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Model-Driven Macrofinancial Policy Analysis in the WAEMU

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ABSTRACT: This quantitative model for Macrofinancial Policy Analysis for the WAEMU was developed to deepen the Fund's engagement in macrofinancial surveillance in the region. By analyzing unobserved credit cycle dynamics and risks, and emphasizing macrofinancial linkages, the model helps assess the consistency between real and credit cycles, build alternative scenarios, offers medium-term macroeconomic projections, and support macrofinancial policy analysis.

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Model-Driven Macrofinancial Policy Analysis in the WAEMU

West African Economic and Monetary Union

Prepared by Knarik Ayvazyan[1]

[1] The author would like to thank Luca Antonio Ricci and Lawrence Norton for their valuable suggestions and comments.

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WEST AFRICAN ECONOMIC AND MONETARY UNION

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African Department

Prepared By Knarik Ayvazyan.

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MODEL-DRIVEN MACROFINANCIAL POLICY ANALYSIS IN THE WAEMU[1]

This quantitative model for Macrofinancial Policy Analysis for the WAEMU was developed to deepen the Fund's engagement in macrofinancial surveillance in the region. By analyzing unobserved credit cycle dynamics and risks, and emphasizing macrofinancial linkages, the model helps assess the consistency between real and credit cycles, build alternative scenarios, offers medium-term macroeconomic projections, and support macrofinancial policy analysis.

A. Model Description[2]

1. **Endogenous linkages between the real economy and the banking sector, along with macrofinancial policy challenges in WAEMU, were analyzed using a semi-structural model.** Each behavioral equation has an economic interpretation in the model, although the coefficients are reduced-form ones rather than deep parameters as in DSGE models. The framework incorporates the New Keynesian modeling approach, which includes features such as monopolistic competition, nominal and real rigidities, and a non-neutral role for monetary policy in the short run. The key addition is the macrofinancial linkages, including a banking sector's solvency problem on the real economy. Additionally, the model decomposes all real variables into a trend component and a gap component, representing the deviation of the variable from its long-run trend.

2. **Building on the earlier work of Carlos et al. (2022), the new model was designed to analyze unobserved credit cycle dynamics and risks, emphasizing the role of macrofinancial linkages and macroprudential policy.** It also helps to examine the interaction between monetary and macroprudential policies, improving the understanding of side effects of macrofinancial linkages, intertemporal trade-offs, thus supporting the achievement of macroeconomic and financial stability objectives. Examples of side effects encompass: the effect of lower interest rates on excessive risk-taking and borrowing (which may lead to an accumulation of household or corporate debt and the formation of asset price bubbles); macroprudential policies (such as higher capital requirements for banks) can make credit less accessible for businesses and households, which may slow down economic growth or affect consumption. A new analytical approach for the WAEMU could further enrich macrofinancial analysis by generating medium-term projections, building different scenarios, and assessing linkages between credit, the real economy, and the effects of monetary and macroprudential policies. Additionally, it would improve understanding of how macroeconomic shocks impact bank solvency, while accounting for feedback from banking sector solvency shocks to the real economy. This approach ensures consistency in the key relationships

[1] Prepared by Knarik Ayvazyan (MCMSR), with suggestions and comments from Luca Antonio Ricci and Lawrence Norton.
[2] A detailed description of the model will be presented in the forthcoming IMF working paper.

between macroeconomic and financial variables, providing a consistent macroeconomic framework with feedback loops between the real and financial sectors.

3. The domestic economy in the model is described by aggregate demand, aggregate supply (the Phillips curve), uncovered interest rate parity (UIP), credit cycle, bank capital buffers and a monetary policy rule. The UIP condition and the monetary policy rule are described in the same way as in Carlos et al. (2022). Expectations are formed based on lagged effects and model-predicted future outcomes. The foreign economy block is exogenous to the model and is modeled as AR (1) processes, with the steady-state values reflecting the corresponding sample average. Advanced economies data is used to represent the foreign economy.

B. The Innovating Modeling Contribution: Credit Cycle and Bank Capital Buffers

4. The credit cycle block assumes that credit fluctuations are driven by the business cycle and the banking system's capital ratio relative to the supervisory threshold. Banks set their desired level of credit based on past credit levels, current economic activity, and their capital ratio relative to the supervisory threshold (Krznar and Matheson, 2017). Since banks cannot immediately adjust credit levels, these levels are slow to respond to fluctuations in output. For example, a strong economy and high capital buffers lead to an increasing level of credit.

5. The cyclical dynamics of credit are defined by equations 1 and 2.

$$C_{gap,t} = i_1 C_{gap,t-1} + i_2 Y_{gap,t} + \epsilon_t^c \qquad (1)$$

where, $C_{gap,t}$ is the real credit gap[3], Y_{gap} is the output gap and ϵ_t^c is a shock to credit supply unrelated to aggregate demand and past credit adjustments:

$$\epsilon_t^c = i_3(Buf_t - Buf_{ss}) + \varepsilon_t^c \qquad (2)$$

where, Buf_t is capital buffer (capital ratio relative to the supervisory threshold), Buf_{ss} is the steady-state level of capital buffers, calibrated as the historical long-term average of capital buffers and ε_t^c is white-noise shocks to real credit.

6. The model incorporates a feedback channel from the credit cycle to the business cycle. The credit channel derives from the failure of the Modigliani-Miller propositions, which assume that the level of bank capital and banks' financial structure are irrelevant to total cost of funding and lending. This concept is well described in Krznar and Matheson (2017) and implies that issuing new equity is costly, which affects credit supply. Undercapitalized banks may raise their capital adequacy ratio by cutting back on lending rather than raising equity, thereby potentially hurting economic

[3] The credit gap is defined as the difference between real private non-financial sector credit and its trend. The trend credit represents the long-term equilibrium (or "natural") level of credit consistent with the economy operating at its potential.

growth. Capital influences lending when breaking regulatory capital thresholds is costly and banks cannot easily issue new equity, conditions supported by empirical literature[4].

7. The banking system capital buffers, Buf_t, are defined as the deviation of the capital ratio K_t (regulatory capital to risk-weighted assets) from a time-varying regulatory requirement, $K_t{}^*$ and are assumed to adjust in response to changes in the regulatory and economic environment (de Resende et al., 2016, 2024). Furthermore, capital buffers are assumed to be positively related to the credit growth gap $\left(C_t^g - C_{ss}^g\right)$, as banks are likely to accumulate more capital via retained earnings when credit grows faster, and profitability improves.

$$Buf_t = K_t - K_t^* \tag{3}$$

$$Buf_t = \rho^{Buf} Buf_{t-1} + \left(1 - \rho^{Buf}\right) Buf_{ss} + i_4(C_t^g - C_{ss}^g) + \varepsilon_t^{Buf} \tag{4}$$

The regulatory requirement is a random walk process without drift.

$$K_t^* = K_{t-1}^* + \varepsilon_t^{K^*} \tag{5}$$

8. Thus, banks play a crucial role in transmitting macroprudential policy to the broader economy. In response to changes in the macroprudential policy stance, banks adjust their capital buffers (Equations 3 and 4), which in turn influence credit supply (Equations 2 and 1) and, ultimately, output (Equation 6). For instance, a tightening of the macroprudential stance or higher capital requirements can lead to lower capital buffers, ultimately reducing credit supply and dampening both credit and real economic cycles.

9. Regulatory changes to capital requirements are formally the primary tool for implementing macroprudential policy in the WAEMU, but have been little used. The prudential framework established in 2018 allows the BCEAO to implement macroprudential measures and aligns with its financial stability mandate.[5] However, the Financial Stability Committee of the West African Monetary Union (CSF-UMOA) and the BCEAO's Macroprudential Policy Committee (CPMP) have so far made limited reliance on macroprudential measures[6].

[4] Jimenez et al. (2009) found that a capital crunch led to a credit crunch in Spain, while Aiyar et al. (2014) observed that tighter capital requirements caused banks in the U.K. to reduce lending. Brun et al. (2013) and Gambacorta and Marques-Ibanez (2011) found that stricter capital requirements and weaker bank capital positions restricted loan supply, particularly during the global financial crisis. Adrian and Shin (2010) showed that banks manage assets to maintain capital ratios, magnifying the effect of capital on lending. Carlson et al. (2011) and Bridges et al. (2014) confirmed a significant relationship between capital ratios and lending, with heterogeneous responses across sectors. De Nicolo (2015) suggested that higher capital requirements negatively impact both bank lending and real activity, in both the short and long term. Other studies (e.g., Berrospide and Edge, 2010) found modest effects of capital shocks on loan growth, while Calza and Sousa (2005) noted threshold effects in the real economy. Meeks (2014) concluded that increased capital requirements lower lending, raise credit spreads, and reduce aggregate expenditure.

[5] The BCEAO's mandate in the area of financial stability is defined in Article 9 of its Statutes, which stipulates that the BCEAO shall ensure the stability of the financial and banking system of the WAEMU.

[6] According to the 2023 WAEMU FSAP findings, since its establishment in 2010, the CSF-UMOA — which has not always met the minimum frequency prescribed by regulations — has rarely issued recommendations on the implementation of macroprudential instruments.

10. The countercyclical capital buffer (CCyB) is part of WAEMU's macroprudential toolkit but has been set to zero since its creation[7]. The tool consists of an additional capital buffer requirement, typically built up during the expansionary phase of the credit cycle, which can then be flexibly used during a downturn. The recent COVID-19 experience as well as empirical research highlight the benefits of having releasable capital buffers, as discussed by studies such as Couaillier et al. (2022a, 2022b) and Mathur et al. (2023). The "headroom"—the capital buffer above regulatory requirements—determines whether banks reduce lending pro-cyclically in response to shocks. Relaxing the CCyB can create additional headroom, thereby encouraging banks to maintain credit provision during adverse conditions.

11. Moreover, international experience with capital buffer tools suggests that maintaining a positive buffer, even when the economy is in neutral territory, facilitates the release of the buffer. The positive neutral rate offers a baseline level of protection against aggregate stresses. The theory highlights the benefits of maintaining releasable capital buffers in normal times (Lang and Menno, 2023). A gradual increase in buffer requirements has only small effects on credit, primarily through a "pricing" channel. However, the release of capital requirements when they are binding can have a much larger effect through a "quantity" channel. Furthermore, according to the latest adjustment in the Basel Core Principles (BCBS, 2024), supervisors can require banks to maintain releasable capital buffers, which could include the CCyB or other releasable buffers (Principle 16).

C. Aggregate Demand is also Affected by the Credit Cycle

12. In the aggregate demand equation, the behavior of output gap (Y_{gap}), which is defined as the deviation of the log of real output from its potential level, is explained by its lag, monetary condition index (MCI), the output gap of the foreign economy ($Y^{*}{}_{gap}$), the credit shocks (ϵ_t^c), and aggregate demand shock (ε_t^Y). For instance, unmodeled influences such as fiscal policy can be attributed to the aggregate demand shock. Notably, the credit shocks (ϵ_t^c) in the demand function allow us to model the feedback effects between the output gap and other macroeconomic variables due to the credit crunch assumption. An expansion of private credit that is unrelated to demand and past credit adjustments is assumed to increase aggregate demand. MCI shows the weighted average effects of the deviations of the real interest rate from its neutral level (RR_{gap}), plus the risk premium ($Prem$) and deviation of the real exchange rate from its trend level (Z_{gap}). The changes in risk premium are negatively correlated with the deviation of the currency coverage ratio (share of foreign assets in BCEAO sight liabilities) from its long-term trend. The real exchange rate is defined as the nominal exchange rate (domestic currency per unit of foreign currency), adjusted for differences in price levels in domestic and trading economies.

$$Y_{gap,t} = \beta_1 Y_{gap,t-1} - \beta_2 MCI_t + \beta_3 Y^{*}{}_{gap,t} + \beta_5 \epsilon_t^c + \varepsilon_t^Y \quad (6)$$

$$MCI_t = \beta_4 (RR_{gap,t} + Prem_t) + (1 - \beta_4)(-Z_{gap,t}) \quad (7)$$

[7] IMF Survey on Macroprudential Policy for WAEMU countries.

D. The Conventional Part of the Model: Aggregate Supply, UIP, and Reaction Function

13. The forward-looking open economy Phillips curve for headline inflation (ΔCPI_t) **depends on past headline inflation (ΔCPI_{t-1}), inflation expectations** (ΔCPI_{t+1})**, and real marginal costs (RMC_t).** The RMC_t is a function of the domestic and foreign factors: the output gap ($Y_{gap,t}$); the real exchange rate gap ($Z_{gap,t}$).The coefficient α_1 capture persistence in the price evolution, the coefficients α_2 capture the contemporaneous pass through from the real marginal costs and α_3 captures the influence of the gap in the real marginal costs on inflation (the slope of the Phillips curve).

$$\Delta CPI_t = \alpha_1 \Delta CPI_{t-1} + (1-\alpha_1)\Delta CPI_{t+1} + \alpha_2 RMC_t + \varepsilon_t^{CPI} \tag{8}$$

$$RMC_t = \alpha_3 Y_{gap,t} + (1-\alpha_3) Z_{gap,t} \tag{9}$$

14. As in Carlos et al. (2022) the arbitrage condition between real returns on domestic and foreign interest rates gives rise to the UIP condition. This relationship is presented in a general form that allows for degrees of exchange rate flexibility and capital controls:

$$S_t = h_2(S_{t-1} + \overline{\Delta S_t}/4) + (1-h_2)[e_1(S_{t-1} + 2/4(\overline{\Delta 4CPI_t} - \overline{\Delta 4CPI_t}^* + \overline{\Delta Z_t})) + (1-e_1)(E_t S_{t+1} + (-RS_t + RS_t^* + Prem_t)/4)] + \varepsilon_t^S \tag{10}$$

where S_t is the nominal exchange rate (domestic currency per one unit of foreign currency), S_{t+1} is expected and S_{t-1} lag of nominal exchange rate, RS and RS_t^* are respectively the domestic and foreign nominal annualized interest rates, and ε_t^S is a shock that captures unexpected deviations from the UIP. $\overline{\Delta S_t}$ is the possible change in the exchange rate driven by the differential between the domestic inflation target $\overline{\Delta 4CPI_t}$ steady state of foreign inflation($\overline{\Delta 4CPI_t^*}$) and the variation of the real exchange rate from its equilibrium level $\overline{\Delta Z_t}$. The coefficient h_2 reflects the degree of exchange rate rigidity and in the case of WAEMU, it is assumed to be close to unity (allowing just for the possibility of minor commissions around the peg). The coefficient e_1 reflect the degrees of capital controls. Since the CFAF has been pegged to the French franc and later to the euro since its inception, with only one devaluation in 1994, the desired exchange rate variation and the long-term variation of the real exchange rate are both assumed to be zero ($\overline{\Delta S_t}$ = 0 and $\overline{\Delta Z_t}$ = 0), consistent with purchasing power parity (PPP).

15. The monetary policy rule describes the evolution of short-term nominal interest rates consistent with the UIP conditions and macroeconomic stability objectives[8]. Despite the peg, the existence of capital controls gives to the BCEAO some independence in monetary policy. In equation (11) below, this is captured by the parameter h_1 (if h_1=1 the CB loses control over the interest rates; if h_1=0, and CB fully sterilizes interventions in the FX market, it retains full control over the interest rates). Equation (11) describes the BCEAO reaction function as aiming to stabilize inflation and maintain a fixed exchange rate, by adjusting short-term interest rates to mitigate macroeconomic fluctuations and influence reserve accumulation. The BCEAO operates under a hard

[8] Extending Taylor rules with additional terms is a common practice in the literature, including within the WAEMU region (see, for instance, Tenou, 2002; BCEAO, 2013; Shortland et al., 2014; Diabate, 2016, Carlos et al. 2022).

peg of the CFAF to the Euro and a decline in reserves towards low levels triggers a monetary policy response[9]. In practice, between 2016 and 2019, the BCEAO tightened its monetary policy when FX reserves fell, even if inflation was low, to ensure a level of foreign exchange reserves compatible with maintaining the fixed parity of the CFA Franc. Short-term nominal interbank interest rate (RS_t) are hence assumed to respond to (i) deviations of the 4-quarter-ahead year-on-year inflation forecast from its target, (ii) the output gap, and (iii) deviation of risk premium from its steady-state level (which is influenced by the reserve coverage). Indeed, maintaining exchange rate parity may require monetary policy adjustment when the currency coverage affects the risk premium.

$$\mathrm{RS}_t = h_1((4(E_tS_{t+1} - S_t) + RS_t{}^* + Prem_t) + (1 - h_1)(\gamma_1 RS_{t-1} + (1 - \gamma_1)(RS_t^n + \gamma_2(\Delta 4CPI_{t+4} - \overline{\Delta 4CPI_t}) + \gamma_3 Y_{gap,t} + \gamma_4(Prem_t - Prem_{ss}) + \varepsilon_t^{RS} \quad (11)$$

$$Prem_t = d_1 Prem_{t-1} + (1 - d_1)Prem_{ss} - d_2 CCR_{gap,t} + \varepsilon_t^{Prem} \quad (12)$$

$$CCR_{gap,t} = k_1 CCR_{gap,t-1} + k_2(\mathrm{RS}_t - RS_t^n) + k_3\left(Z_{gap,t}\right) + \varepsilon_t^{CCR} \quad (13)$$

The deviation of the currency coverage ratio or CCR (share of foreign assets into BCEAO sight liabilities) from its long-term trend ($CCR_{gap,t}$) leads to the changes in risk premium. In turn, $CCR_{gap,t}$ depends on the nominal interest rate and real exchange gaps. The CCR long term value was chosen at 68 percent, close to the value at end 2024. The nominal interbank interest rate also is a function of its own lagged value (RS_{t-1})—which has the effect of smoothing the policy rate, the neutral nominal interest rate (RS_t^n in levels) consistent with economic equilibrium (equal to the sum of the trend real interest rate and the model-consistent inflation expectations), and monetary policy shock ε_t^{RS} . The monetary authority is forward-looking and uses model-consistent inflation expectations, $\Delta 4CPI_{t+4}$.

E. Model Parametrization and Calibration

16. A mix of Bayesian estimation and calibration is used in setting parameter values (Annex I). The parameterization of the business cycle part of the model relies on a similar calibration exercise in Carlos et al. (2022). The newly introduced parameters for the financial block were first calibrated using regression analysis and then estimated based on Bayesian estimation techniques. Model structural parameters were estimated with Bayesian estimation techniques, using the information of observable variables, during the full range of the examined period, 2004Q1 to 2024Q3. The Bayesian estimation procedure started with the construction of the likelihood of the model by employing Kalman filtering. Then, combining the prior knowledge of the parameters based on previous studies (Carlos et al., 2022) with the information contained in the data, we estimated the mode of the posterior distributions by maximizing the log posterior function. Finally, the Metropolis-Hastings algorithm was utilized to get the full information of the posterior distributions and evaluate the marginal likelihood of the model.

[9] There is no formal rule for targeting the CCR. However, Article 76 of the BCEAO statutes specifies a minimum threshold of 20 percent for its level of FX reserves, below which, if maintained on average for three consecutive months, would trigger a reassessment of the monetary policy stance, and remedial actions would have to be taken.

17. Steady-state parameters are calibrated to reflect either the target level of variables or historical data averages. Calibrated parameters in non-structural equations, primarily for trends, are set to achieve a gradual adjustment or smooth dynamics of model variables towards their steady states. The standard deviations of shocks are generally calibrated, unless indicated as estimated. This is done carefully to get reasonable dynamics of gaps and trends as revealed when the calibrated model is applied to filter the historical data.

F. Model Simulation and Historical Data Interpretation

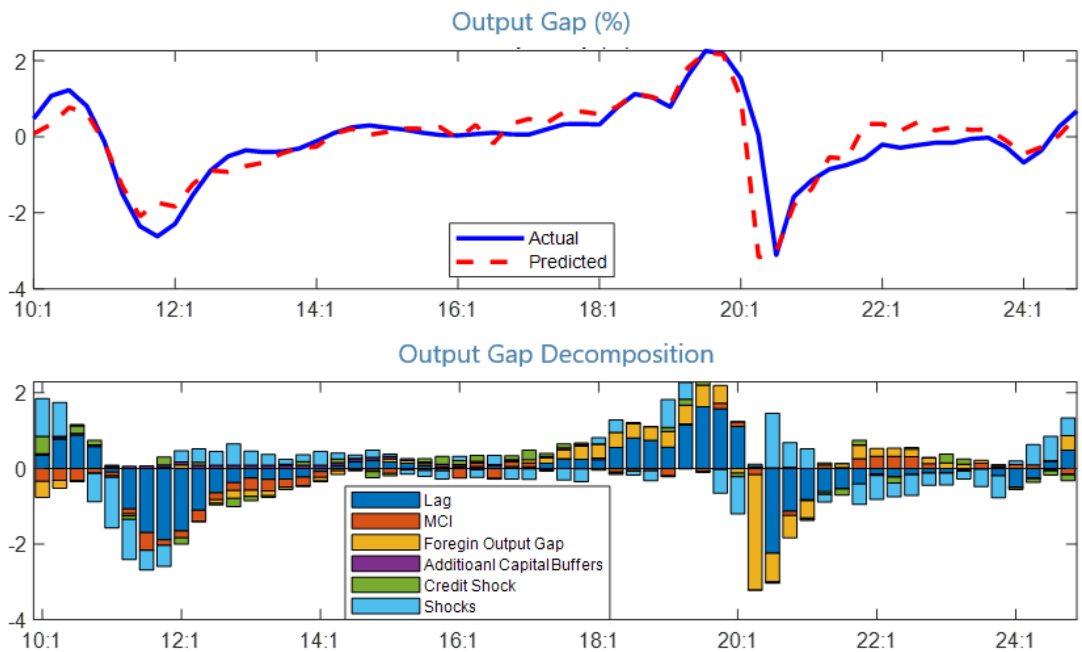
18. The model's predictive power is evaluated using a pseudo-out-of-sample forecasting exercise. An analysis of out-of-sample projections begins in 2010Q1, assuming all foreign and unobserved variables (based on information from the entire sample) are observed throughout the forecast period. All other variables are known until the quarter preceding every forecast realization over the next 8 quarters. Figure 1 represents simulations of inflation, output gap, currency coverage ratio and real credit gap, in which the solid black line represents actual data. The model has good forecasting capabilities since the projected values do not diverge from observations particularly when economic shocks are not large. Differences between the model's forecasts and actual outcomes may also arise from policy mistakes, such as temporary deviations in monetary policies (or macroprudential policies, if historically employed) from the model-prescribed stabilization rules.

Figure 1. Model Based Simulations and the Actual Data

Source: IMF staff estimates.
Legend: The black solid line represents actual, observed values of selected variables, while the dotted lines in color represent their projected values at particular quarters in the forecasting period.

19. Figure 2 displays the decomposition of the business cycle (output gap). It shows that the output gap became negative during 2011 due to the Ivorian crisis and the drought in the Sahel countries, then moved around zero and started to increase until the COVID-2019 pandemic and turned negative again during the pandemic. After the start of the pandemic, favorable monetary conditions, the gradual recovery of foreign output, and credit demand have all stimulated output and its recovery. There are also other unmodeled factors represented as adverse shocks, including the large fiscal package adopted in 2020, which shows up as a large positive shock in mid-2020. The feedback from financial sector shocks to the business cycle does not amount to much. However, this may be an artifact of the historical observations, as there was no financial crisis or significant financial stress in the WAEMU during the period chosen for analysis.

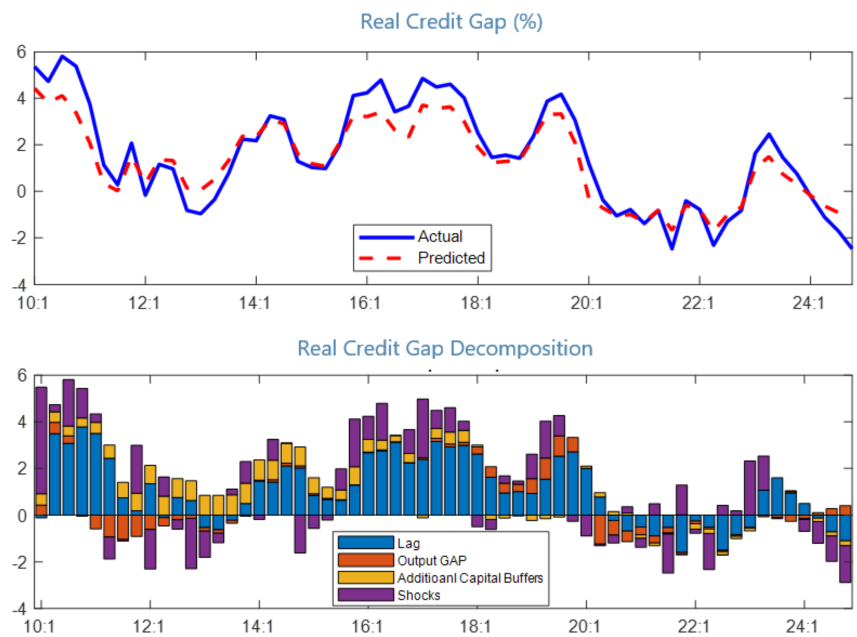
Figure 2. Historical Decomposition of Business Cycle



Source: IMF staff estimates.

20. The decomposition of the credit gap shows that the positive credit gap is narrowing significantly and is expected to turn somewhat negative by the end of 2024. Since late 2023, the positive credit gap has been narrowing and is projected to become somewhat negative by the end of 2024, in line with expectations of slower credit growth (Figure 3). The positive contribution from the favorable business cycle is being outweighed by the strong inertia of the credit gap, capital buffers being below their steady-state level, and the effects of credit shocks, which capture demand shocks and other credit determinants not explicitly modeled. Capital buffers above their steady-state level, along with the underlying persistence of credit, were major contributors to the positive credit gap from 2010 to 2018.

Figure 3. Historical Decomposition of Credit Cycle



Source: IMF staff estimates.

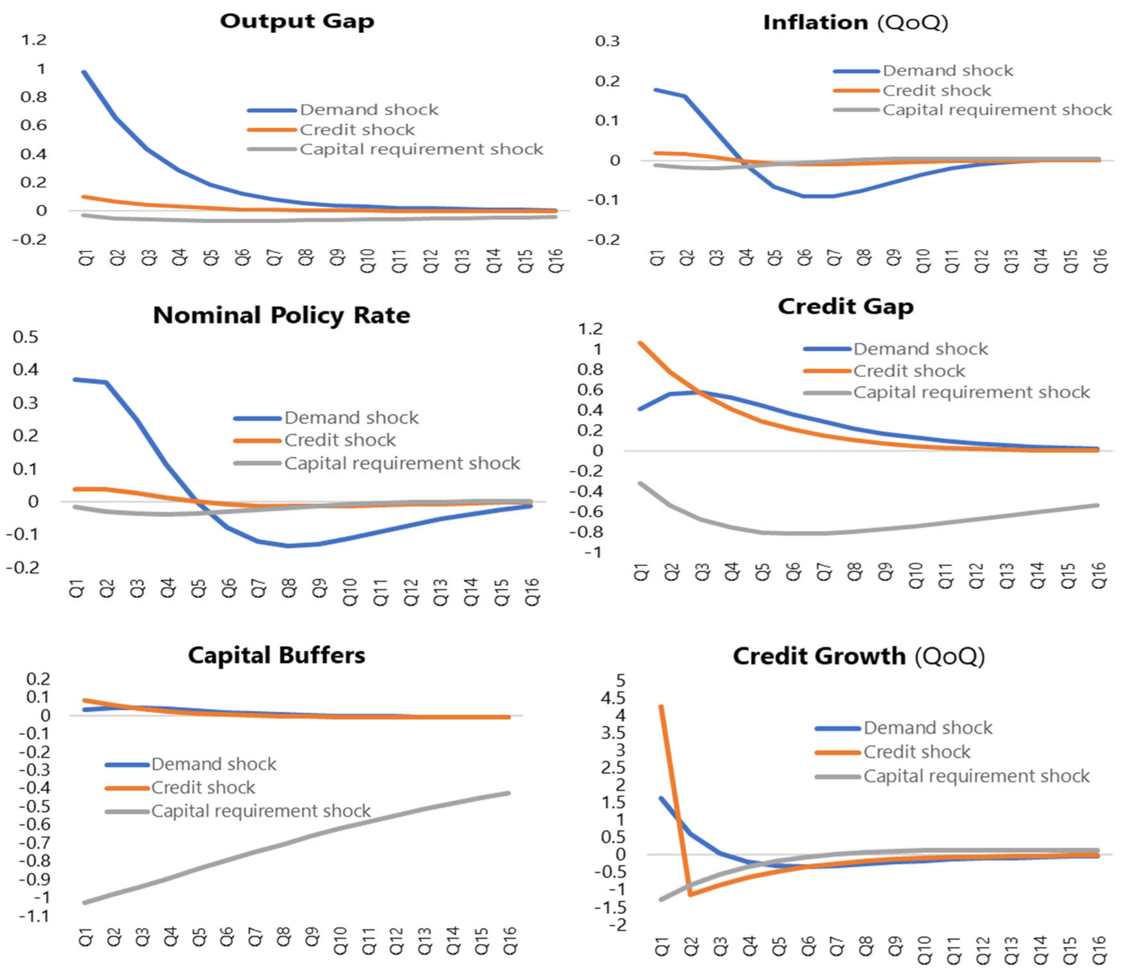
G. Impulse Responses

21. Impulse response analysis suggests that the business cycle appears to lead the financial cycle within the union, and historically there has been limited feedback from financial shocks to the broader economy. Impulse response (IRF) analysis underscores the significance of demand and capital shocks for credit, with the IRFs following a 1 percent shock to output, credit, and capital yielding the following results (Figure 4):

- *A positive demand shock* raises the output gap, the rate of inflation. At the same time, a positive demand shock boosts real credit growth by 1.6% and contributes to capital accumulation via increased profitability. Both the output gap and the deviation of inflation from the target call for an increase in the real interest rate, i.e., a hike in the nominal rate greater than the rise in inflation. Tightening financial conditions dampens output and reduces credit demand, and over the medium term all variables return to their potential level. Moreover, credit responses to a demand shock once the macro feedback effects are taken into account due to the impact of an increase in capital buffers.
- *A positive credit shock* allows banks to accumulate capital by taking advantage of the higher earnings driven by above-trend growth in credit. Tightening monetary conditions and discretionary elements in the decisions about the regulatory requirement puts downward pressure on credit supply and quickly reduces credit growth (which turns negative after one quarter). Since credit shocks do not directly affect inflation, the model is consistent with the

responds to capital only if macro feedback effects are considered. The higher capital requirement lowers the additional capital buffer difference between capital held by the bank and the regulatory threshold, and puts upward pressure on marginal lending costs, leading to a lower volume of credit. The impact of higher capital on output and inflation would induce monetary policy loosening. As expected, the impact on output is mild, with the output gap turning negative slightly, reflecting the weak relationship between credit and the real economy explained by limited financial deepening. These results seem to indicate a relatively easy trade-off facing the macroprudential regulator when responding to excessive credit growth and increasing systemic risks.

Figure 4. Macrofinancial Linkages: Selected Impulse Responses



Source: IMF staff estimates.

H. Model-Based Projections

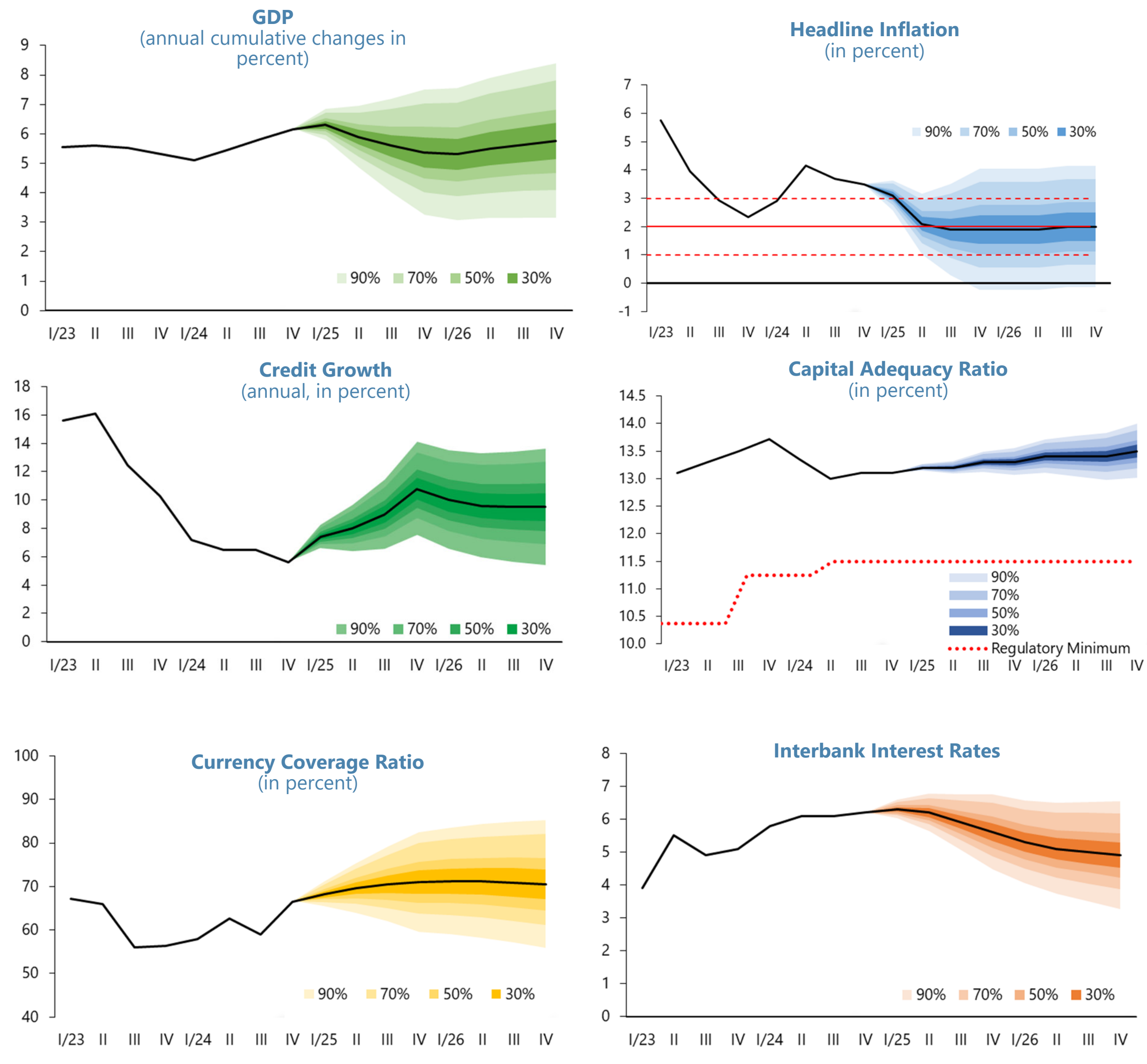
22. Figure 5 presents model predictions for inflation, GDP growth, CCR, nominal credit growth, and the capital adequacy ratio, conditioned on forecasts[10] for foreign inflation, output growth, and interest rates. The model forecasts differ from the IMF WAEMU team's baseline projections presented in the Staff Report, as the model focuses only on the relations presented above, does not have a full external sector, and does not encompass the expected developments in hydrocarbon production, improvements on the current account, and reserve accumulation. Hence, it was chosen chose a CCR target close to end 2024 values to avoid a monetary policy reaction to CCR. Hence the model presents projections that would be reasonable if the impact of expected large-scale hydrocarbon production is not considered. Broadly, the figures suggest that macroeconomic conditions would call for a normalization of monetary policy, as the FX reserve position improved in late 2024, inflation expectations would be declining, and the credit gap is negative. The negative credit gap is expected to close gradually until the end of the forecasting period. Credit demand is expected to recover broadly in line with economic activity, albeit with a lag, and in the forecasting horizon to grow again as a ratio to GDP as financial deepening resumes. This, in turn, would enhance bank profitability and gradually restore capital buffers. However, capital buffers are expected to remain below their historical long-term average. Inflation (quarterly) is projected to converge to the target level by in early 2025.

I. The Model as a Tool to Support the Discussion on Financial Policies

23. The model can offer a crucial link between macrofinancial shocks, cyclical risk, and capital buffers, which can inform discussions on policies related to the capital requirements. For example, at present the historically low level of capital buffers, relative to the steady-state level, may not be sufficient to withstand adverse domestic and international shocks. Placed in a broader context, financial soundness indicators have deteriorated recently, with pockets of vulnerabilities remaining: the financial sector remains exposed to credit, concentration, liquidity, and sovereign risks, particularly in light of the growing sovereign-bank nexus (previously assessed in past consultations and analyzed in SIP/2024/014). The overall capital adequacy ratio declined from 13.7 percent at the end of 2023 to 13 percent in 2024 June (against a regulatory norm of 11.5 percent) and liquidity conditions deteriorated. NPLs and restructured loans increased slightly from 8.7 percent at the end-2023 to 9 percent in June 2024. Against this backdrop, and in light of heightened future uncertainty, further strengthening of capital buffers is necessary. This would help mitigate risk amplifiers (e.g., concentration and contagion) and emerging risks (e.g., interest rate risk), especially given their sovereign exposures and reliance on BCEAO refinancing. The decision taken by the WAEMU Council of Ministers in December 2023 to double the minimum paid-in capital for banks to CFAF 20 billion will help promote the resilience of the system.

[10] IMF WEO October 2024 projections.

Figure 5. WAEMU Model-Based Forecasts



Source: IMF staff estimates.
Note: The confidence intervals of the variable forecast reflect the predictive power of model forecasts and are symmetric.

24. The model also offers a formal link between capital buffers and financial deepening. As banks approach the regulatory minimum capital requirements, they will face an important decision: either restrict credit provision to the private sector or increase their capital buffers to meet regulatory standards. This limitation on available capital may constrain further lending and, as a result, hinder economic growth and investment if not effectively addressed. At present, the average capital adequacy ratio is slightly above the regulatory requirement, while capital buffers remain below their historical average. Meanwhile, overall credit penetration is relatively low, at about one-fourth of GDP. Under the baseline model scenario, capital buffers are projected to recover gradually and approach to the steady-state, suggesting that further financial deepening could be limited under current capital projections. The heavy reliance by banks on central bank refinancing to fund their operations also poses risks, and if banks achieve financial deepening by accessing greater BCEAO financing, the financial stability risks could also directly impact the BCEAO.

25. The recent expansion of BCEAO's macroprudential policy mandate and toolkit is a welcome development. The BCEAO should be ready to adjust macroprudential policy in line with developments in the financial cycle to preempt the build-up of vulnerabilities. The BCEAO could separately move toward a positive neutral level for the CCyB and further develop a CCyB decision framework[11] in parallel. Gradual phase-in of higher capital requirements during the expansion phase of the financial cycle could mitigate excessive credit growth and strengthen banks' capacity to absorb losses in the event of financial stress. In this context, the model could offer useful simulation exercises to assess the macrofinancial impacts of both micro- and macroprudential changes to capital requirements.

J. Conclusions

26. Our analysis demonstrated that the model could formalize linkages between the real and the financial sector, with realistic forecasts, thus helping assess risks and support monetary and financial policy analysis. The model could hence be used to help policymakers analyze historical macroeconomic and financial sector data, interpret the current disequilibria in these sectors, conduct scenario analyses, examine the empirical relevance of various frictions, and make forecasts.

27. A crucial element of the model is the link between the business cycle and the financial cycle within the union. Historically, financial shocks have had limited feedback effects on the broader economy. However, the model's capacity to track and explain credit growth, as well as its linkage to policy decisions, makes it a valuable tool for formulating policy recommendations that address the macroeconomic implications of developments in the financial sector. Going forward, incorporating these linkages into policy decisions will allow for the complementary benefits of macroprudential policy, which focuses on the financial cycle and stability, and macroeconomic policies, which aim to manage the business cycle and preserve macroeconomic stability.

28. The financial block of the model is designed to be simple, while the overall structure of the model is flexible enough to accommodate future extensions. With minor modifications and the availability of data, the model can be extended to address sector-specific financial risks based on the particular concerns of policymakers in specific cases. Additionally, the model can easily be tailored to resemble an FSAP stress test based on supervisory data. It could also help evaluate the implications of specific macroprudential measures, such as the CCyB.

[11] As announced June 24, 2016, and effective January 1, 2018, the transitional provisions of the Prudential System Applicable to Credit Institutions and Financial Firms in the WAMU became applicable. The regulations provide that the authority responsible for macroprudential policy is empowered to require institutions to establish a countercyclical buffer consisting of CET1 capital and representing no more than 2.5% of total RWAs. The criteria for activating the countercyclical buffer must be determined by BCEAO instruction.

Annex I. Parameters

Estimated Parameters

Estimated Parameters	Prior Distribution F (mean, std)	Posterior
α_1	$\beta(0.5,0.04)$	0.45
α_2	$N(0.45,0.04)$	0.43
α_3	$\beta(0.25,0.02)$	0.24
β_1	$\beta(0.72,0.06)$	0.69
β_2	$N(0.15,0.01)$	0.14
β_3	$N(0.28,0.03)$	0.26
β_4	$\beta(0.4,0.04)$	0.39
β_5	$N(0.1,0.01)$	0.1
γ_1	$\beta(0.4,0.04)$	0.51
h_1	$\beta(0.4,0.04)$	0.32
i_1	$\beta(0.65,0.06)$	0.69
i_2	$N(0.4,0.03)$	0.41
i_3	$N(0.3,0.03)$	0.3
i_4	$N(0.02,0.001)$	0.02
k_1	$\beta(0.94,0.1)$	0.98
k_2	$N(0.6,0.04)$	0.62
k_3	$N(0.35,0.04)$	0.34
ρ^{Buf}	$\beta(0.9,0.09)$	0.94

Calibrated Parameters

Parameters	Value
h_2	0.97
e_1	0.5
g_2	1
g_3	1
g_4	1
$\overline{\Delta S_t}$	0
$\overline{\Delta Z_t}$	0
$\overline{\Delta 4CPI_t}$	2
$\overline{\Delta 4CPI_t}^*$	2
$Prem_{ss}$	2
C_{ss}^g	7
Buf_{ss}	2
RS_{ss}[1]	5
CCR_{ss}	68
$GDP\ growth_{ss}$	5.7

[1] The assumption is based on the estimated neutral rates for the Eurozone and the U.S., as well as the historical spread between WAEMU interbank rates. Specifically, the neutral rate in the Eurozone could range from 1.75% to 2.25% (ECB Economic Bulletin, Issue 1/2025) while the neutral rate in the US could range from 2.4% to 3.9% (Monetary Policy Report, February 2025). The WAEMU interbank rate in the 2014 and 2015 (before the large swings) was about 300bps above the policy rate in the Eurozone and the U.S. Hence, if one assumes that the spread in the long term should return to the one in that period, and adopts as reference the neutral ECB rate, the the WAEMU neutral interbank rate could be considered 5 percent at present

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