. However, Nigeria's IE contracts in reaction to shocks from Benin, Burkina Faso, Niger, and Senegal, demonstrating that economic policies in these countries might have an impact on Nigeria's informal sector. This implies that there is a need for policy coordination for strongly connected informal economies. Specifically, ECOWAS should improve regional trade agreements to prevent disruptions in Nigeria's internal market from destabilising neighbouring economies. In addition, border controls should be reformed to encourage informal traders without imposing undue restrictions, to avoid unnecessary disruptions in cross-border trade.

The findings also provide some implications for border-sharing and informal trade networks. There are extensive informal commercial links between the Francophone and Anglophone economies. Francophone countries (Côte d'Ivoire, Benin, Guinea, Senegal, and Togo) have stronger IE spillovers among themselves, reflecting historical trade links and a single currency (the CFA franc). Anglophone countries (Nigeria, Ghana, Liberia, Sierra Leone, and the Gambia) had fewer spillovers with Francophone countries, except large IE responses between Ghana and Nigeria, which are presumably attributable to trade and labour mobility. Border-sharing countries such as Benin-Nigeria, Côte d'Ivoire-Liberia, and Senegal-The Gambia have asymmetric spillover effects, meaning that informal shocks in larger economies have a greater impact on smaller economies than the other way around. ECOWAS should improve customs coordination between Francophone and Anglophone countries to increase informal trade facilitation and eliminate interruptions. Cross-border payment systems should be improved, particularly for informal sector actors that transact between CFA franc and non-CFA economies.

There is a need to address the informal economy competition versus complementarity. IE shocks elicit opposite responses in various economies. Côte d'Ivoire, Guinea, and Senegal benefit from Benin's IE shock, whereas Nigeria and Liberia suffer adverse consequences. Côte d'Ivoire's IE shock boosts Guinea and Senegal while reducing informality in Liberia and Nigeria. Niger's IE shock raises informal activity in Benin, Ghana, and Guinea while decreasing it in Nigeria and Liberia. These patterns indicate that certain informal economies complement one another, whilst others compete. Harmonised policies should prioritise the protection of productive informal companies while ensuring that larger informal economies, such as Nigeria, do not absorb too much activity from smaller economies. Sector-specific policies (e.g., agriculture, industry, and services) should aim to foster more formal-informal links rather than rivalry.

There is a need to manage the role of the informal economy in economic stability. Countercyclical interventions are necessary in highly linked informal economies. Countries with significant positive spillovers (such as Nigeria, Ghana, and Côte d'Ivoire) must assess how policy changes would influence regional partners. Burkina Faso, Sierra Leone, and Mali have lower ties to regional informality, which means they may require local measures rather than regional initiatives. Liberia regularly displays negative responses to IE shocks across several countries, implying that it may struggle to absorb informal economic variations. In increasingly connected economies, specialised social protection policies should assist informal workers in dealing with external shocks. For less linked economies, internal changes (such as digital payment systems for informal traders) should take precedence over regional reliance tactics.

The findings have consequences for ECOWAS' economic planning, hence, there is a need to strengthen the resilience of ECOWAS countries against informal economy shocks. Countries with lesser spillovers (e.g., Cabo Verde, The Gambia, and Mali) should strengthen trade ties to lessen their exposure to external

shocks. Countries with large informal economy fluctuations (such as Nigeria, Côte d'Ivoire, and Senegal) should establish fiscal policies that benefit small businesses. Cross-border labour mobility policy should acknowledge the importance of informal jobs in maintaining economic stability. A regional ECOWAS Informal Economy Stability Fund should be established to give financial support to small firms in highly integrated informal economies. Tax breaks should be offered to stimulate the formalisation of informal businesses, particularly in high-spillover economies.

Furthermore, to achieve an integrated informal economy strategy, ECOWAS policymakers must strike a balance between regional integration and specialised national initiatives to prevent shocks to the informal economy from destabilising smaller economies. Francophone and Anglophone commercial cooperation should be strengthened by policies that unify informal trade restrictions and facilitate cross-border credit access. Border-sharing economies must coordinate economic policies to maximise the benefits of informal commerce while mitigating economic risks.

Study's limitations and suggestions for future research

The study is highly limited by data availability. This has created restrictions on the analysis conducted in the study. For example, broader and more robust analysis could be conducted to determine the spillovers of all ECOWAS countries in a single system, which could provide more nuanced policy recommendations. The data limitations also constrained the inclusion of more exogenous or control variables in the models, which might have changed the findings if included, and the use of more sophisticated methodologies, such as the Global VAR (GVAR) or the Bayesian Global VAR (BGVAR) techniques. Therefore, in the absence of these limitations, future research can incorporate these possibilities into its analysis to improve the findings. Furthermore, the analysis of this study is limited in coverage of the economic activities. Given that the focus is on the informal economy, an analysis that includes the formal economy (i.e. the reported GDP) may offer some more insights into the interdependencies of these economies within the context of ECOWAS. The scope of this study can therefore be expanded by future research to cover this area.

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APPENDICES

Appendix A: Impulse Response Function Plots for all Countries

Figure 2: Responses to a per cent shock to Benin's Informal Economy

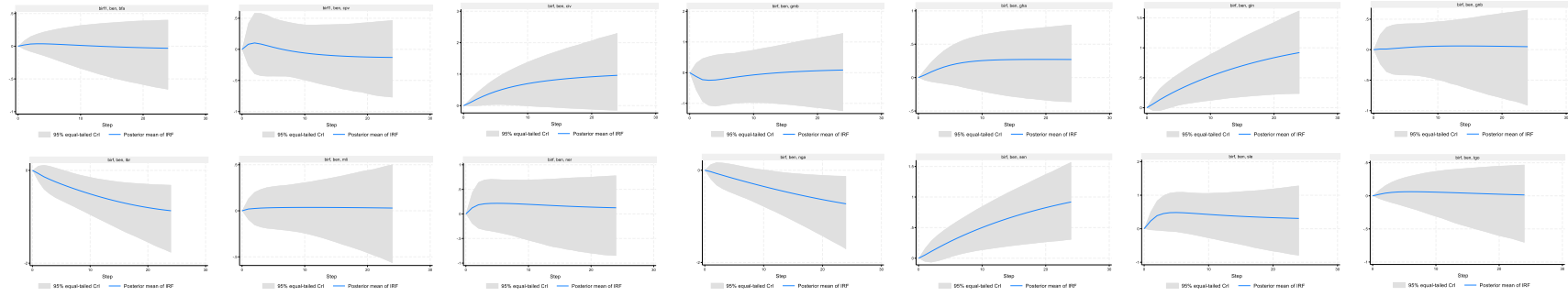


Figure 3: Responses to a per cent shock to Burkina Faso's Informal Economy

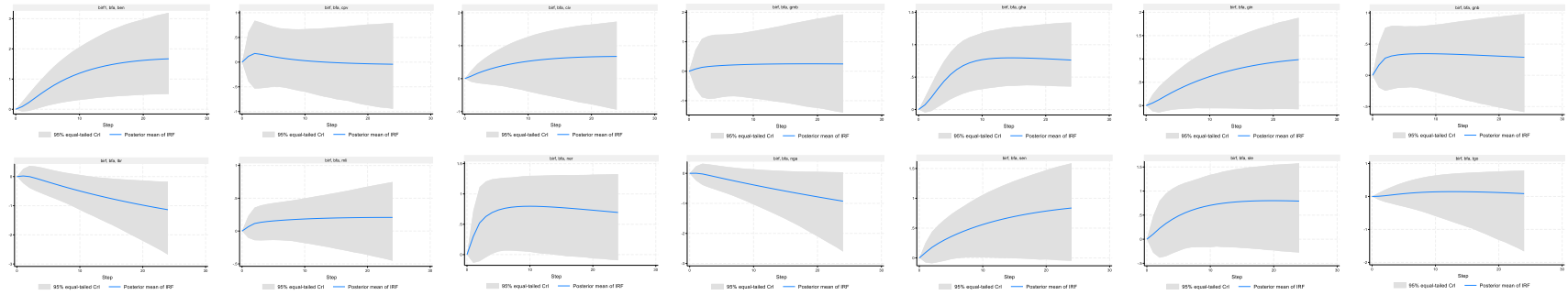


Figure 4: Responses to a per cent shock to Cabo Verde's Informal Economy

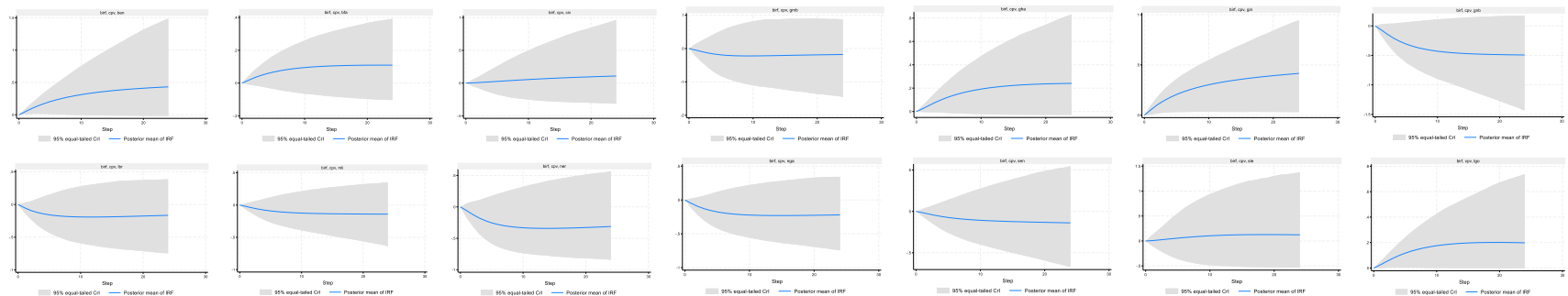


Figure 5: Responses to a per cent shock to Côte d'Ivoire's Informal Economy

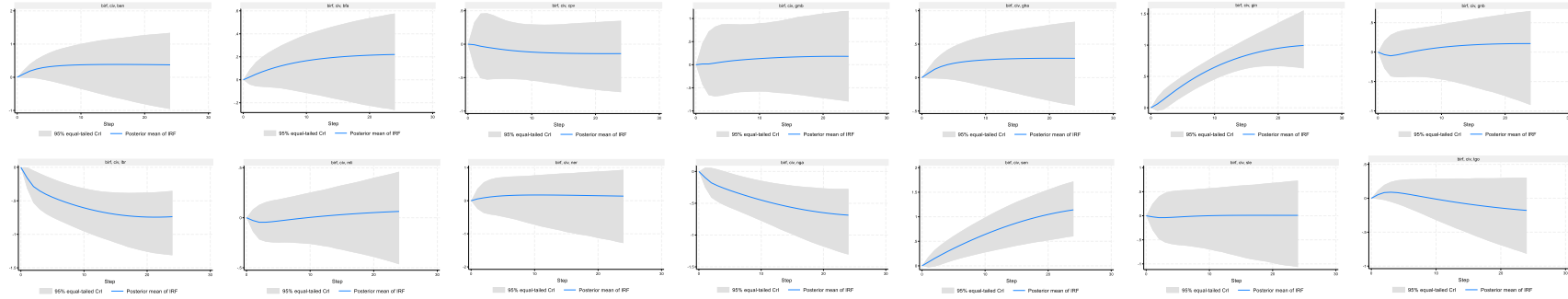


Figure 6: Responses to a per cent shock to the Gambia's Informal Economy

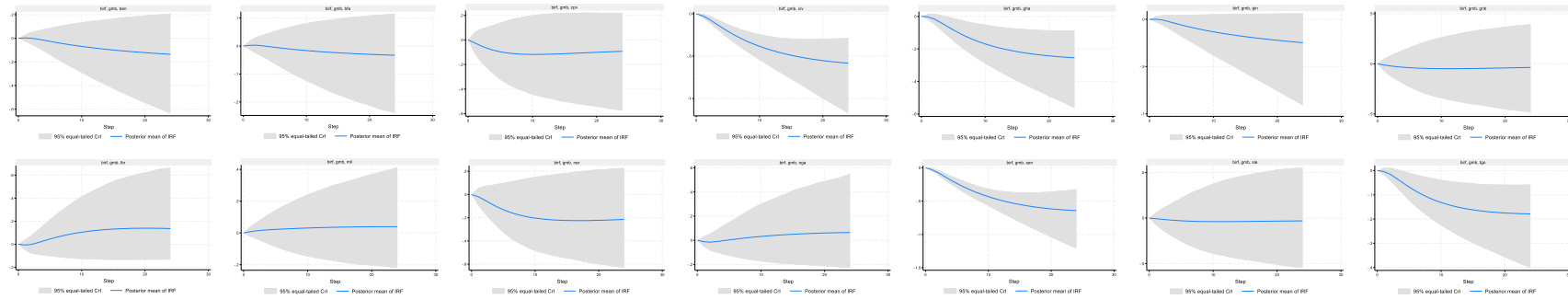


Figure 7: Responses to a per cent shock to Ghana's Informal Economy

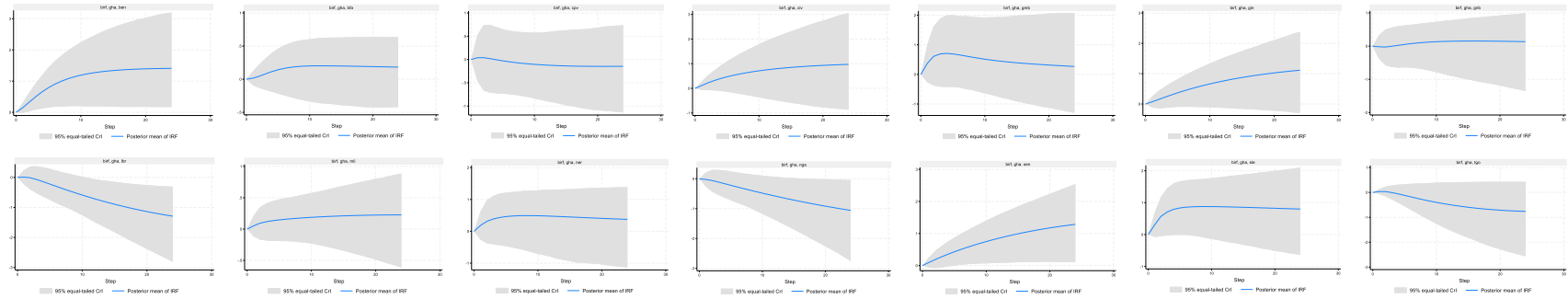


Figure 8: Responses to a percent shock to Guinea's Informal Economy

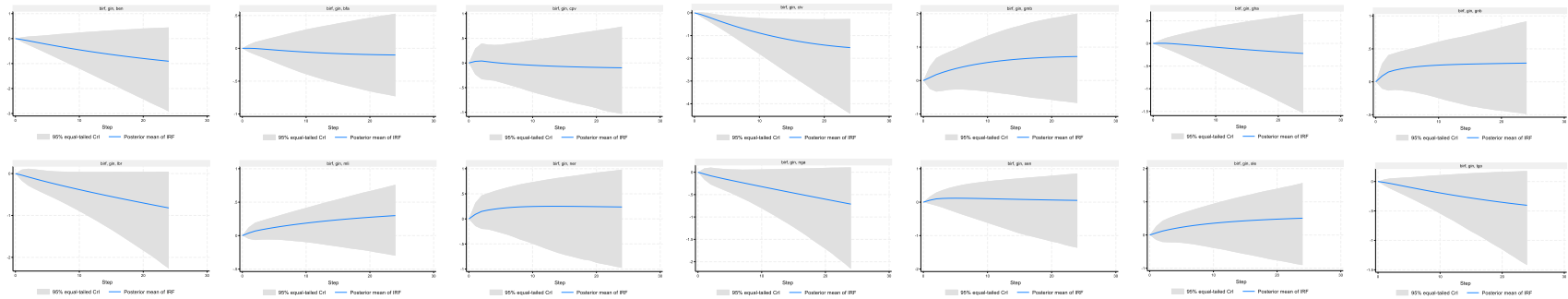


Figure 9: Responses to a per cent shock to Guinea-Bissau's Informal Economy

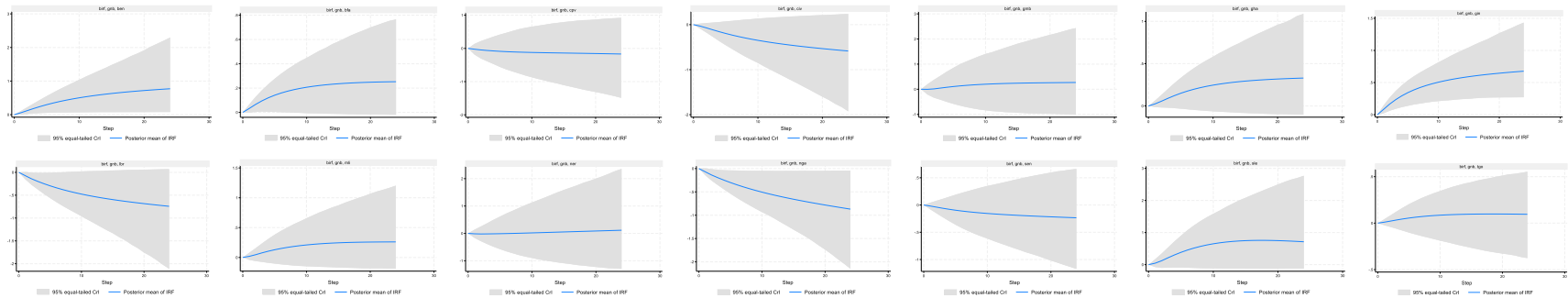


Figure 10: Responses to a per cent shock to Liberia's Informal Economy

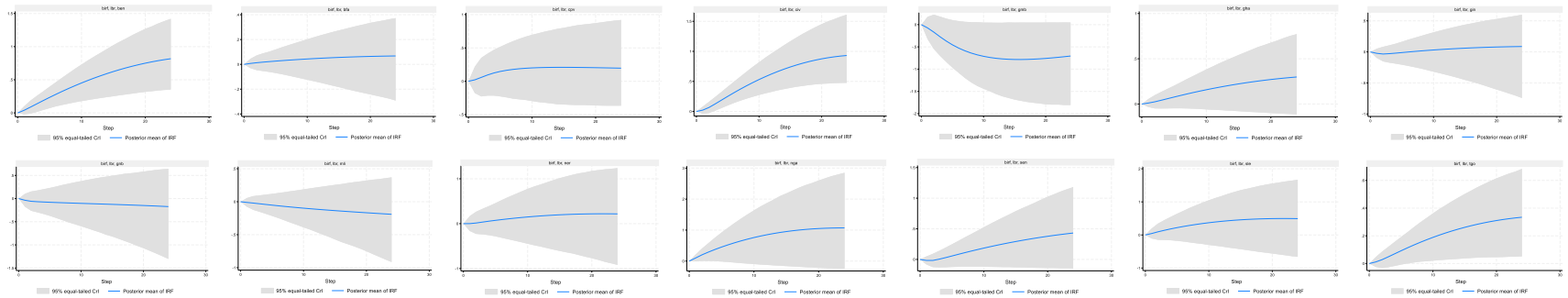


Figure 11: Responses to a per cent shock to Mali's Informal Economy

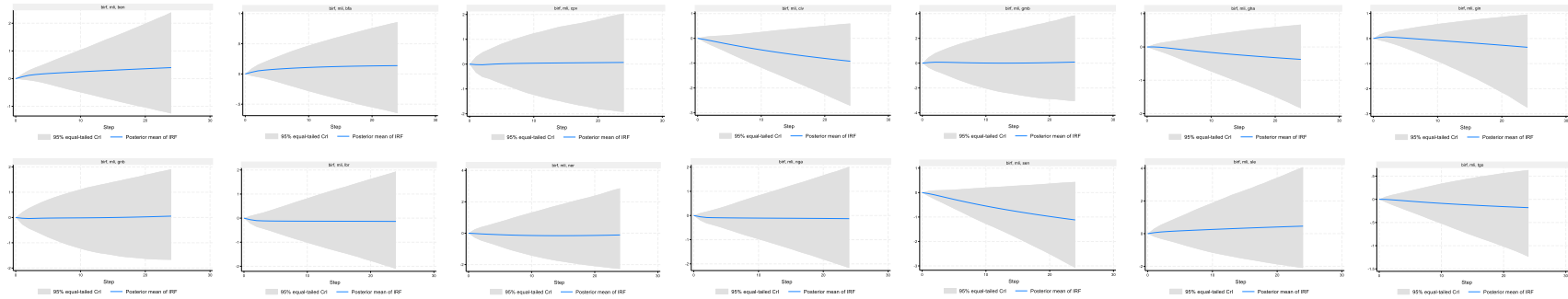


Figure 12: Responses to a percent shock to Niger's Informal Economy

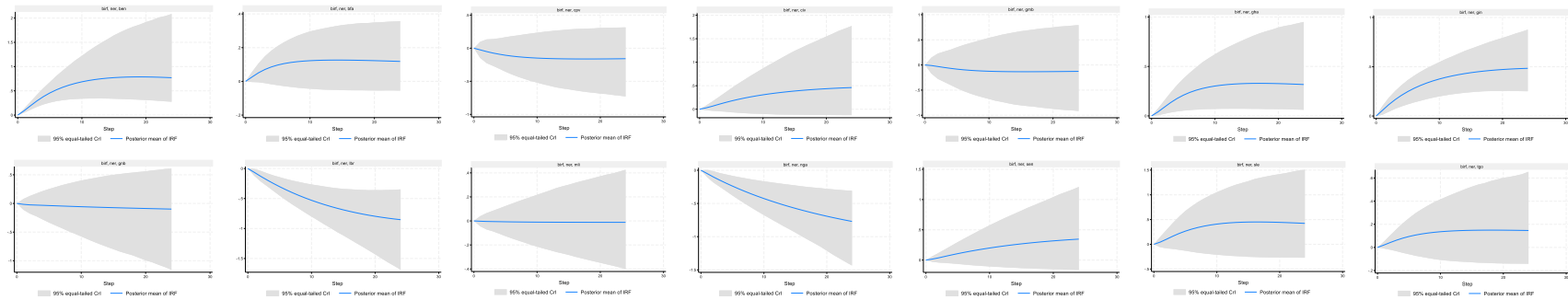


Figure 13: Responses to a per cent shock to Nigeria's Informal Economy

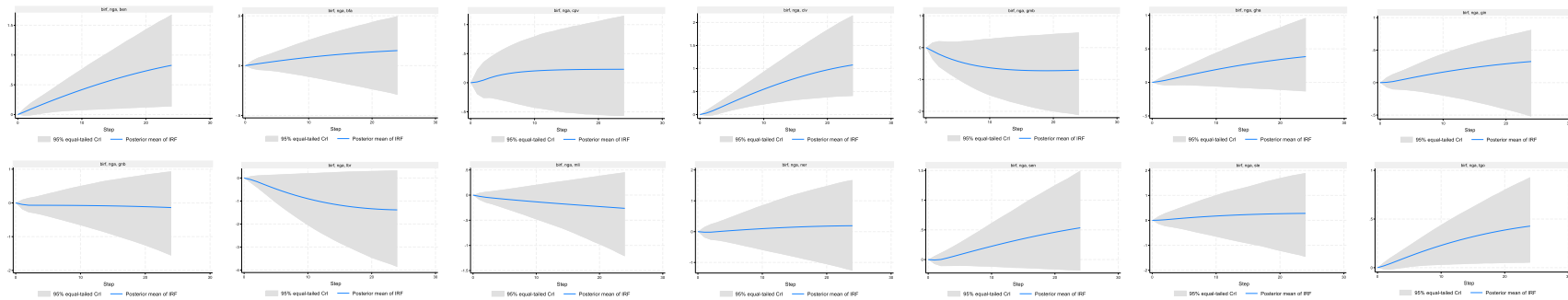


Figure 14: Responses to a per cent shock to Senegal's Informal Economy

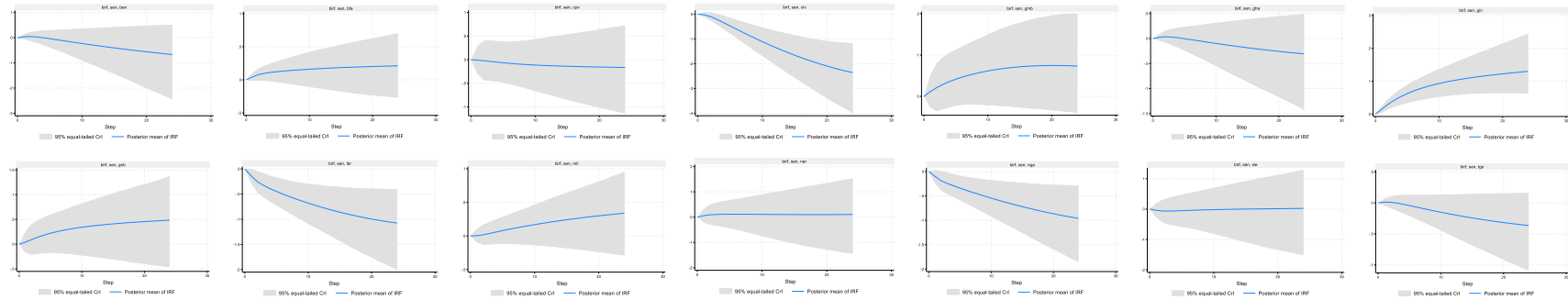


Figure 15: Responses to a per cent shock to Sierra Leone's Informal Economy

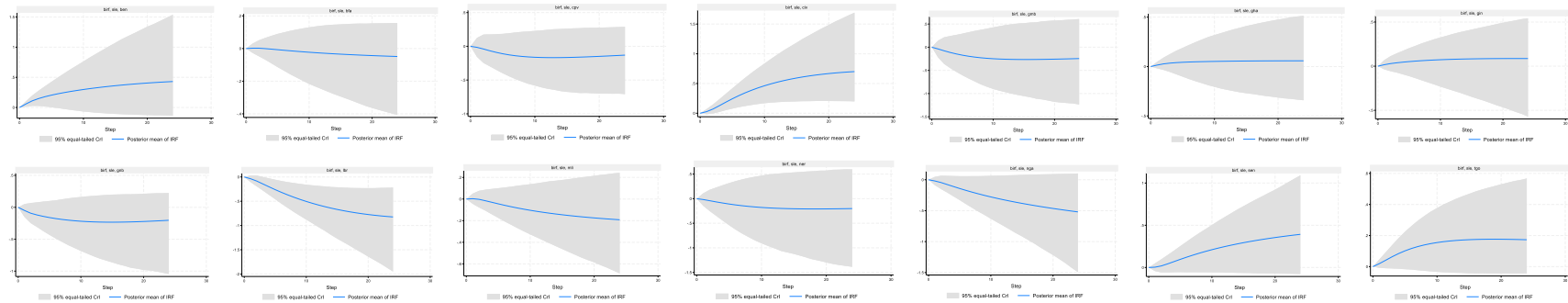


Figure 16: Responses to a per cent shock to Togo's Informal Economy

